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MERIDIAN CORPORATION
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PREFACE

The *Focus on* Series is prepared to give the U.S. Geothermal Industry a quick profile of several foreign countries. The countries depicted were chosen for both their promising geothermal resources and for their various stages of geothermal development, which can translate into opportunities for the U.S. geothermal industry. The series presents condensed statistics and information regarding each country's population, economic growth and energy balance with special emphasis on the country's geothermal resources, stage of geothermal development and most recent activities or key players in geothermal development. The series also offers an extensive list of references and key contacts, both in the U.S. and in the target country, which can be used to obtain detailed information.

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Washington, DC 20585
(202) 586-5340

NOTE

Data presented in this document are based on several U.S. government official publications as well as international organizations, namely:

- Background Notes (U.S. Department of State)
- Foreign Economic Trends (U.S. Department of Commerce)
- World Development Report 1987 (World Bank)
- International Data Base for the U.S. Renewable Energy Industry, May 1986 (U.S. Department of Energy)

The country's geothermal resources write-up is a revision and update of the Appendix in the "Review of International Geothermal Activities and Assessment of U.S. Industry Opportunities." LANL, August 1987.

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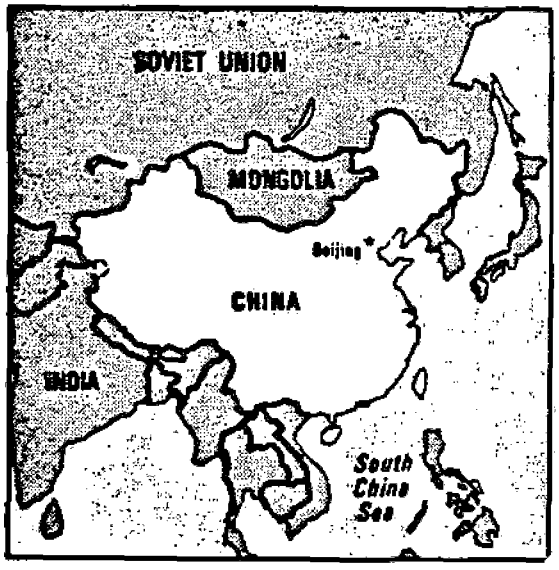


Official Name: People's Republic of China

Area: 9.6 million sq. km (3.7 million sq. mi.)

Capital: Beijing

Population (1985): 1,040.3 billion

Population Growth Rate: 1.5%

Languages: Standard Chinese (Putonghua) or Mandarin

Economic Indicators:

Real GNP (1985): $265 billion
GDP Avg. Annual Growth Rate (1980-85): 9.8%
Per Capita Income (1985): $310
Avg. Annual Inflation Rate (1980-85): 2.4%

Trade and Balance of Payments:

(1985) Exports: $27.3 billion; Major Markets: Hong Kong, Japan, U.S. Singapore, FRG.
(1985) Imports: $42.5 billion; Major Suppliers: Japan, U.S., Hong Kong, FRG, Canada
(July 6, 1986) Official Exchange Rate: 3.704 yuan = US $1

Energy Profile: (Based on 1982 data unless otherwise indicated)

- Commercial Fuel Energy Consumption:

  Total: 415.357 million ton of oil equivalent (mtoe)
  1-Yr. Growth: -2.1

- Commercial Fuel Breakdown:

  Liquid Fuels Pct: 21%
  Solid Fuel Pct: 72%
  Natural Gas Pct: 3%
  Electric Pct: 4%
  Commercial Fuel Consumption Growth Rate (1970-1980): 5.4%

- Electricity Generation Capacity:

  (1982) Total Installed Elec. Capacity: 72,360 MW
  Hydro: 31%
  Hydro Potential: 378,532 MW
  Steam: 52%
  Gas Turbine: 0%
  Diesel: 17%
  Geothermal: Negligible proportion, just over 14 MWe

- Electricity Sales:

  Total: 230,244 GWh
  Residential: *
  Commercial: 7%
  Industrial: 75%
  Government: *
  Other: 18%
  Average Electricity Price: 3.30 US cents/kWh

- Geothermal Power Generation Status

  Reservoir Potential: 220 MWe
  Temperature Range: Varies according to location from 87°C to 220°C

- Geographic Locations: In Beijing-Tianjin-Tangshan region and Tibet Province

- Development Status: Various stages including 14.586 MW of on-line geothermal electricity generation. Continuing reconnaissance, assessment explorations activities.

- Countries Actively Involved: Italy, U.S.

- General Need for Assistance: Mainly exploration, drilling and high tech. equipment.

- International Funding: $10.47 million (UN/DTCD)

* Negligible

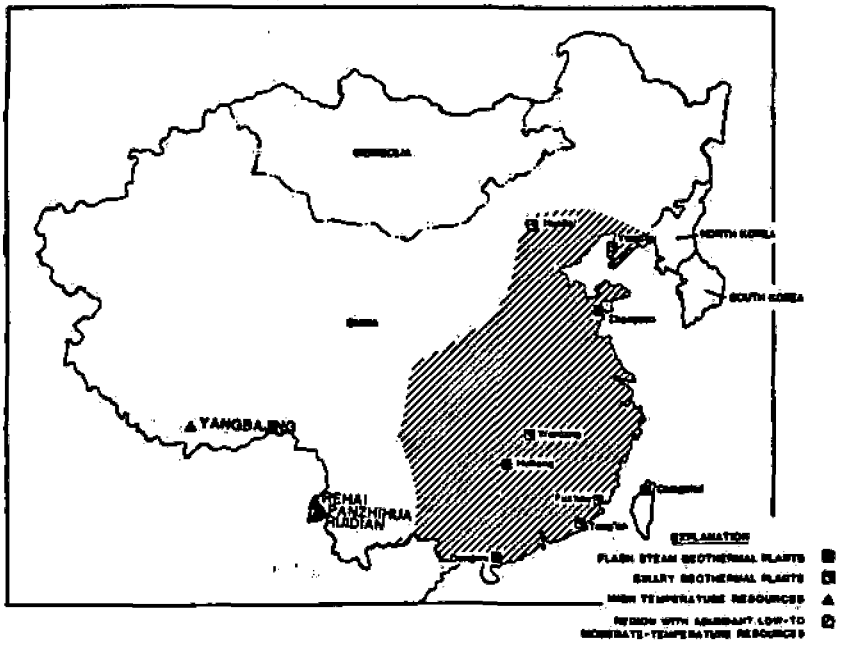
GEOTHERMAL RESOURCES

The use of geothermal waters by the Chinese can be traced back 2,000 years. Up to the 1960's, much of the resource in the country had been used for bathing and medicinal applications. Since that time, China has steadily developed its exploitation of geothermal energy by direct-use applications and power generating stations. Although a national development plant remains unfinished, China appears strong in its commitment to geothermal energy development.

About 3,000 geothermal areas exist in China, about 2,400 of which are natural hot springs. Currently 40 geothermal fields, mostly low- to moderate-temperature, have been or are being explored and assessed. In July 1982, the total recoverable geothermal energy was estimated at about 200 billion tons of standard coal equivalent. Later, in May 1985, a further 30 thermal anomalous regions were identified in the Beijing - Tianjin - Tangshan region with an estimated recoverable energy of 17 billion tons of coal equivalent. Geothermal energy currently produces 14.3 MWe and a total of 20 to 30 MWe is planned by 1990. The overall identified potential for electrical generation is 220 MWe.

The largest geothermal power plant in China is at Yangbajing in the Xizang (Tibet) Province. The field has been under study since 1975. The Yangbajing plant consists of four turbines: The first unit, 1 MWe was reconstructed from a long-standing coal-fired one into a single-stage flashing-separating system and came into operation in 1977. It was mainly used to provide data for the design of the new unit. Another unit (Unit No. 3), a 3 MWe dual-flash unit has been on-line since 1981 followed by another 3 MWe dual flash unit (Unit No. 2) in November 1982. The last unit (Unit No. 4) came on-line in July 1985 bringing the total installed capacity of Yangbajing geothermal power plant to 10 MWe.

GEOTHERMAL DEVELOPMENT IN CHINA



The western to mid-western part of China seems to have the greatest potential for high-temperature geothermal resources. Three other high temperature (>220°C) resources exist there at Rehai, Panzhihua and Ruidian. These three fields have been targeted as power generating fields.

Other power plants (mostly binary) exist at a number of low- and moderate-temperature locations in China. The Dengwu field, located in Fengshu in Guandong Province, was the first field developed in China for electrical production. The first unit was an 86 kW unit that came on-line in 1970 and is still on-line. A 200 kW unit was brought on-line in 1978, and a third unit is under construction. The temperatures at this field range from 87 to 94°C.

Since 1971, a binary-cycle power station has been on-line in Huailai within the province of Hebei. The Wentang power station, located in the Jiangxi Province in southeastern China, also came on-line in 1971 and produces 50 kWe. The flash-steam plant at Huitang (in Hunan Province), brought on-line in 1975, produces 300 kWe. Wastewater from the plant is cascaded to greenhouses, a spa, and a hospital. A 100 kWe unit has been operating at Yingkou since 1977. A geothermal power plant located in the Tong'an field, Fijian Province near Hong Kong, reportedly produces 300 kWe from a binary system. The Zhaouyan power plant in Shandong Province on the east coast of China along the Yellow Sea reportedly has a capacity of 200 kWe. A geothermal power plant is reported to be operating in Fuzhou, Fijian Province; no details are available on its present status and/or capacity.

Since July 1983, a $10 million geothermal development project with UN and Italian funding has been underway in China. The recently completed project provided for consultant services, a geophysical model of the Tianjin basin, exploration of the Yangbajing area, overseas training facilities for 30 Chinese engineers, and more than 30 pieces of geothermal equipment including a computer facility and 3,000 m capacity high-speed portable drilling rig.

The geothermal investigations in all but the remote districts were carried out by the Province Bureau of Geology and Mineral Resources. The China Society of Energy Research has set up a Special Geothermal Commission to coordinate research activities in the geothermal field.

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Wu Fangzhi, Tong Wei, Liu Shibin and Zhang Zhifei, 1986, "First Decade of Geothermal Development in Yangbajing Field, China," Geothermics 1986, Vol. 15, No. 5/6, pp. 633-638.

REFERENCES

AND

KEY CONTACTS

A. Business Climate Sources of Information

The following references are suggested for timely information on the business climate in China.

U.S. GOVERNMENT PUBLICATIONS

U.S. Department of Commerce

- Foreign Economic Trends (FET) and their Implications for the U.S.
- Overseas Business Reports (OBR)

U.S. Department of State

- Background Notes

NON-GOVERNMENT PUBLICATIONS

- International Series, published by Ernst and Whinney
- Businessman's Guide to....., published by Price Waterhouse and Co.
- Information Guide: Doing Business in ....., published by Price Waterhouse and Co.
- Task and Trade Guide, published by Arthur Andersen
- Task and Investment Profile, published by Touche Ross and Co.

B. Geothermal-Related Sources of Information

The following reports and documents are suggested for further information regarding geothermal energy and export opportunities overseas:

Los Alamos National Laboratory:

- Review of International Geothermal Activities and Assessment of U.S. Industry Opportunities

U.S. Department of Energy

- Equipment and Services for Worldwide Applications
- Guide to the International Development and Funding Institutions for the U.S. Renewable Energy Industry
- Federal Export Assistance Programs Applicable to the U.S. Renewable Energy Industry
- International Data Base for the U.S. Renewable Energy Industry
- Committee on Renewable Energy Commerce and Trade: CORECT's Second Year - October 1985-November 1986

California Energy Commission (CEC)

- Foreign Geothermal Energy Market Analysis
- Small Scale Electric Systems Using Geothermal Energy: A Guide to Development

U.S. Department of Commerce - International Trade Administration

- A Competitive Assessment of the U.S. Renewable Energy Equipment Industry

U.S. Export Council for Renewable Energy

- International Renewable Energy Industry Trade Policy

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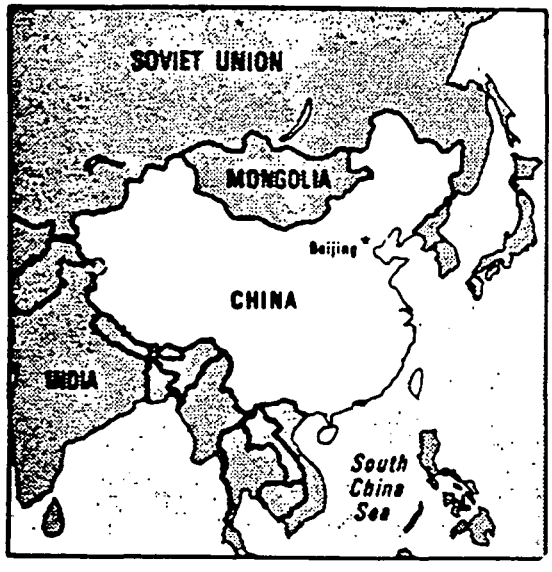

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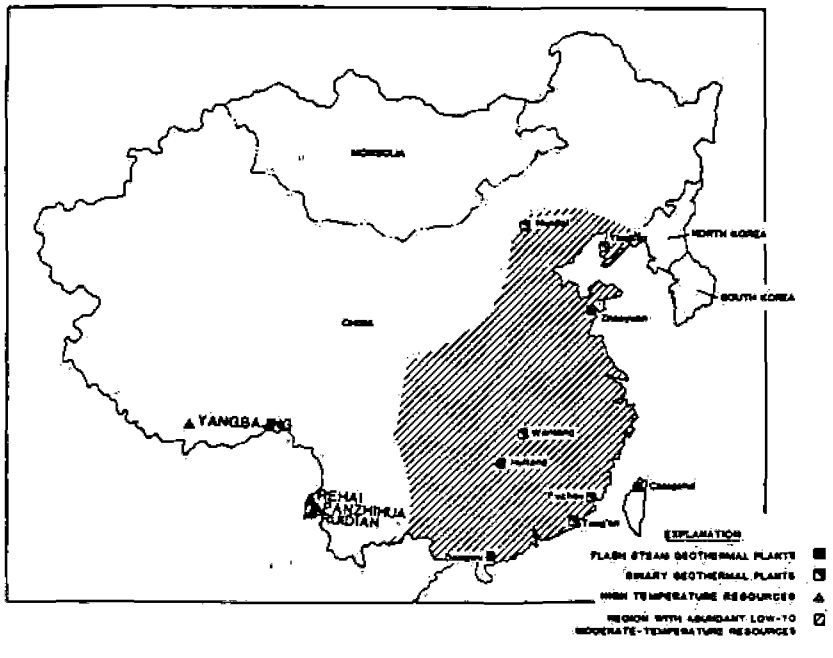
The use of geothermal waters by the Chinese can be traced back 2,000 years. Up to the 1960's, much of the resource in the country had been used for bathing and medicinal applications. Since that time, China has steadily developed its exploitation of geothermal energy by direct-use applications and power generating stations. Although a national development plant remains unfinished, China appears strong in its commitment to geothermal energy development.

About 3,000 geothermal areas exist in China, about 2,400 of which are natural hot springs. Currently 40 geothermal fields, mostly low- to moderate-temperature, have been or are being explored and assessed. In July 1982, the total recoverable geothermal energy was estimated at about 200 billion tons of standard coal equivalent. Later, in May 1985, a further 30 thermal anomalous regions were identified in the Beijing - Tianjin - Tangshan region with an estimated recoverable energy of 17 billion tons of coal equivalent. Geothermal energy currently produces 14.3 MWe and a total of 20 to 30 MWe is planned by 1990. The overall identified potential for electrical generation is 220 MWe.

The largest geothermal power plant in China is at Yangbajing in the Xizang (Tibet) Province. The field has been under study since 1975. The Yangbajing plant consists of four turbines: The first unit, 1 MWe was reconstructed from a long-standing coal-fired one into a single-stage flashing-separating system and came into operation in 1977. It was mainly used to provide data for the design of the new unit. Another unit (Unit No. 3), a 3 MWe dual-flash unit has been on-line since 1981 followed by another 3 MWe dual flash unit (Unit No. 2) in November 1982. The last unit (Unit No. 4) came on-line in July 1985 bringing the total installed capacity of Yangbajing geothermal power plant to 10 MWe.

GEOTHERMAL DEVELOPMENT IN CHINA



Lund, J.W. McEuen, R.B., and Roberts, A., 1984, "Geothermal Energy in Tibet," Geothermal Resources Council Bulletin, September 1984, pp. 5-10.

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Qilong, Y., Kuide, X., Zhang, Z., 1985, "Preliminary Assessment of the Geothermal Resources of China," Geothermal Resources Council (GRC), 1985 International Symposium of Geothermal Energy International Volume, pp. 43-52.

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Wu Fangzhi, Tong Wei, Liu Shibin and Zhang Zhifei, 1986, "First Decade of Geothermal Development in Yangbajing Field, China," Geothermics 1986, Vol. 15, No. 5/6, pp. 633-638.

REFERENCES

AND

KEY CONTACTS

B. Geothermal-Related Sources of Information

The following reports and documents are suggested for further information regarding geothermal energy and export opportunities overseas:

Los Alamos National Laboratory:

- Review of International Geothermal Activities and Assessment of U.S. Industry Opportunities

U.S. Department of Energy

- Equipment and Services for Worldwide Applications
- Guide to the International Development and Funding Institutions for the U.S. Renewable Energy Industry
- Federal Export Assistance Programs Applicable to the U.S. Renewable Energy Industry
- International Data Base for the U.S. Renewable Energy Industry
- Committee on Renewable Energy Commerce and Trade: CORECT's Second Year - October 1985-November 1986

California Energy Commission (CEC)

- Foreign Geothermal Energy Market Analysis
- Small Scale Electric Systems Using Geothermal Energy: A Guide to Development

U.S. Department of Commerce - International Trade Administration

- A Competitive Assessment of the U.S. Renewable Energy Equipment Industry

U.S. Export Council for Renewable Energy

- International Renewable Energy Industry Trade Policy

- Bureau for Asia

  Mr. Robert F. Ichord
  Chief, Energy and Natural Resources Division
  Bureau for Asia
  Agency for International Development
  Washington, DC 20523
  (202) 647-8274

- Publications

  Ms. Dolores Weiss
  Director, Office of Publications
  Bureau for External Affairs
  Agency for International Development
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  (202) 647-4330

Asian Development Bank

- General

  Asian Development Bank
  P.O. Box 789
  2330 Roxas Boulevard
  Metro Manila 2800, Philippines
  Telephone: (63-2) 711-3851
  Telex: 23103 ADB PH

- Publications

  Operational Information on Proposed Projects
  Information Office
  Asian Development Bank
  P.O. Box 789
  Metro Manila 2800, Philippines

U.S. Department of Commerce/International Trade Administration

- Office of International Major Projects

  Mr. Leo E. Engleson
  Office of International Major Projects
  Room 2015-B
  International Trade Administration
  U.S. Department of Commerce
  Washington, DC 20230
  (202) 377-2732

Regional Offices:

Atlanta, GA (404) 881-4091
Chicago, IL (312) 353-0182
San Francisco, CA (415) 556-7234
Dallas, TX (214) 767-8001
New York, NY (212) 264-3262
Washington, DC (202) 377-8275 or 8267

- DOC Marketing Periodicals

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
(202) 783-3238

U.S. Department of Energy

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U.S. Department of Energy
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Export-Import Bank

- International Lending

Mr. James R. Sharpe
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Mr. John Paul Andrews
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- Office of Development

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Small Business Administration

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Trade and Development Program

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United Nations

- United Nations Development Program

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Director
UNDP Energy Office
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- United Nations Department of Technical Cooperation for Development

Mr. Edmund K. Leo
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Mr. Ibrahim I. Elwan
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- Publications

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New York, NY 10163-5850
(212) 754-4460

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To Mike Wright	From David Anderson
Co.	Co.
Dept. Mike - What to do	Phone # ?
Fax #	Fax #

U.S. FOREIGN COMMERCIAL SERVICE

AMERICAN EMBASSY

JAKARTA, INDONESIA

Fax: 62-21-386-1632
Tel: 62-21-360-360

Date: February 3, 1994 **Pages:** One

To: David N. Anderson, Exec Director

Company: Geothermal Resources Council

Fax: 916 758 2839 **Approved by:**

From: Doangsa Situmeang, Commercial Specialist

Subject: Request for assistance

Dear Mr. Anderson:

We are the overseas arm of the US Dept of Commerce promoting U.S. products and services.

One of our clients is interested in developing a geothermal power plant in Bali. For this purpose, the local company had submitted the application to the Indonesian Department of Mining and Energy which administer the licensing for power generation plants. The local company had been requested by the Department to prepare the basic studies necessary to back up its application.

Since the geothermal power is still new to the country and lack of knowledge and expertise, we would appreciate information on any assistance GRC can provide to proceed the project. The preliminary geothermal assessment on the project site (Bratan Caldera, Bali) was made in 1982 by a team of experts from New Zealand. We are looking forward to your advice and guidance.

Best regards,

Doangsa Situmeang
Commercial Specialist

UNIVERSITY OF UTAH RESEARCH INSTITUTE
UURI
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108-1295
TELEPHONE 801-524-3422

October 7, 1993

Mr. Ben Holt, Chairman/CEO
The Ben Holt Co.
201 South Lake Avenue
Pasadena, CA 91101

Subject: Indonesia Geothermal Projects:
Privileged and Confidential Settlement Proposal

Dear Mr. Holt:

Enclosed are the data as agreed under Item 2. Cash Settlement of the terms and provisions in the DIENG INDONESIA GEOTHERMAL PROJECT INTEREST PURCHASE AGREEMENT, dated September 15, 1993.

I appreciate your efforts in processing the "Buy Out" check No. 13211, dated 23 September 1993 in the amount of $20,600.00. The check was received prior to the close of our fiscal year which is greatly appreciated.

Good luck and success in your business endeavors.

Sincerely,

Wilford L. Forsberg
Treasurer

Enclosures

cc: D. L. Nielson
D. A. Petty
P. M. Wright

TRANS-PACIFIC
GEOTHERMAL
CORPORATION
1901 Harrison
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Oakland, Calif.
94612-3501
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FAX 763-2304

FAX DATA SHEET

Date: / / FAX no. called ( )

Attention: Mike Wright / Dave Anderson

Company:

No. of Pages (inc. this page) 1+2

Documents sent: Preliminary comments on the Indonesia proposal.

Comments:

Questions:

1. Lombard's letter: What initiated it?
Who is Kathleen Rees

2. Who is BPPT? What is its institutional authority?

3. Who are the other entities: PT, BPIS (p. 25 of fax).
They are identified as working closely together. It appears that PT is a private company.

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a) With what authority?
b) on what fields?
c) Who will provide the steam?
d) Who will finance?
e) Who will buy the power?
Has the Govt of Indonesia (GOI) contacted the World Bank? Asean? Exim bank? The Rural Electrification Authority of Indonesia?

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a) Who will organize the rural electrification authority?
Who will buy the power?
Who will distribute the power?
Who will own and operate the plants?
Who will drill for the steam?

6. Use of funds:
$16 m of foreign currency is requested. What will it be used for? Who will manage it?

7. Feasibility study: The purposes cannot persuade the entity to do the feasibility study. Heritage is not qualified in either the geothermal area, rural electrification, or small power plants.

The correct approach:

1. Find out who all the entities mentioned in the BPPT proposal are, their authority and ability to function.
2. Find out who is willing to support a pre-feasibility study (DOE? State Dept.? IFFREE? USEAPE? Dept of Commerce? World Bank? ASEAN?)
3. Organize a pre-feasibility study (a competitive bid among NGA companies? Or, let the NGA Executive Committee select consultants?)

Such a study would cost $100-150k and would include:

(1) Definition of need for power
(2) GOI participation and role.
(3) Resource and demand considerations
(4) Economic evaluation, technology, schemes for implementation of electrification
(5) Discussions with funding institutions.
(6) Recommendations for a feasibility study at selected sites.

A full-fledged feasibility study (if possible, i.e. if enough hard data on costs can be derived in from the previous phase): Detailed economic analysis of cost of implementation of small scale geothermal projects, rural electrification establishment procedures, analysis of costs of produced power, taking all costs, including taxes, international tax treaties etc into account. Estimated cost: $0.5-1m.

TO: Tsvi Meidav & Mike Wright
From: Dave Anderson

DEPARTMENT OF ENERGY
WASHINGTON, DC 20585

GEOTHERMAL DIVISION
RENEWABLE ENERGY CONVERSION
CONSERVATION AND RENEWABLE ENERGY
FAX # (202) 586-5124

FACSIMILE TRANSINISSION

DATE: 8/16/93

TO: Dave Anderson

ORGANIZATION: Geothermal Resources Council

FAX NUMBER: (916) 758-2360

FROM: Dave Lombard, EE-122

TELEPHONE #: (202) 586-4952

REMARKS:

PAGE 1 **OF** 10

DOE F 1325.8
(8-89)
EFG (07-90)

United States Government DRAFT **Department of Energy**

memorandum

DATE: August 16, 1993 DRAFT

REPLY TO ATTN OF: Dave Lombard, EE-122, x64952

SUBJECT: Indonesian Geothermal Proposal

TO: Kathleen Rees, PO-70

THRU: J.E. Mock, EE-122
R.R. Kessler, EE-12
A.R. Hoffman, EE-10
R.L San Martin, EE-1

The proposal in question potentially represents a first class opportunity for parts of the U.S. geothermal industry.

The proposed deployment of modular geothermal power plants in the size range of a few megawatts evidently is under way. The deal involves surplus World War II General Electric steam turbines originally manufactured as propulsion units in U.S. Navy destroyers and cruisers. An American entrepreneur, Geothermal Power Company, owns a substantial quantity of these, and retains GE to refurbish them for geothermal service. There are several of these machines in service in the U.S. and elsewhere. They are economical and have a good record of reliability. Depending on the geothermal resource temperature and flow capacity, such a unit is capable of generating power in the range of one to ten megawatts.

While these retrofitted steam turbines are effective, they are not terribly efficient for geothermal service, and the discharged fluid is still quite hot. Modern energy conversion systems based on binary cycle technology can convert thermal energy in lower temperature fluids to electric power. By feeding such a system with the fluid discharged from one of the marine turbines, one can generate additional power at a cost comparable to that from the steam turbine alone. A major advantage of this arrangement is that no additional geothermal wells are required. Another advantage is that the modular binary cycle units can be used alone at geothermal sites where temperatures are too low for effective use of steam turbine technology. Such sites are more abundant than those suitable for the steam turbines. Several U.S. companies manufacture modular binary cycle equipment, and the Indonesian situation would seem to present market opportunities for them. However, the market would be worldwide.

The issue of manufacturing such systems in Indonesia, given a potentially large market there, is one that only the industry can resolve. However, it should be noted that each of the companies in question is a small business, probably incapable by

DRAFT DRAFT

DRAFT

itself of making a substantial investment abroad. This situation may present the Department with an outstanding opportunity to broker an arrangement involving the manufacturers, U.S. capital investment firms, other U.S. agencies, international financing bodies and the energy authorities in Indonesia. Some of the Department's involvement could be under the auspices of Section 1211 of EPAct.

Italy could be a competitor in this arena, but the biggest threat will come from Japan. The Mitsubishi Company and other Japanese firms nearly own the world steam turbine market, which U.S. companies like General Electric, Westinghouse and Allied abandoned over a decade ago. Virtually all of the large steam turbines in U.S. geothermal plants are of Japanese manufacture. Recently the Japanese have announced development of modular binary cycle geothermal power conversion systems, but have not marketed a working model yet. Consequently, although the international market may be ripe for development, and although U.S technology may be more advanced, the golden opportunity for U.S. exporters to build business in these emerging markets cannot last forever.

The National Geothermal Association, a non-profit trade organization, and the Geothermal Industries Corporation, a for-profit organization, have briefed world bank officials on a tour of Nevada geothermal plants. These groups are active in an initiative to provide rural electrification in developing countries, particularly Indonesia and the Philippine Islands. NGA is sponsoring prefeasibility studies on two rural areas in Indonesia.

The Geothermal Division would like to pursue this matter further with the U.S. geothermal power industry, your office and other interested parties. An excellent time and place would be just before or during the Annual Meeting of the National Geothermal Association to be held in San Francisco the morning of October 10. If you agree, I will try to arrange a meeting.

cc: Ray LaSala, EE-122

DRAFT

BADAN PENGKAJIAN DAN PENERAPAN TEKNOLOGI
(BPP TEKNOLOGI)

1000 MW GEOTHERMAL PROJECT

Background Information and Justification

Indonesia has a proven oil reserve of ± 11 billion bbl. Its production is about 1.5 million bbl per day. Domestic consumption is increasing every year. If the present trend continues, and if no new reserves are added to the present known one, Indonesia will be a net importer of oil before the end of this century.

On the otherhand Indonesia's resource base is large : 35 bill, tonnes of coal; 200 trillion SCF of gas, 75,524 MW water power potential, and a potential of 16000 MW installed capacity of geothermal energy source (Table 1 and Fig. 1).

Unfortunately until today only 142 MW of electricity is being produced from geothermal sources.

Most of Indonesia geothermal fields are in Sumatra, Java, North Sulawesi, and also in the smaller islands of East Indonesia (Fig. 1).

Since geothermal energy can be considered renewable (if the groundwater system and the catchment area of its surroundings is preserved), geothermal source can be a considerable contribution in the energy economy of Indonesia.

Besides, geothermal energy generating cost can be made competitive if most parts of the plant are being produced locally. This can be done through a jointventureship or partnership with as foreign company, idem dito with the expertise.
The cost will be much reduced if indegenous engineers/scientists are deployed.

Indonesia's electric consumption grows at a rate of 16% per year. By the year 2000, 10,500 MW electricity has to be added to the present installed capacity of ± 20,500 MW in the Java-Bali system only.

BADAN PENGKAJIAN DAN PENERAPAN TEKNOLOGI
BPP TEKNOLOGI

It is therefore imperative that Indonesia launches an integrated national program to produce 1000 MW of electricity (from various fields in Indonesia) towards the year 2000 (Table 2-3).

The program should include (i) manpower development and (ii) indigenous capability to manufacture most parts of the plants in Indonesia.

Working closely with BPPT is PT. Enerindo Supra Abadi from the Bukaka Group. Besides there is also the BPIS (Strategic Industrial Group) which is headed by the Minister of Research and Technology which has the potential capacity to produce turbines and generators.

The amount of electric energy to be generated is enormous. Public money alone will not be sufficient. Indonesia also has to rely on the private sector to generate electricity. Under the present Indonesian law this is possible by selling the generated electricity to the State Electric Company (PLN), or through a BOT (Built Operate and Transfer) scheme or the BO (Built and Operate) scheme.

Through a close cooperation batween a US company (Geothermal Power Company) in New York and an Indonesian company Enerido of the Bukaka Group), a 1000 MW scheme is being contemplated by using skid-mounted turbine generator set which is delivered complete with all steam valving and electrical controls. These low pressure (80 psig) 6 MW to 11 MW geothermal modules can be disassembled into truck portable units for delivery and start-up at remote geothermal areas in a matter of months. Geothermal Power Co has a large inventory of new surplus General Electric Marine turbines. GPC can offer up to 220 MW of incremental 11 MW power plants at low cost with rapid delivery.

This 1000 MW Program should start with a 100 MW power plants using modules of 11 MW each at various known geothermal fields.

Title of project :
Generating 100 MW at Lahendong; Ulumbu; ... and ... (to be selected).

Table 1
INDONESIA'S ENERGY RESOURCE BASE

	Proven Reserve	Estimated Potential
Oil	12 bill bl	40-50 bill bbl
Gas	104 TS CF	217 TS CF
Hydro	3,209 MW (utilized)	75,000 MW
Coal	4 bill MT	> 30 bill MT
Geothermal (Conventional)	1,155 MW	16,036 MW
Peat (Energy)	8.8 mill ha	

Table 2

Indonesian Geothermal Development Plan To Year 2000

Time Frame / Fields	To the end of PELITA VI (1998) Installed MW				To 2000 MW	
Field	Operational	Committed	Planned	Total	Planned	Total
Kamojang	140	55	-	195	-	195
Dieng	-	55	-	55	-	55
Lahendong	-	20	-	20	20	40
Sibayak	-	-	20	20	20	40
Wayang Windu	-	-	60	60	50	110
Patuha	-	-	60	60	50	110
Karaha	-	-	60	60	50	110
Ulubelu	-	-	40	40	40	80
Salak	-	55	55	110	110	220
Darajat	-	55	-	55	55	110
Sarulla	-	-	55	55	55	110
Sibual-buali	-	-	55	55	110	
	140	240	405	785	505	1290

Note : The 2 MW and 2.5 MW sets currently installed at Dieng and Lahendong respectively are not included in the above totals.

Table 3

Minimum Estimated Installed Capacity by 2000

Field	Capacity
Kamojang	195
Dieng	55
Salak	220
Darajat	110
Sarulla	110
Lahendong	20
Total	710

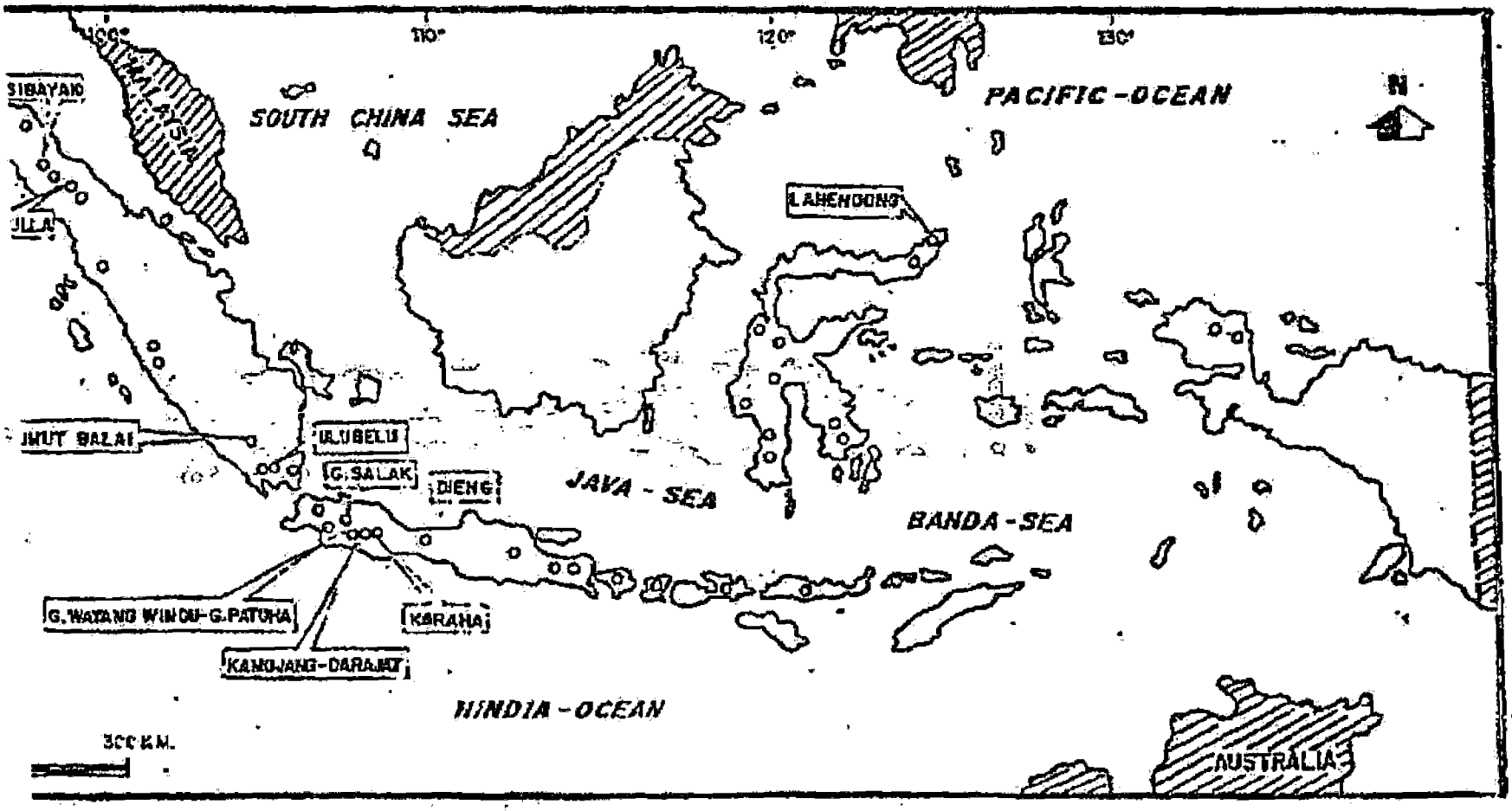

Fig. 1 Geothermal Fields of Indonesia

BADAN PENGKAJIAN DAN PENERAPAN TEKNOLOGI
[BPP TEKNOLOGI]

Implementation of Project

PC, BPPT, Pertamina, and PLN will together identity 3-4 locations at existing geothermal fields from which altogether 100 MW will be generated.

BPPT will buy steam from Pertamina (it is a Pertamina fields), generate electricity with GPC and sells eleccctricity to PLN.

Therefore an engineering study (feasibilyty study is needed).

Time Schedule

The 100 MW project should spearhead the 1000 MW project. Therefore it is of atmost importance to complete this fost to show that the 1000 MW by year 2000 project is not just a dream.

This must be completed in the 1993/1994 Indonesia's financial year.

Financial Resources
US Exim Bank
BPPT Development Budget

1. Project title : Renewable Energy-based Electrification of the Eastern Outer Islands.

2. Location : Selected areas in the Eastern Island of Indonesia.

3. Executing Agency : Agency for the Assessment and Application of Technology (BPPT).

4. Objectives : To demonstrate the technical, economic of a pilot project that will porvide communities in the Eastern Islands of Indonesia with sustainable access to reliable electricity for household, community, and economically productive application through commercially available renewable energy based power systems.

5. Background : Indonesia's population is over 180 million people ; roughly 130 million live in rural areas. Over 80% of rural households lack electricity and are seriously limited in opportunities for economic and social development. Services essential for such development include reliable access to clean water, sanitation, health, lighting, education, communication, information and entertainment services. Without electricity, most of these services cannot be adequately provided. Typically kerosene will be used for lighting and cooking, and expensive batteries will be used for radio and television.

The Government of Indonesia has designated the Eastern Islands as a priority region for social and economic development, and is searching for the preferred least-cost, most efficient means for providing electric power-based services to thousands of isolated villages. The Government has already taken the bold step of launching a program to bring solar home lighting systems to a million households over the coming half decade.

The Goverment of Indonesia's Agency for Assessment and Application of Technology (BPP Teknologi) has been given the mandate to design and to implement a pratical path-way to extend electric power services to rural Indonesia.

However, the pilot project will focus on electrification of small Island, with based sites in South Sulawesi and NTT. In

appliration of hybrid systems in South Sulawesi and NTT, but most of these sites are likely to be condidates for electrification by PLN.

6. Scope of the project : The proposed project activities are as follows :

- To promote the application of renewable energy power systems
- To establish the basis for widespread use of community-scale renewable energy power system for remote communities.
- To test new models of rural power delivery system ownership and financing.
- To establish a new industry in Indonesia for the large-scale manufacture, supply, and sevice of viable power systems.

7. Implementation : 3 (three) years

8. Project Cost :

Total Cost	US $	18,800,000
Local Cost	US $	2,000,000
Foreign Exchange Cost	US $	16,800,000

9. Stage of the project preparation : Completing Feasibility study carried out by Integrated Power Corporation (Westinghouse, US) and BPPT.

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FAX DATA SHEET

Date: ____/____/____ FAX no. called (____) _____

Attention: Mike Wright / Dave Anderson

Company: _____

No. of Pages (inc. this page) 1+2

Documents sent: Preliminary comments on the Indonesia proposal.

Comments: Ken

Questions:

1. Lambard's letter: What initiated it?
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      Who will drill for the steam?
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   $16m of foreign currency is requested. What will it be used for? Who will manage it?
7. Feasibility study: The proposer cannot preselect the entity to do the feasibility study. Westinghouse is not qualified in either the geothermal area, rural electrification, or small power plants.

The correct approach:

1. Find out who all the entities mentioned in the BPPT proposal are, their authority and ability to function.
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Such a study would cost $100-150k and would include:

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(5) Discussions with funding institutions.
(6) Recommendations for a feasibility study at selected sites

A full-fledged feasibility study (if possible, i.e. if enough hard data on costs can be derived in from the previous phase): Detailed economic analysis of cost of implementation of small scale geothermal projects, rural electrification establishment procedures, analysis of costs of produced power, taking ~~tax~~ all costs, including taxes, international tax treaties etc into account. Estimated cost: $0.5-1m.

Dr. Peter A. Jezek
Private Power Advisor

DJLEB, Tenaga Listrik Swasta
Jl. H.R. Rasuna Said Blok X-2,
Kav. 7-8 Kuningan, Jakarta 12950

Phone : 520-3849
Fax : 520-3850

4 pm

NATIONAL GEOTHERMAL ASSOCIATION

P.O. Box 1350
Davis, California 95617-1350 USA
(916) 758-2360 Fax: (916) 758-2839
Telex: 882410

INDONESIAN PREFEASIBILITY REPORT
WHY IT WAS TURNED DOWN

The Ben Holt feasibility study could not be approved because of the following reasons:

1. The prefeasibility study had not been submitted. It has now been received by ECRE,

2. AID Mission claims that the Indonesians have not made a decision on whether Ben Holt will get a concession,

3. The Indonesians must award Dieng to Ben Holt before AID will approve the feasibility study,

4. The feasibility proposal was unartfully written - both feasibility and prefeasibility were intermixed into one report which confused the whole process,

5. There will be no problem getting the feasibility study funded if all procedures are followed. Someone should call and explain the whole project to Ross, and

6. To get feasibility funds USGIC must get a go-ahead from the US/AID Indonesian Mission.

The above was provided by Ross Pumpfrey of US/AID, with some comments from John Armstrong.

NATIONAL GEOTHERMAL ASSOCIATION

P.O. Box 1350
Davis, California 95617-1350 USA
(916) 758-2360 Fax: (916) 758-2839
Telex: 882410

TRIP REPORT - NOVEMBER 5-10, 1992

WASHINGTON D.C., AND ARLIE HOUSE IN VIRGINIA

The purpose of the trip was to do two things: 1) meet with three separate funding agencies to discuss the availability and procurement of feasibility funds, and 2) to attend the meeting of the US/ECRE Board of Directors of which I am a member.

The reason for seeking sources of feasibility funds is that several NGA/USGIC projects have been through the prefeasibility fund stage and are ready to move into the feasibility phase. The three agencies visited are:

WINROCK International
Tod Burtholf
1611 N Kent Street, Suite 600
Rosslyn, VA 22209
703/325-9430

World Bank
Loretta Schaeffer, Program Manager
Asia Alternative Energy Unit (ASTAE)
1818 H Street, Room 3069
Washington, D.C. 20433
202/458-1434

US/AID
Ross Pumpfrey
1601 N Kent Street, Suite 506
Rosslyn, VA 22209
703/875-4694

I was accompanied by John Armstrong at all three meetings.

WINROCK

The meeting with Tod Burtholf of WINROCK uncovered the following.

-WINROCK is almost entirely funded by US/AID and although the funds for REPSO (explanation below) came from US/ECRE they are provided as a pass through by US/AID. A very small portion of their operating funds come from the WINROCK Foundation. They are essentially a US/AID contractor.

-They primarily fund feasibility studies. The definition of feasibility studies is broad and can cover a wide range of tasks as well as studies, but they are essentially those studies that look at the social, economic, legal and resource aspects of a country that is planning to have its geothermal resources developed.

-WINROCK is developing the Renewable Energy Project Support Office (REPSO) (see Attachment A). The official title is The International REPSO Network. Funds for the REPSO are provided by US/ECRE. Essentially REPSO was set up to locate responsible persons in developing countries, contract with them for their services and have them available as an information source on all kinds of information pertaining to the export of U.S. renewable energy goods and services to that country. The REPSO person will work independently of the US/AID Missions and regional offices. Also, in certain situations (REPSO Countries) REPSO funds can be used for prefeasibility studies.

To date a REPSO office has been opened in San Jose, Costa Rica (call Tod Burtholf for the name, phone, and fax numbers). The REPSO offices to be developed, in the order they are scheduled are: Indonesia, Philippines, India, Thailand, Mexico, Guatemala, Brazil, and searches are underway for representatives in Africa and Eastern Europe. The scheduled online of these offices is unclear but they are working on it. For some reason, possibly because of a delay by WINROCK, Scott Sklar of US/ECRE has applied to US/AID to start their own country representative program. This is obviously a duplication of effort. When I learn more about this program, why it is being duplicated and the schedule I will print it in the First Alert.

-Tod Burtholf gave us the names of four persons in Indonesia who can help projects along and pass on information: Their names, addresses and contact numbers follow in descending order of importance.

Edi Setianto
Energy Officer
USAID/PED
American Embassy

Dr. Peter A. Jezek
Private Power Advisor
Directorate General of Electricity
and New Energy

Jl. Medan Merdeka Selatan 3-5
Jakarta 10110 Indonesia
Phone: 360-360 Ext. 2361
Telex: 44218 AMEMB IA
Fax: 62 (21) 380-6694

Jl. H.R. Rasuna Said Blok X-2
Kav. 7-8 Kuningan, Jakarta 12950
Phone: 520-3859
Fax: 520-3850

Dr. George T. Lewis
US Technical Advisor
To The State Minister for
Research and Technology
BPP Teknologi
Jl. MH. Thamrin No. 8 (4th Fl)
Jakarta Pusat
Phone: 328-073 - 304-2975
Fax: 324990

Robert W. Beckman, Director
Private Enterprise Development
American Embassy
Jl. Medan Merdeka Selatan 3-5
Jakarta 10110
Phone: (62) 21-360-360 Ext. 23.08
Telex: 44218 AMEMBJKT
Fax: (62) 21-380-6694

We were told that Dr. Peter Jezek, who is located in the Indonesian Government not the US/AID Mission is the most effective.

-WINROCK also manages the Environmental Enterprises Assistance Fund, which is covered below under US/AID.

-WINROCK needs a geothermal person(s) on their Feasibility Study Review Team. If you are interested, please call me. I suppose a reviewer would be paid, and I am not sure if a reviewer would be ineligible to participate in a project that he or she reviewed. There is a possibility that they would be eligible.

-I have personally concluded that it would be better to submit a feasibility study to WINROCK than to US/AID because AID is so bogged down with work that long delays are inevitable.

US/AID

The meeting with Ross Pumpfrey of US/AID revealed the following:

-US/AID funds US/ECRE for two types of projects: 1) Prefeasibility Studies, and 2) Education and Training. The parameters of these funds are fairly flexible, however, they must fit within US/AID's

guidelines, called Questions To Be Addressed...Copies of these Questions are included in this report as Attachments B and C.

-The important energy funds within US/AID are:

1. EPDE - Engineering Project Development Fund - This fund is set up to do Feasibility Studies for both private and public entities. The key contact persons are: John Hammond and Rolf Anderson.
   Energy Project Development Fund
   US/AID
   Room 508, SA-18
   Washington, D.C. 20523-1810
   Phone: 703/875-4052
   Fax: 703/875-4053

2. EEAF - Environmental Enterprise Assessment Fund - This fund is small and is setup to make equity investments and loans for environmental projects. The key contacts for this loan program are not known. (Attachment D)

3. IFREE - IFREE consists of two funds: International Fund for Renewable Energy and Efficiency and the Education and Training. These two funds are administered by US/ECRE with a review by US/AID of the decisions and operations. Their specific parameters have been covered above. These are the two basic funds used by the NGA. As the agreement and ground rules for these funds were only completed a short time ago by US/ECRE the funding has taken place only recently and has been sporadic. In the future, funds should become available on a regular basis.

4. WINROCK - WINROCK International was covered above.

5. REPSO - Renewable Energy Project Support Office - This fund is administered by WINROCK International and was covered above. Note that in a REPSO country REPSO funds can be used for prefeasibility studied.

-US/AID is interested in writing a contract with the NGA to supply persons for Geothermal Technical Reviews. The NGA office will get underway with the preparation of a proposal to accomplish this objective as soon as possible. It is not known at this time if reviewers will be ineligible to participate in programs they have reviewed. If you or your firm are interested in participating in Technical Reviews for US/AID, please call me.

-Again as the US/AID office is heavily overloaded, delays on any project activities can be expected. Delays can be lessened by being more accurate and staying within the parameters during the preparation of proposals and correspondence. (Attachments B and C)

WORLD BANK

The meeting with Loretta Schaeffer, Program Manager of the Asia Alternative Energy Unit (ASTAE) - Asia Technical Unit (the acronym does not fit but that's what's on her card) turned up the following:

-ASTAE was formed by the World Bank in 1992. Its goal is to incorporate energy conservation and renewable energy options in the design of energy strategies and in lending operations for the Asia region. Refer to Attachment E for a more detailed description of this program. There are possible sales in some of the programs, specifically the Indonesian Second Rural Electrification Project and in the Southeast Asia FINESSE program in the countries of Thailand, Philippines and Indonesia. FINESSE is covered below.

-In 1989 the World Bank launched the Financing Energy Services for Small-Scale Energy Users (FINESSE) program. FINESSE seeks to find new and better ways to provide energy services in the developing countries. It is founded on the belief that traditional energy sector lending-characterized by large-scale coal and hydropower will face formidable economic, social and environmental obstacles in the future. Projections have been made that indicate between 1990 and the year 2000 the demand for power in the four target countries will grow as follows: Thailand 69%, Malaysia 70%, Philippines 80% and Indonesia 74%. What they are looking for are small, relatively non-polluting renewable energy sources and energy efficiency measures that match the needs of small scale energy users. (Attachment F)

-Global Environmental Facility (GEF) - GEF is designed to help solve the global pollution problems. Approximately $1.5 billion has been allotted for GEF in the next 3 years. It will concentrate on four areas: 1) climate change, 2) biodiversity conservation, 3) international waters, and 4) the protection of the ozone layer.

The energy component in GFE is estimated to be about $400 million. The program covers all types of energy but renewables can be used when they prove less polluting or even slightly more polluting than conventional energy sources.

-GFE was finalized in April of 1992 in Washington D.C. and it is now in the pilot stage which should end in 1994. Although this program is new it represents possible sales to US vendors of geothermal goods and services. If you would like a more comprehensive description on GFE call me at the NGA office. (Attachment G)

-Loretta Schaeffer has asked the NGA for the following:

1. A small scale seminar on geothermal energy approximately 50 to 60 minutes in length. The presentation should last about 20 minutes and the remainder of the time would be used for questions and answers. To date, none of the World Bank energy experts assigned to the above programs has a good idea of the scope and potential of geothermal energy.

2. A description of the geothermal resources areas in Indonesia that could be used for development of small (1-5 MW) units to be used in their rural electrification programs.

3. A description of each of the four companies in the NGA that design and construct small power plants. Each description should include a company background, a list of the past projects, the type(s) of units they design and sell, the cost of the installation of small power plants, the cost of the operation and maintenance of these plants, the cost of kilowatts produced and the environmental advantages of this type of power generation system.

-The NGA will also send Loretta Schaeffer data on the NGA and its members, their areas of expertise and several 18 x 24 inch photos of geothermal power plants for their offices.

-World Bank Contacts:

For information on ASTAE, FINESSE and GFR

Contact: Loretta Schaeffer
Program Manager
Asia Alternative Energy Unit
Asia Technical Department
World Bank
1818 H Street S.W.
Washington, DC 20433
Phone: 202/458-1434
Fax: 202/477-3129

The specific ASTAE contacts are:

Anil Cabroal - Solar p.v. and wind expert
World Bank
1818 H Street S.W.
Washington, DC 20433
Phone: 202/458-1434
Fax: 202/477-3129

John Irving - Task and Project Manager
World Bank
1818 H Street S.W.
Washington, DC 20433
Phone: 202/458-1434
Fax: 202/477-3129

The contact for the GFE Program is:

Ian Johnson and Ken Newcomb
GFE Program
World Bank
1818 H Street S.W.
Washington, DC 20433
Phone: 202/458-1434
Fax: 202/477-3129

WINROCK INTERNATIONAL

RENEWABLE ENERGY AND THE ENVIRONMENT PROGRAM

THE INTERNATIONAL REPSO NETWORK

PROGRAM SUMMARY

Winrock International's Renewable Energy and the Environment Program (REEP), funded by the U.S. Agency for International Development's Office of Energy and Infrastructure (U.S. AID) with support from the U.S Export Council for Renewable Energy (US/ECRE), has devised a plan to stimulate the world's awareness and use of environmentally sensitive power production technologies. The framework for this plan is an unique, yet practical, strategy of establishing an international network of in-country affiliates to support the program's varied activities, all aimed at stimulating potential markets for renewable energy development. The overall goal of this plan is to assist in the timely and proper adoption of technologies that provide environmentally appropriate solutions to the increasing energy demands of the developing world.

THE REPSO

Each locally managed facility, which represents its respective country's participation in this global network, is known as a renewable energy project support office, or REPSO. The REPSO is an effective vehicle for matching the global interests of the renewable energy industry with the specific needs of the numerous rural populations, most living without any electrical service at all, in many regions of the developing world. Once established, each REPSO gains access to REEP's international technical and financial assistance programs.

THE NETWORK

Collectively, the REPSO members form an international network which can capitalize on Winrock's international presence to provide private and public organizations worldwide with the assistance necessary to accelerate their interest and investment in renewable energy technology and project development. The Network becomes the medium for the critical exchange of ideas and information which, in turn, promotes an alliance between the growing community of renewable energy users and their suppliers in a common pursuit of transforming research into sustainable development.

The International REPSO Network will consist of regional as well as local representation on five continents and in approximately 10 to 15 countries by the end of 1994. The Network will enable international project developers and industry members to access a worldwide database of up-to-date information regarding specific market developments, proposed projects and related regulatory issues associated with each of the renewable energy technologies. The Network will also benefit the emerging industry members, policy makers and technology users of each of the member countries as they learn the details of progress being made in other areas around the world. Winrock's Renewable Energy and the Environment Program will maintain the lead role in the overall management and supervision of the International REPSO Network, coordinating the many activities that will comprise the overall agenda of each REPSO.

FOCUS

Each member organization will concentrate its efforts on the following four main program initiatives:

1. *Renewable Energy Project Identification and Preparation* Assisting in the identification and preparation process for renewable energy project development through technical, economic and financial support.

2. *Trade Promotion and Technology Transfer* Creating and disseminating knowledge that will help resolve critical problems in the deployment and transfer of renewable resource technologies.

3. *Utility Exchange Program for Renewable Energy Applications (RETAP)* Facilitating the exchange of renewable energy ideas and experience between the U.S. utilities and their in-country counterparts.

4. *Renewable Energy Market Information Service* Collecting information relevant to the network's international renewable energy newsletter and database service which will be disseminated as a means of matching renewable energy developers with global project opportunities.

These initiatives collectively compose the basic identity of the REPSO and shape its principle activities. Additionally, the program is designed to accommodate an individual REPSO's periodic emphasis on related projects of special interest that may be unique to a member country or its immediate region.

SELECTION

The process for determining the countries to be included as part of the network, the timeframe for their initiation and the particular organization within a selected country that will collaborate as the REPSO will involve several steps, including a discussion of the candidates with US/ECRE and its industry members, U.S. AID's Office of Energy and Infrastructure and U.S. AID Mission representatives in the country being considered. The standard criteria used in this process are outlined in the *International REPSO Network Development Plan* (9/92).

AGREEMENT

An agreement will be reached between Winrock International and the selected organization to support the REPSO program goals and objectives as outlined in the above-referenced and future development plans. The agreement will include an initial six month grant to cost-share expenses that are incurred for authorized activities that pertain to the promotion of renewable energy projects (see *International REPSO Network Development Plan*). Winrock will cost-share up to 50% of these expenses. At the conclusion of month four of the initial agreement, a program review will be conducted to determine the benefits of renewing the agreement to allow for program continuation for a period of up to one year beyond the completion of the first six month term. Specific terms and conditions are outlined in the Winrock agreement that must be signed by both parties before associated activity can begin. Additionally, all agreements must meet the requirements of, and gain approval from, U.S. AID as a part of the acceptance process.

To indicate your organization's interest in the International REPSO Network and/or to obtain further information on the program, please contact:

Renewable Energy and the Environment Program
REPSO Program Officer
Winrock International
1611 North Kent Street
Arlington, Virginia 22209 USA
Tel: (703) 525-9430
Fax: (703) 243-1175

10/92

QUESTIONS TO BE ADDRESSED WITH REGARD TO PROPOSALS FOR A.I.D. FUNDING FOR PRE-FEASIBILITY STUDIES THROUGH IFREE

1. What is the demand for energy that is proposed to be met?

2. What technology and renewable energy resource are proposed?

3. What is the commercial track record of the specific technology?

4. What indication is there that the regulatory environment is compatible?

5. What indications are there that a commercial deal can be consummated and the project come to fruition? This includes several subsidiary questions:

   A. Has a buyer been identified? Show some evidence (e.g., a letter) of the buyer's interest and willingness and ability to pay.

   B. Is the seller (assumed to be the applicant for funds) in good standing and capable of performing? Show evidence (company capabilities and financial standing).

   C. Assuming a buyer and assuming that the applicant is the seller, are other investors going to be necessary? Show evidence of their interest and capabilities.

6. What has the applicant done already, and what does s/he propose to do, in order to catalyze a commercial sale and application of the technology? That is, what is the "roadmap" for the project and what questions need to be answered in order to satisfy whoever will approve and/or finance the <u>next</u> step in the overall project? Within this context, for what specific purpose are A.I.D. funds being requested?

7. Will possible environmental problems be addressed?

8. Is the proposer willing to pay at least 50 percent of the costs of this stage of the market development? The budget for the

proposed set of activities should indicate the proposed breakdown of funding.

9. Are any other funders being asked to contribute grants at this stage (e.g., another federal agency or a foundation)? If so, R&D/EI will want to meet with representatives of that other organization in order to compare judgements, criteria, and goals.

10. What evidence exists that the project will be sustainable from the standpoint of operation and maintenance? Who will operate and maintain it? Will local people be trained? Is a local business involved?

11. If the project is small or is aimed only at a segment of a potential market, what evidence exists that if this project is successful, it is likely to be replicated in a significant way in the country or region? I.e., What market is being opened up?

12. What are the approximate local and U.S. contents of the project should it come to fruition?

13. Have any discussions about this project been held with the USAID Mission in the target country? If so, how would you characterize the interest or support of that Mission? (Such discussions are not a prerequisite to submission of a proposal, but approval of the Mission will be required before any A.I.D.-funded travel to the country can occur. If no previous communication has occurred and R&D/EI believes that the proposal is worth pursuing, R&D/EI will submit the proposal, or a summary thereof, to the Mission.)

Notes:

If a proposal is accepted and an award made, three additional conditions must be met:

(i) Any travel to an A.I.D.-assisted country must be granted "country clearance" by the local A.I.D. Mission and Embassy. US/ECRE will be asked to submit a draft cable requesting such clearance (a handbook explaining this and many other things will be sent to you within the next ten days) fifteen days prior to such proposed travel, and R&D/EI then will forward the cable to the Mission).

(ii) A member of any visiting team must be prepared to brief the local A.I.D. Mission and must inquire of that Mission regarding interest and convenient scheduling.

(iii) The scope of work must include a statement that the pre-feasibility study must be submitted to R&D/EI for approval of payment.

QUESTIONS AND/OR REQUIREMENTS TO BE ADDRESSED WITH REGARD TO PROPOSALS FOR A.I.D. SUPPORT AS TRADE MISSIONS UNDER THE "EDUCATION AND TRAINING" FUND

1. What technologies will be represented on the trade mission?

2. Who is going on the trade mission?

3. What countries will be visited?

4. With respect to the technologies represented, why were these countries chosen?

5. What education or training activities will be implemented and who is the audience? Why was this particular audience chosen, and have they agreed to the visit?

6. If the mission also is intended to investigate project opportunities, what site visits are proposed, what data is going to be gathered, and what people or organizations will be interviewed and for what purpose?

7. If the mission includes #6 as a purpose, it must be organized by a trade association.

8. If the purpose of the trip is solely education and/or training, it must be organized by either (a) a trade association, or (b) by a particular company and for the purpose of training local nationals on the implementation (operations, maintenance, monitoring, or evaluating) of a commercial renewable energy project, conditioned on all other financing for the project being assured.

9. With regard to missions that fall into either of the categories mentioned in #7 and #8(a) above, at least half of the costs of the activity must be paid by private-sector participants (the association or participating companies).

10. If the activity falls into the category described in #8(b), then the company must provide evidence that education or training tied to a single project will have a direct impact on opening up a larger market.

11. Are any other public agencies or foundations being asked for support? If so, A.I.D. will want to discuss the proposal with them.

12. Have any discussions about this activity been held with the USAID Mission in the target country? If so, how would you characterize the interest or support of that Mission? Such discussions are not a prerequisite for funding.

Note: If a proposal is accepted and an award made, three additional conditions must be met:

(A) Any travel to an A.I.D.-assisted country must be granted "country clearance" by the local A.I.D. Mission and Embassy. The procedure described in the R&D/EI Handbook (to be sent to US/ECRE within the next week) must be followed, with respect to submitting a travel authorization form and a draft cable to R&D/EI at least fifteen days before a proposed trip.

(B) A member of any visiting team must be prepared to brief the local A.I.D. Mission and must inquire of that Mission regarding interest and convenient scheduling.

(C) The scope of work for the trade mission must include a statement that a report on the mission will be submitted to R&D/EI for approval of payment.

ATTACHMENT C

Pathfinder

How to Obtain A.I.D. Documents

Where

DISC
Suite 1010
1500 Wilson Blvd.
Arlington, VA 22209-2404

telephone: (703) 351-4006
fax: (703) 351-4039

How

Order documents using the correct order number (also called document identification number, or docid) for each document you want. This is the 5-letter, 3-digit number in the top left-hand corner of the citation record in the Development Information System. Example: PN-AAY-486.

PN- prefix designates A.I.D.-supported studies; an XN- prefix designates an annex to a PN- document of the same number.

PD- prefix designates an internal A.I.D. project document, and XD- similarly designates an annex to a PD- document of the same number. You may need to request authorization from an A.I.D. officer to obtain a recent PD- or XD-.

DIC call no. in the record indicates that the publication or document is also in the A.I.D. Library collection, and you may borrow it through your local academic, public, or corporate library using OCLC's Interlibrary Loan system.

Cost

A.I.D. documents are archived in microfiche form (105 x 148 mm, 98 pages per microfiche, 24x reduction). You can purchase either paper enlargements ("blowbacks") or duplicate microfiche.

Paper copy $0.13 per page. Microfiche $1.08 each.

Postage and handling are additional, charged according to the actual size and weight of your order.

Institutions located in developing countries may receive up to five (5) titles in microfiche form free of charge.

Payment

DO NOT SEND PAYMENT WITH YOUR ORDER.

If your order totals over $30.00, you will be invoiced for prepayment in full before your order is processed. Otherwise, your bill will be enclosed with your documents. Payments are accepted in U.S. dollar checks only. Charge accounts are not available. Contact the Supervisor of Unser Services about establishing a deposit account.

ENVIRONMENTAL ENTERPRISES

ENVIRONMENTAL ENTERPRISES ASSISTANCE FUND

Headline: Winrock International and U.S. AID help create an innovative nonprofit investment fund to promote environmentally responsible private enteprises in developing countries.

Overview

The Environmental Enterprises Assistance Fund (Environmental Enterprises) is an experimental international development nonprofit established in September, 1990, with the help of Winrock International and the United States Agency for International Development. The goal of Environmental Enterprises is to promote the spread of commercially viable renewable energy and other environmentally responsible technologies in the developing countries. The Fund will accomplish this by making carefully targeted investments in promising projects which, if they lead to profitable businesses, will return funds for further portfolio development. It will provide entrepreneurs with technical and management assistance, loans, and equity, seeking to serve as a catalyst to overcome the many non-market barriers that these smaller-scale technologies encounter. When fully operational, the fund will manage a $20 million portfolio of investments while adding value with a program of technical assistance funded by grants.

Goals

Developing countries are in the midst of a mounting energy crisis that is closely tied to parallel crises in economic growth, international finance, and environmental quality. Power shortages are hobbling economic growth and are especially disruptive to rural communities that rely on power for pumping, grinding, milling, and lighting. A heavy debt burden, scarce foreign exchange, and escalating prices for fossil fuels have forced country after country to forgo new additions of conventional generating capacity, despite the economic losses associated with power shortages. Governments and utilities have also postponed extensions of grid-based electric service to new areas. These conditions, plus a growing concern for the global implications of further fossil-fuel use, have made cost-effective renewable

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energy systems--systems operating profitably at thousands of locations in the United States--increasingly attractive on technical, economic, and ecological grounds.

Unfortunately, commercially sound, smaller-scale, renewable energy systems--such as biomass combustion and cogeneration, small hydropower, or wind power--face powerful artificial barriers that prevent their adoption. Banks prefer large investments; utilities discourage small, private power systems they do not directly control; owners of renewable resources are often unfamiliar with technical opportunities; and small businesses selling renewable energy technologies often have limited funds for international travel and marketing. The result has been a clear example of market failure: attractive private renewable energy projects have been systematically bypassed by banks and utilities in the developing nations, where these projects would make an especially valuable contribution. To a considerable extent, the same applies to other environmentally responsible technologies, ranging from those that increase energy efficiency to a wide array of waste-management systems.

Concerned by this widespread market failure, the founders of Environmental Enterprises, with the backing of U.S. AID and the technical assistance of Winrock International, have created a novel mechanism, one that will harness grant-based assistance with loans and investment capital to help entrepreneurs overcome these barriers. Motivating the creation of Environmental Enterprises is a powerful set of ideas--ideas about the critical place of energy in development, about the creative role of private initiative in helping overcome poverty, and about the importance of environmentally responsible technologies for the future.

Operation

Environmental Enterprises will seek to act as a catalyst for project development by identifying project sites and participants, supporting prefeasibility and feasibility studies to reduce investment risks, making loans and equity investments where necessary, and then moving on to other projects once the new ventures have become profitable. The Fund will also maintain a strong team of experienced private sector specialists who can assist inexperienced developing country managers until they get their feet on the ground.

Because of the importance of on-site project identification and development, Environmental Enteprises will often establish for-profit in-country investment companies--often in the form of joint ventures with local partners--to carry out its mandate. The target countries identified as candidates for the first of these

companies are: Costa Rica, Indonesia, and Pakistan. Earnings from these local investments and partnerships will be used to cover Fund costs and to support further grants, loans and investments. The Fund will also support the efforts of small- and medium-sized companies as they seek to establish markets in developing countries for renewable energy and other environmental management technologies, possibly forming joint ventures with them as well.

Funding

Environmental Enterprises has set a funding target of US $20 million, to be achieved within three years. Of this, Enterprises will seek US $5 million in endowment support. The remainder will comprise funds managed in behalf of investment institutions sharing the Fund's commitment to environmentally responsible international development. The founders of Environmental Enterprises expect that the Fund will fill an important niche by identifying qualifying projects and bringing them to the attention of investment institutions that may have little or no access to actual project sites in developing countries.

Enterprises has signed a loan agreement with AID's Private Enterprise Bureau for US $2.4 million, the proceeds of which will be used for loans to qualifying projects. A distinctive feature of this loan agreement is that it takes the form of a matching challenge: Environmental Enterprises must raise, from other sources, funds equal in amount to those it proposes to utilize from the AID loan. Fund managers expect to make their first investments within several months, and are developing business plans for the first two local investment companies.

For further information, contact:

Franklin Tugwell
Environmental Enterprises Assistance Fund
1611 North Kent Street
Suite 600
Arlington, Virginia 22209
Phone: 703-525-9430; Fax: 703-243-1175

THE ASIA ALTERNATIVE ENERGY UNIT (ASTAE)

In January 1992, the World Bank established the Asia Alternative Energy Unit within the Office of the Director of the Asia Technical Department. ASTAE's goal is to incorporate energy conservation and renewable energy options in the design of energy strategies and in lending operations for the Asia region. ASTAE participates in alternative energy sector work, identifies and prepares components for Bank projects, designs and implements training in energy efficiency and renewable energy options, helps formulate alternative energy policies and strengthen institutional capabilities, collaborates with donor agencies, and mobilizes technical assistance funds in support of its work program.

Over the past nine months, ASTAE has initiated a comprehensive program aimed at mainstreaming alternative energy services into the Bank's Asian activities. A core staff[1] with renewable and energy efficiency expertise is in place. ASTAE has secured donor support from the U.S. Department of Energy (USDOE), the Government of the Netherlands, the U.S. Agency for International Development (USAID), and the International Fund for Renewable Energy and Energy Efficiency (IFREE). Operational programs underway include:

- pre-appraisal and appraisal of the solar PV component of the India Renewable Energy Resources Development project;
- preparation of the renewable energy component of the proposed Indonesia Second Rural Electrification project;
- preparation and appraisal of the Lao PDR Provincial Grid Integration project;
- preparation of the Thailand Demand Side Management (DSM) project, financed by the Global Environmental Facility (GEF);
- preparation of renewable energy components of the GEF-funded China Greenhouse Gas Study; and
- evaluation of Southeast Asia FINESSE market studies with follow-up missions to Thailand, Philippines and Indonesia.

As part of its technical assistance program, ASTAE has hosted five alternative energy seminars/workshops for Bank staff and developing country officials and co-sponsored three energy efficiency seminars with the Bank's Industry and Energy Department and the Economic Development Institute (EDI). In addition, ASTAE is providing technical assistance to the Lao PDR electric power utility for institutional development, collaborating with ESMAP on a study of energy efficiency in the Philippines and has contributed to Bank policy papers on energy efficiency and the Bank's role in the electric power sector.

The ASTAE experience has led donors to consider providing comparable assistance to other regions, in particular, Latin America and the Caribbean.

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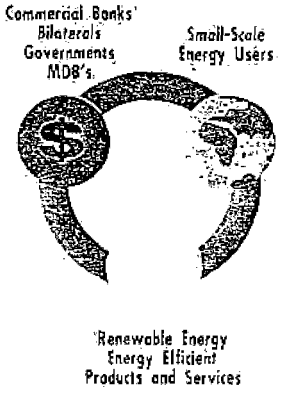
[1] The ASTAE core team consists of a Program Manager, two Economists, a Renewable Energy Expert, an Energy Efficiency Expert and a Research Assistant. The team also draws on the services of two support staff and short-term alternative energy consultants.

ESMAP was ASTAE's Predecessor

FINESSE

Financing Energy Services for Small-Scale Energy Users



Launched in 1989, Project FINESSE mobilized the growing interests of donor organizations and host countries alike in seeking new and better ways to provide energy services in the developing world.

FINESSE is founded on the belief that traditional energy sector lending — characterized by large-scale coal and hydropower — will face formidable economic, social and environmental obstacles in the future. This situation becomes most evident when the largely unmet, rapidly expanding energy requirements of households, cottage industries, and enterprises are considered.

Alternative energy technologies — energy efficiency and renewable energy — offer a choice. They match the needs of small-scale energy users and employ the skills, products, and services of the private sector. When bundled together, alternative energy projects provide for a more sustainable energy future.

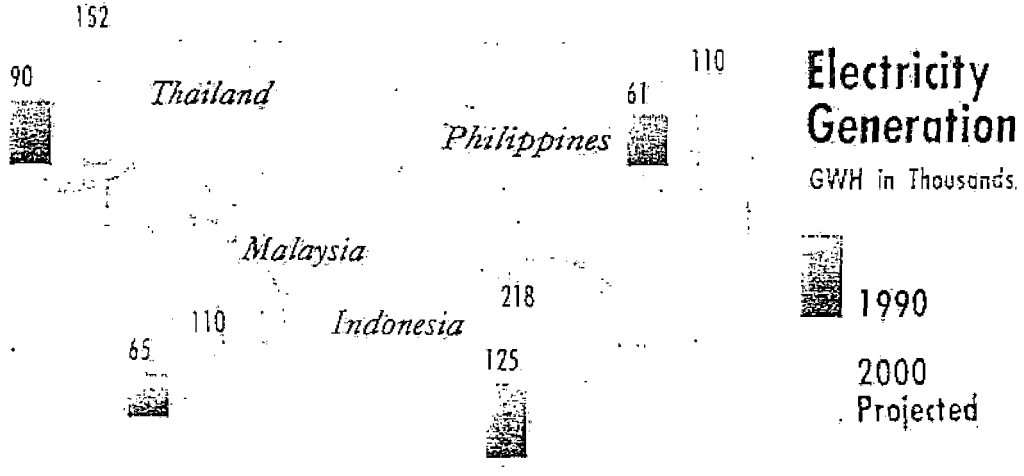
FINESSE challenges both the developing world to incorporate alternatives into national energy planning and policy making, and the international financing community to lend needed capital and support for these projects.

To aid in this challenge, FINESSE proposes replicable models for financing and institutionalizing alternative energy services. These models are based on channeling donor funds through a range of utility, private sector, non-governmental, and commercial lending intermediaries. FINESSE also outlines needed policy reforms for more equitable consideration of alternative energy technologies.

Project FINESSE encompasses a number of key activities:

- Conducting ASEAN country market studies
- Initiating efforts to promote the upstream manufacture of energy efficient lightbulbs and appliances
- Examining the institutional environment for setting up and operating alternative energy projects
- Identifying ASEAN project opportunities and financing strategies
- Establishing a multi-donor FINESSE feasibility fund
- Hosting an international forum assembling key members of the development and financial community.

FINESSE initiatives will contribute to positive national impacts on energy supply, industrial growth, employment, the environment, and revenues. FINESSE sets in motion the "innovation" of today that will become the "standards" of tomorrow.



Electric generation growth in Southeast Asia is among the highest in the world. A World Bank study indicates that between 1990 and 2000, energy requirements for electric power will increase by 69% for Thailand, 70% for Malaysia, 80% for the Philippines and 74% for Indonesia.

The Need

The developing world is facing a crisis in the energy sector.

Electricity demand for the developing world is projected to grow at 7% per year over the next 20 years, as compared to 2-3% for industrialized countries. In several Southeast Asian countries demand growth exceeds 15% per year.

The cost of meeting this growing energy demand is estimated at over one trillion dollars for the decade, or at least $100 billion per year. Current spending in this sector accounts for about half this amount.

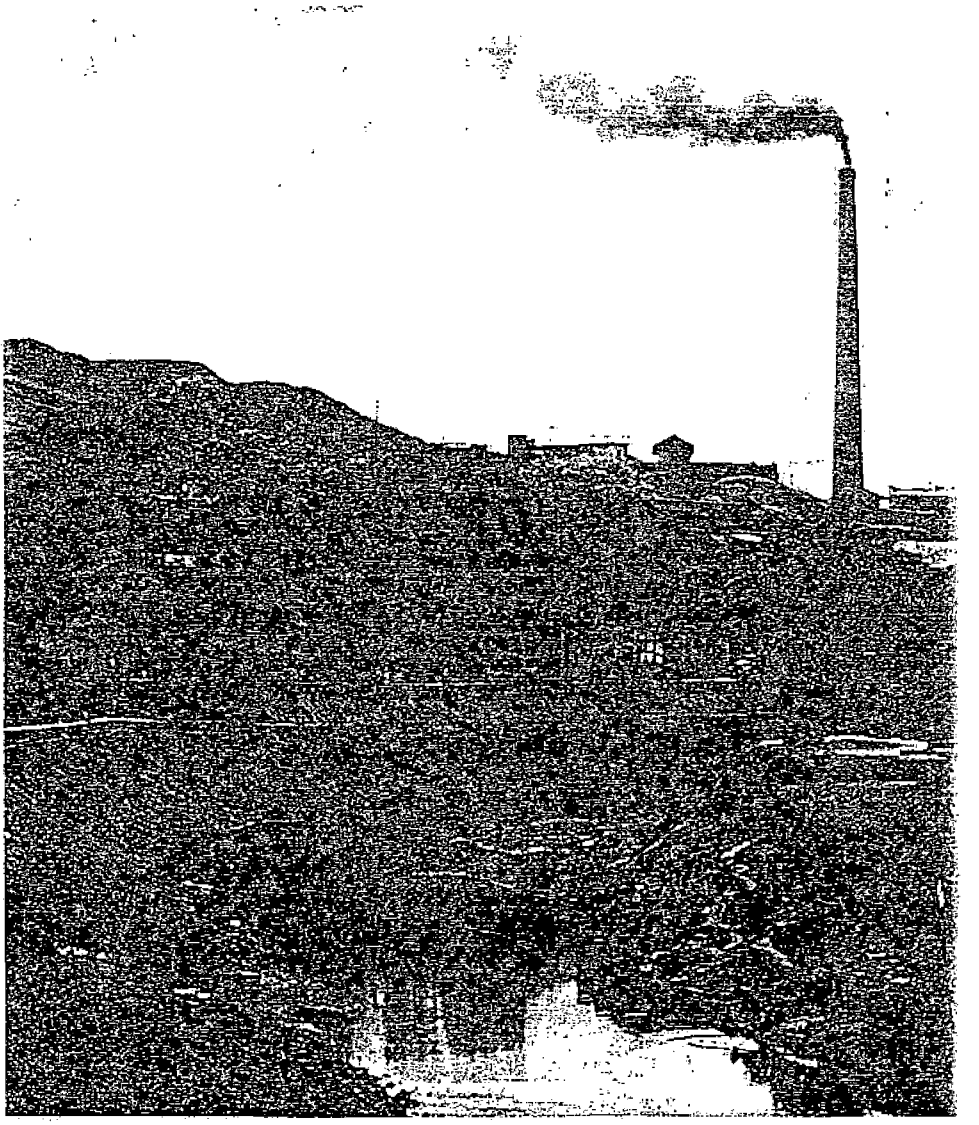
As the demand for electricity exceeds supply, many developing nations face power shortages surpassing 10% of their generation capacity. This situation will only worsen as urban population growth continues to accelerate. Power shortages and unmet power demands inhibit domestic growth and reduce foreign exchange earnings.

Much of the developing world is planning to use environmentally damaging coal thermal and large-scale hydropower to satisfy approximately 80% of its planned energy needs.

Despite enormous investments in rural electrification, two billion people, or approximately half the population of the developing world, continue to live without adequate power supplies for economic growth and basic human needs. Even in those countries which implemented rural electrification programs in the last 10-20 years, only a few serve more than 20% of their rural population.

Rural electrification programs are both costly and problematic. Line extensions are frequently unreliable and characterized by low loading ratios and high losses. The programs are typically highly subsidized, recovering only 50-80% of costs.

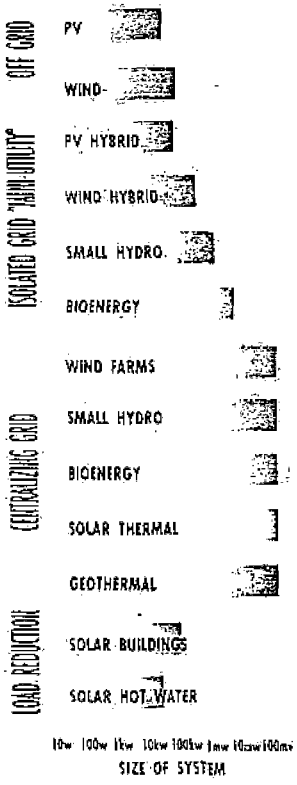
These emerging realities are motivating leaders in the development community to seek new ways of providing the vital energy services needed to fuel economic and social development. Energy efficiency in urban areas and renewable energy in rural areas can play an important role in satisfying developing country energy needs, while helping to mitigate environmental pressures.



Energy efficiency can help reduce the rapid growth of energy demand in urban areas — typically twice that of other sectors of the economy.

Alternative Energy Technology Benefits

Renewable Energy



Renewable energy can supply electricity in a broad variety of configurations. The modularity of these systems enables them to be precisely matched to the power requirement of the applications they are serving. Currently they are supplying power economically to applications that need just a few watts, as well as to central generation facilities in the 100 MW range.

Renewable energy (RE) technologies lend themselves well to the needs of energy users in remote areas–these technologies are modular, reliable, environmentally benign, and rely on indigenous fuels.

Modularity
RE systems can be easily sized to meet user needs. They require short lead times to build as compared to conventional energy systems. RE systems such as solar PV are ideal for rural "pre-electrification", where only small amounts of power are used for basic services. In contrast, grid extension provides capacities in excess of initial needs resulting in costs that cannot be recovered over system lifetime.

Reliability
In the past decade, thousands of RE systems have been successfully deployed worldwide under a wide range of operating conditions. Field tests of RE systems demonstrate that the reliability of PV arrays are nearly 100%, wind turbines over 90%, and micro-hydro systems 85 to 90%. This reliability permits their use in the most demanding and isolated of conditions.

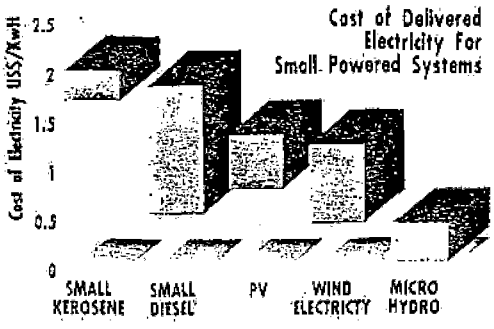
RE systems require considerably less maintenance than conventional systems such as diesel generators or grid-electric, and they are better matched to the technical skills available in rural areas.

Indigenous Resources
RE systems use indigenous resources eliminating the need for fossil fuels. For example, biomass consumes waste products as fuel that would otherwise not be used productively. Solar energy is abundantly available in all areas as are wind resources.

Risk Reduction
RE systems do not rely on fossil fuels. Therefore, users are insulated from price fluctuations and fuel supply disruptions.

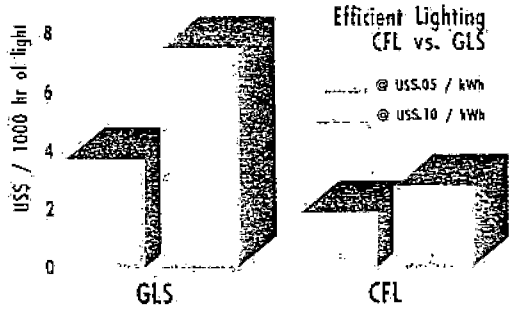
Environmental Benefits
RE systems are environmentally benign. Biomass offers positive environmental impacts by reducing methane generated from decay. When RE systems displace fossil fuel consumption, the environmental benefits are immediate, visible, and global.

Markets
RE applications are economic in a growing number of markets. PV systems provide least cost power for small rural villages more than a few kilometers from the grid. Wind turbines provide competitive power for residential, agricultural, commercial and industrial applications. Biomass energy systems are ideally suited for meeting agro-industrial needs while reducing wastes. Micro-hydro provides power for agro-processing, milling and heat generation. A further benefit is that the low fuel and O&M costs of RE systems compensate for high capital costs resulting in competitive life-cycle costs.



Less Costly

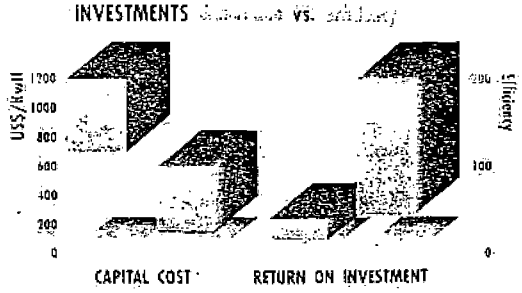
Saving a kilowatt is inevitably cheaper than generating a kilowatt. Recent developments in efficient lighting, appliances and building design provide dramatic opportunities for saving up to 80% of energy consumption while receiving equal or better energy services. The CFL lasts over 10 times longer and generates considerably less heat, thus reducing building air-conditioning loads. CFLs have a cost recovery from energy savings of less than nine months.



Compact fluorescent lamps (CFLs) consume only one-fifth the energy required to power a standard incandescent lamp (GLS) of equal lighting intensity.

Better Investment

Investments in energy efficiency generally yield higher returns than investments in power plant capacity, are less risky and require less time for installation. The internal rate of return (IRR) for investments in efficient lighting, cooling and appliances are routinely in excess of 50% and, for efficient lighting, can exceed 200%. Return on investments for centralized power plants are rarely over 20%. In addition, many investments in efficiency require less capital than building new capacity. For example, investments in efficient lighting approximate US$ 200/kW of avoided capacity while that for centralized coal-fired power plants are greater than US$ 1,000/kW of capacity.



Energy efficiency requires less investment and provides greater rates of return than electricity generation.

Environmentally Beneficial

Energy efficiency translates directly into environmental benefits, both locally and globally. A unit of energy saved results in less air pollution (CO_2, SO_x, NO_x, particulates, global warming), water pollution (oil spills, coal mine runoff, acid rain, thermal waste, etc.) and land disturbance (flooding, deforestation, soil erosion, toxic and radioactive waste disposal) than a unit of energy generated. The social benefits of energy efficiency significantly outweigh the social costs of energy production.

One CFL over its lifetime will eliminate the need for 0.25 tons of coal and 0.66 tons of CO_2 or one barrel of oil and 0.36 tons of CO_2.

Strategies For Financing Alternatives in the Developing World

Forms of Technical Assistance Offered in Donor Projects

- Long- and Short-Term Advisors for Financial Institutions
- Training Courses
- Export Assistance
- Pilot Projects for New Technologies
- Promoting and Financing Trading Companies
- Linking Host Country Manufacturers With Foreign Suppliers
- Pre-Investment Studies
- Market Surveys
- Industrialized Country Site Visits

Technical assistance is critical to ensuring project success.

New solutions to meeting energy needs are warranted and alternative energy technologies can play a major role. For the most part, however, decision makers have been reluctant to incorporate these technologies as a major component of their national energy programs due to:

- **Technology Awareness**
  Misconceptions about alternative energy performance, applications, and cost competitiveness.
- **Financing**
  Donor preference for large energy projects. The financing network does not effectively serve smaller borrowers whose individual projects tend to have high administrative and overhead costs.
- **Policy**
  Existence of host country barriers (subsidies, tariffs) that lead to market distortions and hinder competitiveness.
- **Institutional**
  Lack of adequate infrastructure in-country to identify, develop, finance, implement and maintain alternative energy projects.

The design of viable alternative energy projects must successfully address these considerations.

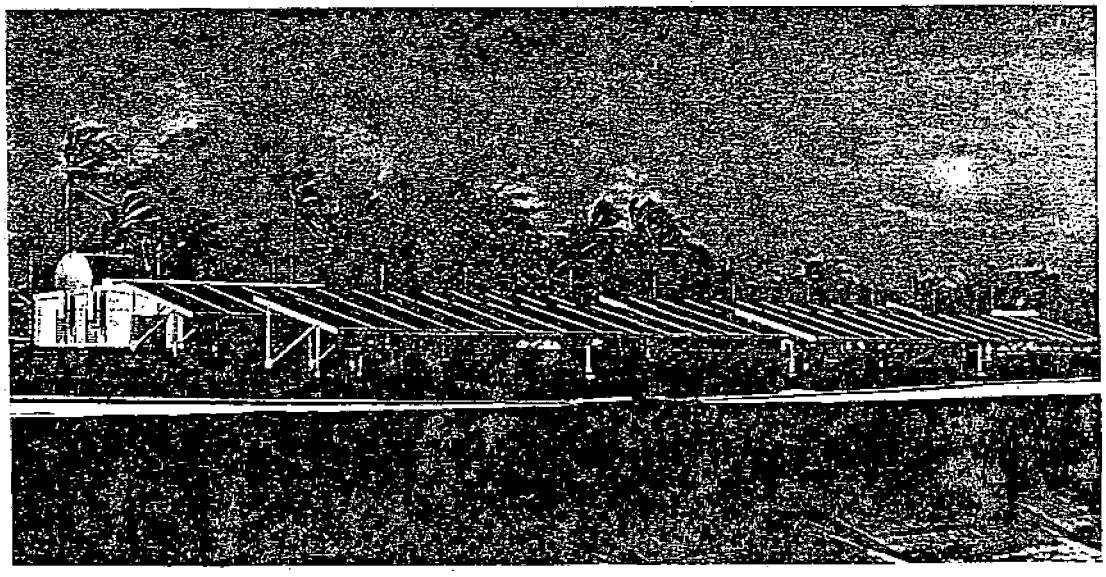
Through **project bundling**, energy-efficiency and renewable projects for residential and commercial applications can be packaged into singular project or subproject components to be of sufficient size to gain international lending agency support.

By incorporating these technologies into **national planning decisions**, projects will be accorded the recognition needed to be considered a full-scale partner in a country's energy balance, and have the prominence to address trade and regulatory barriers.

Selection of appropriate institutions and staff to develop and implement programs will be a critical factor in securing a favorable outcome.

Attention to **technical assistance and training** is required at all levels in the project cycle.

Several strategies are proposed to incorporate these elements and provide effective energy services to small-scale consumers.



A PV/diesel hybrid system has been generating power for the Queensland Electric Commission on Cook Island since 1987.

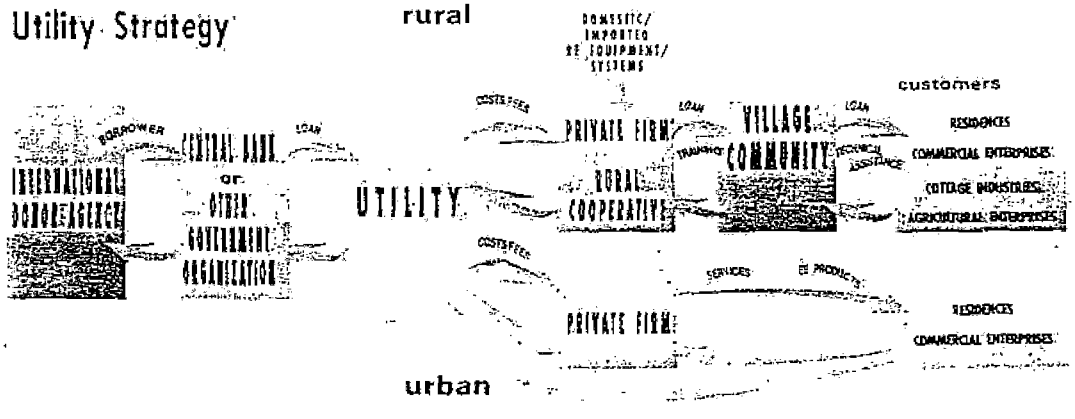
Channels donor funds through host country utilities to deliver energy efficiency products in residential and commercial sectors, or renewable energy services for rural power needs. Draws heavily on the participation of the private sector.

Utilities are a key player in the implementation of FINESSE schemes. The advantage of using the local utility is that it is charged with providing electricity, typically in the most cost-effective manner possible. Further, utilities have in place the financial and accounting systems to recoup payments for these services.

In an urban energy efficiency scheme, utilities would receive funds from a donor organization for use in purchasing and distributing energy efficiency appliances to residences and commercial enterprises. Equipment could be sold at cost or on a discount considering the net economic savings resulting from avoided capacity investments. Customers could either pay at the time of installation, or over time through an adjustment to the monthly utility bill.

In rural areas, donor funds could be used to establish mini-utilities powered by renewables as an alternative to grid extension. The utility would be responsible for installation, operation, and maintenance of the systems, as well as system billing and accounting.

Extensive use of the private sector is recommended to implement this strategy. For urban areas, private firms and energy service companies (ESCOs) can be used to conduct energy audits, and supply or install energy efficiency measures. For more remote locations, local firms, as well as rural electrification cooperatives, could be employed to provide energy services on behalf of the utility.



What is the purpose of the GEF?

The Global Environment Facility (GEF) is a three-year experiment that provides grants for investment projects, technical assistance, and — to a lesser extent — research. GEF resources are to be used to explore ways of assisting developing countries to protect the global environment and to transfer environmentally benign technologies. In doing so, the activities of the GEF are in harmony with the development goals of the countries involved.

How did the GEF come about?

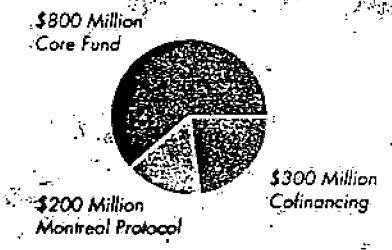
Awareness about worldwide environmental stress has grown during the past decade. The Bruntland Commission's report concluded in 1987 that there was a "serious lack of funding for conservation projects and strategies that improve the resource base for development." Shortly thereafter the United Nations Development Programme (UNDP) commissioned the World Resources Institute to study the problem. One suggestion that emerged from the study was the idea of an international environment facility. In September 1989 the French government, backed by Germany, proposed the establishment of the Global Environment Facility. The World Bank was asked to sound out potential donors and international agencies. A series of meetings held in Washington and Paris culminated in an agreement in November 1990. The first meeting of participating countries was held in Washington, D.C., in May 1991.

Why was the GEF set up?

The Facility was set up to assist developing countries deal with four main global environmental problems:

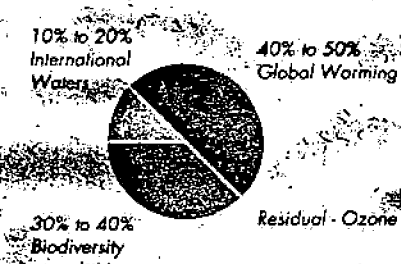
- *Global warming, particularly the effects on the world's climate of greenhouse gas emissions resulting from the use of fossil fuels and the destruction of carbon-absorbing forests.*
- *Pollution of international waters through, for example, oil spills and the accumulation of waste in oceans and international river systems.*
- *Destruction of biological diversity through the degradation of natural habitats and the "mining" of natural resources.*
- *Depletion of the stratospheric ozone layer from emissions of chlorofluorocarbons (CFCs), halons, and other gases.*

How much money is available to the GEF?



Nominally, the facility has Special Drawing Rights (SDR) 1 billion ($1.3 billion) to commit over the three-year pilot phase that began in 1991. In fact, the GEF is an umbrella made up of funds from three distinct sources. The main part is the so-called "core fund," the global environment trust fund (GET). With some $800 million in commitments, the GET accounts for the bulk of the GEF's resources. In addition, the GEF includes several associated cofinancing arrangements. These funds (some $300 million) are available on grant or highly concessional terms. The GEF also includes some $200 million provided under the Montreal Protocol to help developing countries comply with its provisions to phase out ozone-destroying substances. These funds are administered — totally separately from the core fund and the cofinancing arrangements — by the United Nations Environment Programme (UNEP) under the auspices of a 14-country Executive Committee.

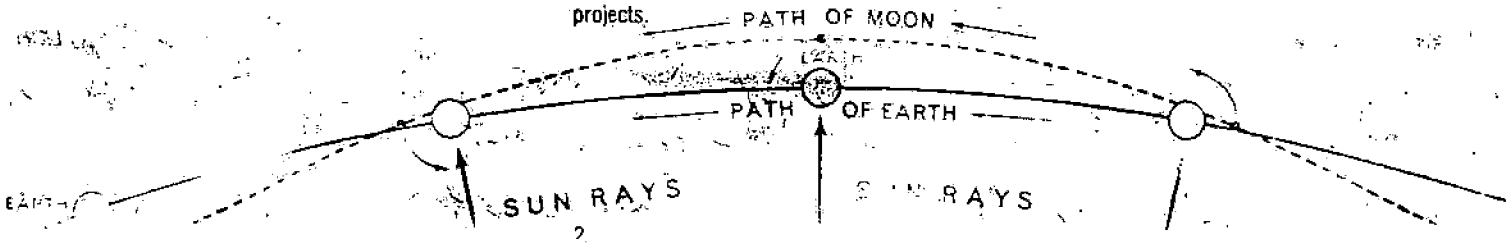
How are resources allocated among the four problem areas?



There is no set formula, but the rule of thumb in the allocation of GEF resources is that 40-50% should go to projects to reduce global warming, 30-40% to conserve biological diversity, and 10-20% to protect international waters. Most ozone projects are funded by the Montreal Protocol's Interim Multilateral Fund.

Where does the money come from?

Twenty-four countries (nine of them in the developing world) had pledged some $800 million to the core fund by December 1991: Austria, Belgium, Brazil, Canada, China, Denmark, Egypt, Finland, France, Germany, India, Indonesia, Italy, Japan, Mexico, Morocco, the Netherlands, Norway, Pakistan, Spain, Sweden, Switzerland, Turkey, and the United Kingdom. In addition to their contributions to the core fund, Belgium, Canada, Japan and Switzerland have separate cofinancing arrangements. Australia and the United States have not contributed to the core fund, but Australia has established cofinancing arrangements and the United States has announced plans for parallel financing of GEF-type projects.



Who runs the GEF?

Responsibility for implementing the GEF is shared between the UN Development Programme (UNDP), the UN Environment Programme (UNEP), and the World Bank. The Facility's organization is based on the understanding that no new bureaucracy will be created and that only modest organizational modifications will be made to the three implementing agencies. Within this framework the agencies play distinct roles:

- *The UNDP is responsible for technical assistance activities and, through its worldwide network of offices, helps to identify projects through pre-investment studies. It is also charged with running the small grants program for non-governmental organizations (NGOs).*
- *UNEP provides the secretariat for the Scientific and Technical Advisory Panel as well as environmental expertise for the GEF process.*
- *The World Bank administers the Facility, acts as the repository of the Trust Fund, and is responsible for investment projects.*

Who chairs the GEF and what is his role?

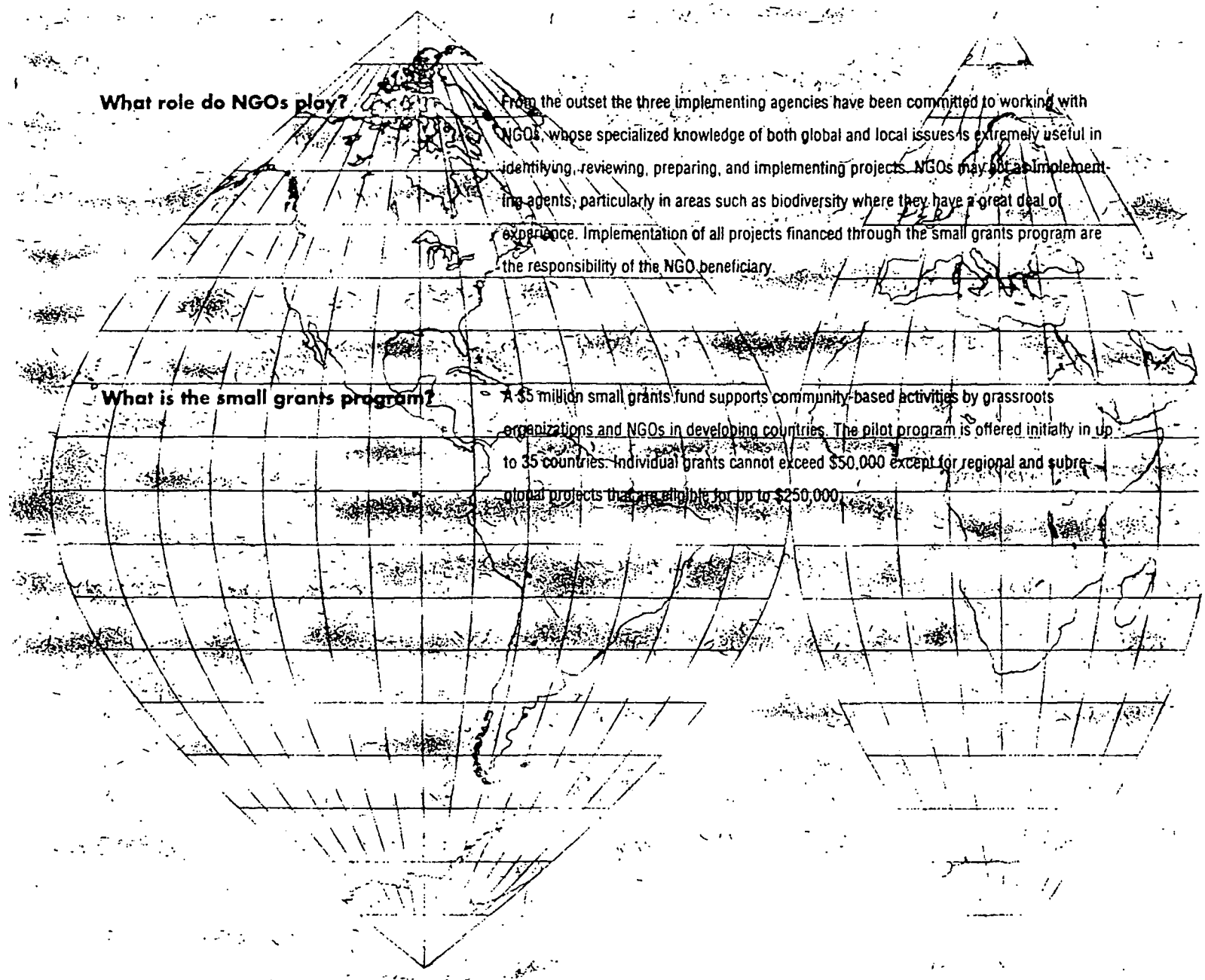
The chairmanship of the GEF is vested in the World Bank. Dr Mohamed T. El-Ashry, Director of the Bank's Environment Department, was appointed to this position in December 1991. His responsibilities include representing the facility, assisting the agencies fulfill their designated roles, and building consensus among participating governments on policy and strategic issues.

What is the role of the GEF administrator?

The administrator (located at the World Bank) supports the chairman, coordinates the work programs of the three implementing agencies, and oversees the administration of the GEF. The administrator is also responsible for external affairs and communications strategy as well as the development of a policy and strategy work program to underpin the GEF and provide guidance in its implementation.

What role do other intergovernmental agencies play?

The UNDP, UNEP, and World Bank were chosen to co-manage the GEF because of their complementary skills in the fields of development and the environment. But it is not an exclusive arrangement. GEF projects may be sponsored by regional development banks and specialized UN agencies, including those working on food, agriculture, health, climate, and maritime issues.



What role do NGOs play?

From the outset the three implementing agencies have been committed to working with NGOs whose specialized knowledge of both global and local issues is extremely useful in identifying, reviewing, preparing, and implementing projects. NGOs may act as implementing agents, particularly in areas such as biodiversity where they have a great deal of experience. Implementation of all projects financed through the small grants program are the responsibility of the NGO beneficiary.

What is the small grants program?

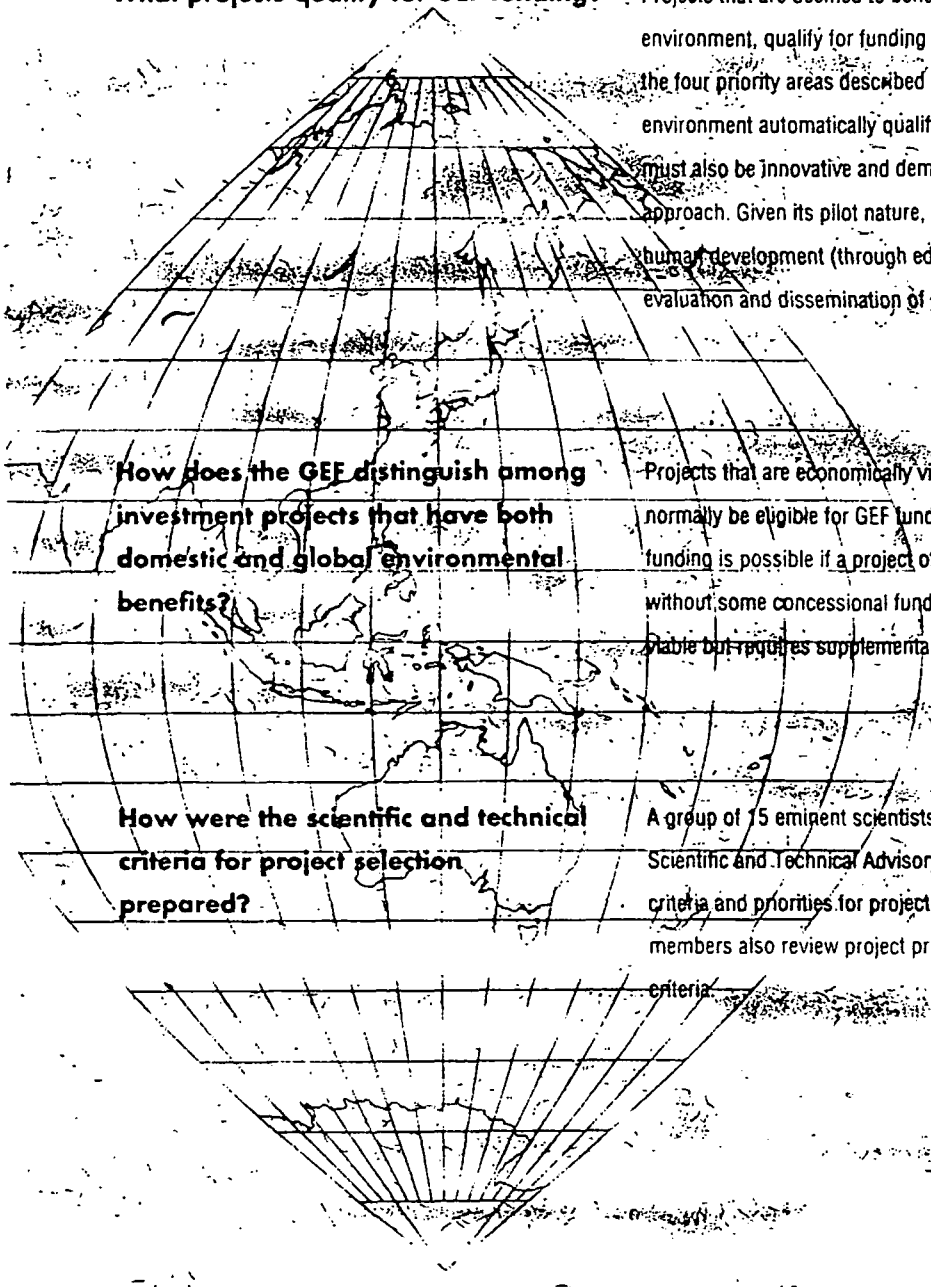
A $5 million small grants fund supports community-based activities by grassroots organizations and NGOs in developing countries. The pilot program is offered initially in up to 35 countries. Individual grants cannot exceed $50,000 except for regional and subregional projects that are eligible for up to $250,000.

Which countries are eligible for GEF funding?

All countries with a per capita income of less than $4,000 a year (as of October 1989) and a UNDP program in place are eligible for GEF funds.

What projects qualify for GEF funding?

Projects that are deemed to benefit the global environment, as distinct from the local environment, qualify for funding under the GEF. To this end, projects must fall into one of the four priority areas described above. But not all projects that benefit the global environment automatically qualify for support from the GEF. Projects financed by the GEF must also be innovative and demonstrate the effectiveness of a particular technology or approach. Given its pilot nature, other criteria include the contribution a project makes to human development (through education, training, and so on), and the provision for evaluation and dissemination of results.



How does the GEF distinguish among investment projects that have both domestic and global environmental benefits?

Projects that are economically viable on the basis of local costs and benefits would not normally be eligible for GEF funds, whatever the benefits for the global environment. GEF funding is possible if a project offers substantial global benefits but is unlikely to be viable without some concessional funding. The same is true for a project that is economically viable but requires supplementary finance to bring about global benefits.

How were the scientific and technical criteria for project selection prepared?

A group of 15 eminent scientists from industrial and developing countries constitutes the Scientific and Technical Advisory Panel (STAP). This independent group helps formulate criteria and priorities for project selection and coordinates research and data collection. The members also review project proposals and advise on whether they meet the established criteria.

How much money will be required for administration and other overheads?

The implementing agencies charge only actual incremental operating costs. However, administrative costs over the three-year pilot program are estimated at 3-4% of the total facility.

On what terms are GEF funds available?

All money from the core fund is provided in grant form. Co-financing arrangements must be provided on grant or highly concessional terms.

How can criteria on cost-effectiveness be applied to the global environment?

The cost-effectiveness of GEF investment projects is determined — at least initially — on the basis of physical rather than monetary measures of global benefits. So, for a global warming project the main measure is the reduction in carbon emissions; for marine pollution, the amount of ship-generated waste disposed of; or the expected improvement in the health of the ecosystem. But an excessive price must not be paid to achieve a given physical benefit.

How are projects evaluated and lessons learned?

Finding out what works and why — and what does not — is crucial to the GEF process. Information obtained in monitoring, review, supervision, and evaluation of projects will be used to refine GEF guidelines and procedures, to evaluate different technologies, and to establish where GEF intervention is most successful.

How are projects identified for GEF funding?

Proposals for GEF funding can be generated in several different ways. Governments, the Bank, UNDP, and UNEP, as well as NGOs and the private sector, can all put forward suggestions on innovative projects that meet GEF criteria. All projects must be endorsed by the government of the country in which the project is situated. In most cases governments will submit project ideas directly to the implementing agencies, either through the UNDP Resident Representative, a World Bank field office, the appropriate World Bank Regional Environment Division/Country Department, or UNEP.

How is an application filed for GEF funds?

Governments may apply for GEF funds direct to the UNDP or the Bank. NGOs can do the same once the government has accepted the project in principle. For projects submitted for funding under the small grants program (in countries where the "program" is operating), no specific government permission need be sought. Applications for small grants should be made directly to the UNDP. Private firms can apply to the International Finance Corporation (IFC) for eligible investment projects.

How are projects approved?

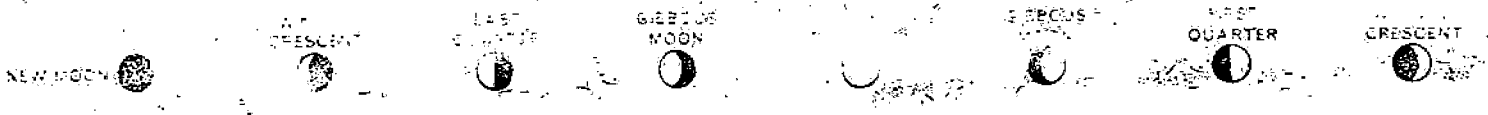
All projects are screened to ensure that they meet the basic GEF criteria. Investment projects undergo a technical review by a panel that includes at least one person chosen from a roster of independent experts compiled by the STAP. If the project is cleared, it is submitted to the Implementation Committee, made up of the three implementing agencies. The committee's role is to choose a group of projects that represents a balance among the regions and the four thematic areas covered by the GEF. The projects selected by the committee are then forwarded to the participating governments for review at their biannual meetings. Each group of projects is known as a "tranche." After review by governments, projects return to their sponsoring agency for further preparation, appraisal, and final approval according to each agency's regular procedures.

Who implements GEF projects?

The recipient of the GEF funds (mainly governments) has primary responsibility for implementing projects, and must seek and engage executing agencies according to established procedures for UNDP and World Bank projects.

Is there a relationship between GEF investment projects and regular Bank loans?

Yes, there can be. From the inception of the GEF a major objective was to "leverage" global benefits from regular Bank projects that might not otherwise take these global concerns into account. An example is a Bank loan for a coal-fired power station. A potential borrower needs additional energy and is prepared to borrow the funds to build the fossil fuel power plant on regular Bank terms, incorporating technology that conserves the local environment. For an additional sum (say 20% of the total) the technology can be switched to allow use of a nearby source of natural gas. The country is not prepared to pay the additional cost for what is perceived as a global benefit — lower emissions of carbon dioxide. In this case the GEF can step in and cover the difference between what the country is willing to pay and the cost of the globally benign technology.



Is there a cap on individual GEF grants?

Yes. Free-standing GEF projects are limited to $10 million. GET components of Bank projects must not be higher than $30 million.

What are the procedures for procurement under the GEF?

The World Bank and UNDP follow their standard procurement procedures. Details on upcoming projects are published quarterly in the Bank's Monthly Operational Summary (for investment projects) and in the UN publication Development Business (for technical assistance projects).

Are local people involved in GEF projects?

Donors and the implementing agencies set a premium on involving local people in project identification and design. In addition to the small grants program aimed specifically at projects put forward by grassroots bodies, and an active policy dialogue with NGOs, there is a desire to increase awareness and public understanding in developing countries about global environmental issues. Specific activities designed to do this are included in many GEF projects.

How is the long-term viability of GEF projects assured?

The long-term viability of GEF projects is an important qualification for funding. The emphasis is on providing funds to projects that would not be economic without GEF funds, but can become so with them. The challenge is particularly great in the area of biodiversity, where long-term funding is more likely to be required. Here the GEF is experimenting with trust funds and other financial mechanisms to ensure that recurrent costs are met.

Do GEF projects undergo environmental assessment?

Yes. Each agency follows its own procedures on environmental assessment for the projects it is managing. Thus, all investment projects are screened for their environmental impact according to the World Bank's operational directive on the subject. Under this directive all projects likely to have a significant impact must undergo full-scale environmental assessment. The UNDP follows its Environmental Management Guidelines used for all its projects. Furthermore, GEF projects are checked for their possible impact on other areas covered by the GEF. Thus, a greenhouse gas project might be analyzed in terms of its impact on biodiversity and so on. In addition, the GEF endeavors to take account of the social impact of projects, notably in the area of biodiversity where local people may be displaced or their food supply affected. Investment projects are also subject to the World Bank's directives on tribal peoples, resettlement, wildlands, and so on.

Can the GEF support private sector ventures?

The GEF can support eligible private sector ventures with the appropriate government's endorsement. All such investment projects pass through the IFC, the World Bank's private sector affiliate. GEF funds must not be used to avert normal commercial risks. The use of GEF funds is justified if they provide for a global environmental benefit that an entrepreneur in a developing country could not reasonably be expected to underwrite in prevailing market conditions. In addition GEF funds might be used for a regular IFC project that is economic but could have important demonstration effects for the global environment with the addition of a GEF grant. An example would be a tourism project with a GEF component providing for the protection of a nearby area of biodiversity.

What is the relationship between the GEF and the Montreal Protocol?

Finance for projects to protect the ozone layer will normally come from the interim Multilateral Fund of the Montreal Protocol. GEF finance is available only to eligible countries that have signed the protocol but do not qualify for support under the interim fund because their ozone-depleting emissions are above the cut-off-point of 0.3 kilograms per capita, as specified at the London meeting in June 1990 when agreement was reached on the interim fund.

Does the GEF have enough resources to deal with such enormous problems?

The GEF is not supposed to solve all global environmental problems. It is a pilot project designed to help developing countries contribute to solving global environmental problems by testing new approaches and technologies. The size of the facility (SDR1 billion) reflects its experimental nature while providing enough resources to constitute a credible basis for action in a significant number of countries.

Are developing countries represented in the governance of the GEF?

Yes. Substantial developing country representation in the GEF is essential. When the facility was set up, the hope was that it would involve at least one country from each of the constituency groupings in the Development Committee (a joint World Bank/IMF body) that represents mainly developing countries. To encourage participation, the minimum contribution to the core fund has been set at SDR4 million, which developing-country donors can pay in over eight years. Furthermore, the World Bank will contribute half of the SDR4 million on behalf of the developing country. Some nine developing countries had pledged funds to the GEF by December 1991.

Are GEF funds additional to traditional development assistance?

There is a continuing need for development assistance, and every effort is made to ensure that GEF operations complement — not substitute for — regular aid programs. GEF resources are aimed at projects with global environmental benefits for which official development assistance is not normally available.

Are global concerns considered in regular development programs?

Yes, increasingly. There are many opportunities for investment and policy reform that meet both economic and environmental criteria, local as well as global. Most development agencies now integrate environmental concerns into their regular programs. But while developing countries are prepared to divert or borrow resources to improve their local and regional environments, few are willing to do so for programs and projects that they see as benefiting the rest of the world.

How does the GEF fit in with the UNCED?

The GEF and UNCED are closely linked. In the preparations for the the United Nations Conference on Environment and Development (UNCED), the GEF has emerged as a significant focus of international attention as an evolving instrument for multilateral cooperation in addressing global environmental concerns.

How are GEF projects related to overall policies in implementing countries?

Individual projects are unlikely to succeed on their own. The challenge is to create the policy framework and institutional capacity that provide the right mix of incentives and disincentives, of regulations and market mechanisms, to give GEF projects the chance to provide viable long-term solutions. For instance, new techniques to generate energy (like solar and photovoltaics) will not displace fossil fuels if national pricing policies provide no incentive to produce environmentally-sound alternatives. The GEF should be seen as a kind of testing ground to persuade people to recognize the importance and practicality of long-term environmental management.

What will happen when the pilot phase is over?

The pilot phase of the GEF comes to an end in mid-1994 by which time all funds will be committed, although actual disbursement is likely to continue until 1997 or 1998. In the meantime, the international community is assessing the effectiveness of the GEF and its contribution to the global environment. The lessons learned will form a basis for cooperation in the years to come.

December 1991

Designed by Mitchell & Company Graphic Design

INDONESIAN PREFEASIBILITY REPORT
WHY IT WAS TURNED DOWN

The Ben Holt feasibility study could not be approved because of the following reasons:

1. The prefeasibility study had not been submitted. It has now been received by ECRE,

2. AID Mission claims that the Indonesians have not made a decision on whether Ben Holt will get a concession,

3. The Indonesians must award Dieng to Ben Holt before AID will approve the feasibility study,

4. The feasibility proposal was unartfully written - both feasibility and prefeasibility were intermixed into one report which confused the whole process,

5. There will be no problem getting the feasibility study funded if all procedures are followed. Someone should call and explain the whole project to Ross, and

6. To get feasibility funds USGIC must get a go-ahead from the US/AID Indonesian Mission.

The above was provided by Ross Pumpfrey of US/AID, with some comments from John Armstrong.

[redacted]

P.T. ROYAL PERINTIS ABADI CORP.

Address : Ciks Bldg. 4th Floor, Jl. Cikini Raya 84-86 Jakarta 10330 Indonesia
Phone : 320158, 327855, 322758, Fax : (021) 327850, Telex : (021) 61328 RPA IFF IA

8/25/92

To: P.M. Wright. (Fax: 801-524-3458)
From: D.L. Nielson.

1. Gary Shulman has been asked to apply for the concession at Ulubelu, but has not yet responded. Dan pestered him yesterday. He is going to need resource help, so it may be useful for you to talk with him and see if UUAI can fit in.
2. Fax machine jamed last night in the middle of transmission of info from Ben Holt. If Huttrer transmitted his report or you responded to yesterday's fax, I did not receive it.
3. Pertamina has not confirmed time for my seminar as of yet.
4. Will be visiting USAID this afternoon.
5. DDI/Fadel(ESA) pushing a 5 site proposal which includes Lahendong, P/GW, Ulubelu, Raja Basa, Lumut Balai.
6. All looks positive here.

Dennis

To: PMkl. 801-524-3453

From: DLN. Jakarta 8/24/92

1. Need trip reports from G. Huttrer and B. Holt to complete deliverable to USAID. Could use a fax, but hard copy would be better. DDJ brought report from Koenig. Would you please contact GH! Larry Rooster will contact Holt.

2. Sofyan Hotel

   Phone 62 21 320695

   Fax 62 21 3100432

   Please inform Dianne.

TRIP REPORT

DIENG GEOTHERMAL PROJECT,

INDONESIA

By

Dennis L. Nielson
University of Utah Research Institute
391-C Chipeta Way
Salt Lake City, Utah

For

The Ben Holt Co.
201 South Lake Avenue
Pasadina, California

May 26, 1992

CONFIDENTIAL

Notice: This report was supported by UURI to aid the efforts of the Ben Holt consortium in negotiating with Pertamina and PLN. It contains sensitive information and unsubstantiated impressions and is not intended for public distribution.

1.0 INTRODUCTION

This is a report of findings on business and resource aspects of geothermal development concessions offered by the Government of Indonesia (GOI) to the Ben Holt Company in the Dieng area, Central Java. The information was gathered between May 10 and May 18, 1992. The objective was to compile sufficient information to expedite contract discussions between Ben Holt and Pertamina scheduled for the first part of June.

Pertamina management has set a goal of developing 1000 MWe of geothermal energy by the year 2000. To accomplish this, they realize they must move aggressively. This, in conjunction with the Presidential Decree that authorizes private power, has fostered a business climate that has not existed in the past. Through its Indonesian partners, Himpurna, the Ben Holt Co. has the opportunity to establish relationships that will result in long-term sales of power plant hardware and resource development services.

Bob Pangerapan, Managing Director of P.T. Royal Perintis Abadi and agent for the Ben Holt Company in Indonesia, was very helpful in setting up appointments and advising me on strategy. For the upcoming presentation to GOI, Bob advises that Ben Holt should briefly introduce his company and its geothermal experience, but that the presentation should stress economic options of this project. PLN and the Minister of Mines and Energy will be represented at the meeting as well as personnel from Pertamina. We were advised to make the presentation to GOI and not worry about Pertamina/PLN relationships or politics.

The objective of the presentation and subsequent discussions should be to enter into a preliminary agreement with Pertamina for the development of Dieng. This should dictate the intent of all parties (including PLN) and give Himpurna/Ben Holt (H/BH) exclusive rights to carry out their feasibility work. It should also allow H/BH the right to withdraw and set a time frame for final negotiations.

Mr. Robert Beckman, Director of Private Enterprise Development at U. S. A.I.D inJakarta, cautions us against doing business with PLN. He feels this is an entrenched bureaucracy that will resist all efforts of outsiders to generate power in either Java or Bali.

He would feel much better about our chances of success if power were being delivered to an industrial concern.

2.0 RESOURCE DEVELOPMENT

2.1 Introduction

The concession offered to Himperna/Ben Holt (Figure 1) includes the Sileri, Pakuwaja and Siglagah areas that are marginal to the Sikidang-Merdada area that is the most developed of the prospects in the Dieng province. Pertamina has signed an agreement with PLN to provide steam for a 55 MWe development at Dieng.

A large number of reports have been completed by Pertamina, and most of these concern the Sikidang area. These were copied by P.M. Wright and D. Dahlo-Johnson at the data release, that marked the initiation of H/BH's efforts. Only data from DNG-1 through DNG-13 were available and a trip to the operations office in Dieng was required to get information on subsequent wells. I have not had the opportunity to review all of these reports, but I have attempted to summarize pertinent aspects of the reports and my impressions in the following sections.

I had lengthy discussions about the present wells with Sayogi Sudarman of Pertamina (Manager Operations Exploration). His comments can be summarized as follows.

1. Early wells were drilled in areas of alteration and suffered acid damage. The present practice is to site the wells outside the alteration areas and directionally drill.

2. Little testing of the wells has been done because (a) they have not budgeted for testing equipment, (b) surface acid conditions destroy testing equipment, (c) testing often kills potatoes on immediately adjacent agricultural lands.

3. Pertamina drills with mud and changes to water at lost circulation. The water is straight with no polymers to increase viscosity. The wells are T.D.'d at 2500m or after drilling approximately 300 m of lost circulation. The wells are not flowed following TD to attempt to clean them out. Pertamina has had considerable problems with loss of wells and wants to try air/foam drilling. However, they have no expertise in this procedure.

4. Generally the wells are cased at $9\text{-}^{5}/_{8}$" to 1200m and are completed with 7" slotted liner below that depth. Information on early wells and other resource data is summarized in a very

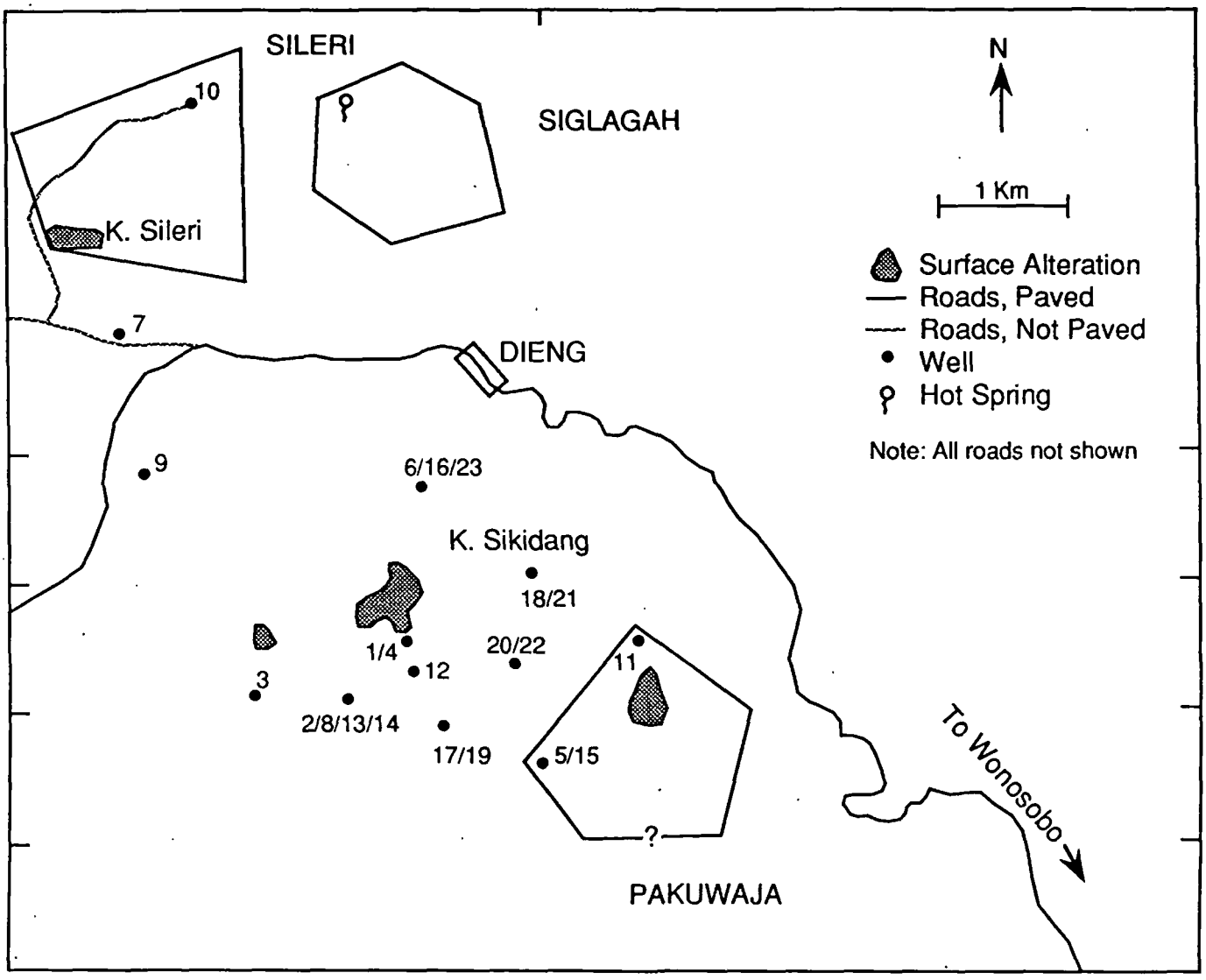


Figure 1 - Dieng geothermal area (map modified from Boedinhardi et al., 1991)

comprehensive paper by M. Boedihardi, Suranto, and S. Sudarman (1991, Evaluation of the Dieng geothermal field; review of development strategy: Proceedings Indonesian Petroleum Association, 20th Annual Convention).

5. The three concession areas and the Dieng area in general are heavily farmed. Pertamina has bought out farmers to construct well pads, but is still concerned with the effect of testing on crops.

2.2 Unocal Feasibility Study

I had the opportunity to read, but not copy, Unocal's Technical and Economic Assessment of the Dieng area. This report was dated July, 1989 and superseded an earlier, less comprehensive assessment. At the time the report was written, 13 wells had been completed. It is a comprehensive assessment involving resource, reservoir engineering, drilling, power plant, and economic studies. The report recommends that Unocal not proceed on the Dieng prospect for the following reason.

> "The primary concerns are with the ability of the wells to deliver useable steam at flowrates large enough to make the project economically competitive with other sources of energy. Flowrates indicate wells produce non-condesible gases at a rate which could seriously restrict the output of a conventional power plant. Also adversely affecting the economics of the project is the high cost of drilling wells into a relatively deep reservoir."

Other pertinent findings of the study are listed below.

1. Reservoir. The probable capacity of the reservoir is 161 MWe. 90% of the probable reserves occur in the liquid-saturated zone in the lower reservoir. Reserves found in both the steam cap of the lower reservoir and in the upper reservoir are small, less than 10 MWe each.

The upper reservoir is a small steam cap and boiling two-phase zone with high concentrations of NCGs. It is separated from the lower reservoir by a silicified zone approximately 100m thick. The lower reservoir includes a 300 m, high pressure (127 bars) steam cap and a thick, high-temperature (320 C) liquid zone. Wells completed in the liquid-dominated zone can be expected to produce fluids with 1-2 weight % NCG. However, computer reservoir simulation predicts CO2 production rates will increase with time.

Permeability-thickness products are low, generally less than

4 darcy-meters, except for DNG-10 which is 12 darcy-meters.

Simulation shows initial decline rates as high as 25% per year in the lower reservoir.

2. Environmental.

"Other concerns are the impact of development on the Dieng plateau. Natural phreatic eruptions have already caused numerous fatalities. Reservoir simulation studies show that certain production scenarios can increase upper reservoir pressures, thereby increasing the possibility of phreatic eruptions. Development to the west of the proven field will be limited because of surface hazards."

"Any development at Dieng will have to contend with and plan for near-certain hydrothermal eruptions and associated poisonous gas release."

3. Economics.

"The base case model for a 110 MWe development indicates a resource price of more than 60 mils would be required to meet Unocal's rate of return criteria."

The economic evaluations use a discounted cash flow rate of return approach. Their required rate of return is 20% for foreign projects. The calculation used the old tax law and was based on 2 x 55 MWe stages. The following tables present Unocal's cost considerations.

Preproduction Costs-Best Case 110 MWe

	$ 000
Misc. roads and locations	7,300
Surface Facilities	22,500
22 wells	48,000
Field Operations	12,000
G & A	13,000
	$103,600

Surface Facility cost Estimate /55MWe

	$ 000
Steamline	3,500
Wellhead Piping	1,750
Injection Line	1,750

Vessels, pumps	1,750
Rock muffler	500
Engineering	1,000
Contingencies	1,000
	11,250

One of the most sensitive parameters in the cost model is the required number of wells. Unocal estimated the cost of each well at $2,120,000. No extensive road work was considered in their cost estimates.

4. Power Generation. Maximum pressures used for power generation were 170 psia for condensing and 230 psia for non-condensing. Their calculations were based on removing 5% NCG using two stage steam ejectors and a turbine exhaust pressure of 1.8 psia.

2.3 Sileri

The Sileri area is the best of the concessions offered to H/BH. The area contains well DNG-10 in its northeast corner. Pertamina rates DNG-10 at 3.4 MWe. Several hot springs were observed in the area with temperatures of about 120°F. These were not depositing sinter of any type and probably reflect steam-heated ground water. Boedihardi et al (1991) suggests that the area has a potential resource of 80 MW.

Access is a disadvantage of the Sileri area. An unpaved road nearly 4km long provides the only access to the area. The road has been inset with cobbles that make for a very rough ride. This road also traverses a valley adjacent to Kawaja Sileri, an active fumarolic area which last erupted in 1985.

2.4 Siglagah

The Siglagah area to the east of Sileri is even more remote. We reached the town of Siglagah by driving several kilometers along a dirt road and down steep slopes. The site would be inaccessible during heavy rains.

There is no drilling in this area. I observed three hot springs that are similar to those in the Sileri area. In addition, there are several zones of altered ground, but the local inhabitants claim they are not presently active. Boedihardi et al (1991) claim that fumarolic are active and attribute further significance to a gravity low centered on the area. They estimate that the area has a potential resource of up to 45MW.

Due to the success of well DNG-10, given no more surface evidence than exists at Siglagah, the potential of this area cannot be written off. This is, however, a rank prospect and will require preliminary resource exploration work, as well as road construction, prior to drilling a production-scale well. The terrain is very steep and potential sites for drilling pads are limited.

2.5 Pakuwaja

The Pakuwaja area contains three wells, DNG-11,5, and 15. The $9\text{-}^{5}/_{8}$" casing in DNG-11 has collapsed at 1597m. The other two wells are shut-in and "heating up." Pertamina believes that the Pakuwaja area is separated from the main production at Dieng by a permeability barrier. Boedihardi et al. (1991) states that DNG-15 was directionally drilled into this block and confirmed its existence.

There are no obvious exploration targets within the Pakuwaja area at the present time. The area would require geologic mapping and evaluation of subsurface geology from DNG-11, 5, and 15. Well pad sites are again limited due to the steepness of the terrain. Approximately 2 km of road improvements would be required to reoccupy the DNG-15/5 sites, and approximately 1.5km to reoccupy the DNG-11 site.

2.5 Sikidang-Merdada

The Sikidang-Merdada area is not included in the H/BH concession. It is, however, the area with the greatest number of drilled wells. Pertamina has ostensibly reserved this area for their development, and has signed an agreement to provide the steam for a 55 MWe plant to PLN. Pertamina is presently drilling two wells in this area, and has plans to drill several more.

There are three fundamental concerns with development in this area. 1. Pertamina has had a great deal of problems in completing wells, 2. There has not been adequate testing of the wells, and 3. The wells are dispersed across a rather large area resulting in expensive steam gathering systems.

1. Well Completions. Tables 1, 2, and 3 summarize data on the production wells drilled at Dieng. Pertamina's well drilling program has changed in the later wells drilled to emphasize directional drilling. This allows them to site the wells off hydrothermal alteration zones to reduce the corrosion damage to

Table 1 Production Data Dieng Area

Well	Pressure Kg/cm²	Mass T/hr	Steam T/hr	Water T/hr	Dryness %	Potential MWe
			FLOW			
Sileri Area						
DNG-10	10.0	76.6	34.2	42.4	45	3.38
Dieng Area						
DNG-2	15.0	84.0	60.5	23.5	72	5.50
DNG-7	10.0	75.4	62.3	13.2	83	6.85
DNG-8	10.0	31.7	31.6	0.1	99	2.87
DNG-9	10.0	34.3	22.4	10.0	65	3.11
DNG-13	10.0	80.9	61.5	19.4	76	5.59
DNG-14	10.0	15.9	12.4	3.5	77	1.13
DNG-16	9.5	4.6	4.4	0.2	96	0.34
DNG-19	23.2	49.7	47.5	2.2	95	4.30
DNG-20	No Test					
DNG-22	Sidetracking around fish					
DNG-23	T>320C, good permeability					
DNG-24	Drilling					
					Proven	29.69
					Avg	3.71 MWe/well.
						4.19 MWe/well w/o DNG-16

Table 2 Well Status, Dieng Area

Well	Water Depth	Drilled Depth	Current Depth
DNG-2		1662	1333
DNG-3	180	1944	805
DNG-4		1905	1000
DNG-5	1323	2495	2056
DNG-7		2401	269
DNG-8		1866	1800
DNG-9*	759	2450	1131
DNG-10	1580	2294	2265
DNG-11		2431	1597
DNG-12		2099	790
DNG-13	1610	1853	1655
DNG-14	1358	1890	1811
DNG-15*	560	2073	2043
DNG-16*		2501	2150
DNG-17*	1470	2252	2235
DNG-18	2090	2662	2646
DNG-19		2133	2015
DNG-20	2207	2348	2297
DNG-21*		2302	1503

*Kuster tool in hole

Table 3 Well Data, Dieng Area

		$*	DEPTH	$/M	DRILLING TIME
DNG-18	vertical	2,077,963	2662m	780	132d
DNG-19	directional	1,931.759	2133m	906	196d
DNG-20	vertical	2,145,394	2348m	913	133d
DNG-21	directional	2,404,765	2302m	1,045	130
DNG-23	directional	1,785,602	2118m	843	94d
			Avg.	$897/m	

*Exchange rate of R_p 2000/$US

casing experienced in the earlier wells. However, there have been a large number of wells drilled recently that have suffered either casing collapse or filling by cuttings. These wells are being drilled in the reservoir zone using only water, and lost circulation is apparently total. It is Pertamina's assessment that the wells are subsequently filled in by cuttings coming back into the well, or that their inability to re-enter the wells is due to scaling. It can be seen that a number of expensive wells have been lost in this manner. It may be possible to clean these wells out using workover rigs for substantially less cost than their original drilling. However, the production potential of these wells remains in doubt.

It is clear that Pertamina requires immediate assistance in drilling and completing the wells they are drilling. I suggested foam systems, but they have no expertise in this method.

Note in Table 1 that the average production is around 4 MWe, not particularly high. However, Table 3 shows that well costs are high and confirms the estimate presented in Unocal's feasibility study.

2. Flow Tests. None of the wells have been adequately tested, individually or collectively (interference). This testing in combination with chemical sampling is required to understand long term well performance, including temperature and chemistry of fluids delivered to the power plant. Note that testing addresses Unocal's principal concern long-term steam deliverability.

3. Well Locations. Well locations are widely dispersed and a great deal of expensive piping would be required to connect all producers for the generation of 55 MWe. It is thought by some of Pertamina management that the situation is more suited to modular well head units. Indeed, present producing wells show that the only viable area for a power plant would be the pad for wells DNG-2,8,13 and 14, which is also the location of the Gary Shulman's 2 MWe Monoblock. These four wells have a potential of 15 MWe according to Pertamina's estimate. The nearby well DNG-19 could add another 4.3 MWe for a total of 19 MWe.

3.0 BUSINESS ASPECTS

3.1 Existing Geothermal Contracts

In the Salak area, Ansaldo is building a 2 x 55 MWe geothermal power plant for $90 million. Construction is financed by a soft loan from the Italian government.

Unocal is receiving a base price for steam of $.047/kwh. The

actual price is indexed to the price of fuel oil.

Diesel power now costs PLN $72.4/MW-hr, and this is the cost they may try to evaluate geothermal against. However, it was pointed out several times, by Pertamina and Ing. Ridwan, Special Assistant to the Minister of Mines and Energy, that the point is not to use diesel because of its environmental problems and marketability.

3.2 Business Arrangements with Pertamina and PLN

Dan Dahlo-Johnson presented his concept on the business arrangements between Ben Holt/Himpurna and Pertamina to Agus Danar, Economic Advisor to Director of Pertamina. Agus has been assigned the task of advising Pertamina on business arrangements associated with their Build-Own-Operate solicitation. Pertamina's past experience has been with the steam purchase agreements and that seems to be their mindset. Agus is intrigued with the BOT concept presented to him by DDJ, and he raised no objections.

Figure 2 outlines the basic concept discussed with Pertamina. I have added a few details after discussions with Bob Pangerapan. The relationship between Pertamina and Himpurna/Ben Holt would be established through a joint operations contract (JOC). In the case of the Dieng area, Pertamina would be the steam supplier. Himperna/Ben Holt would be responsible for financing, designing, and constructing the gathering system and the power plant. H/BH would then operate the power plant and deliver electricity to PLN.

The power purchase agreement (PPA) would be consummated between Pertamina and PLN and would reference the JOC. The intent would be to keep the PPA between Pertamina and PLN while providing a bankable document to H/BH.

Although it has not been discussed with Pertamina, the PPA should contain the following provisions:

1) The power purchase price should be indexed to the U.S. dollar to provide protection from Indonesian inflation and consequent loss of value of the Rupiah;

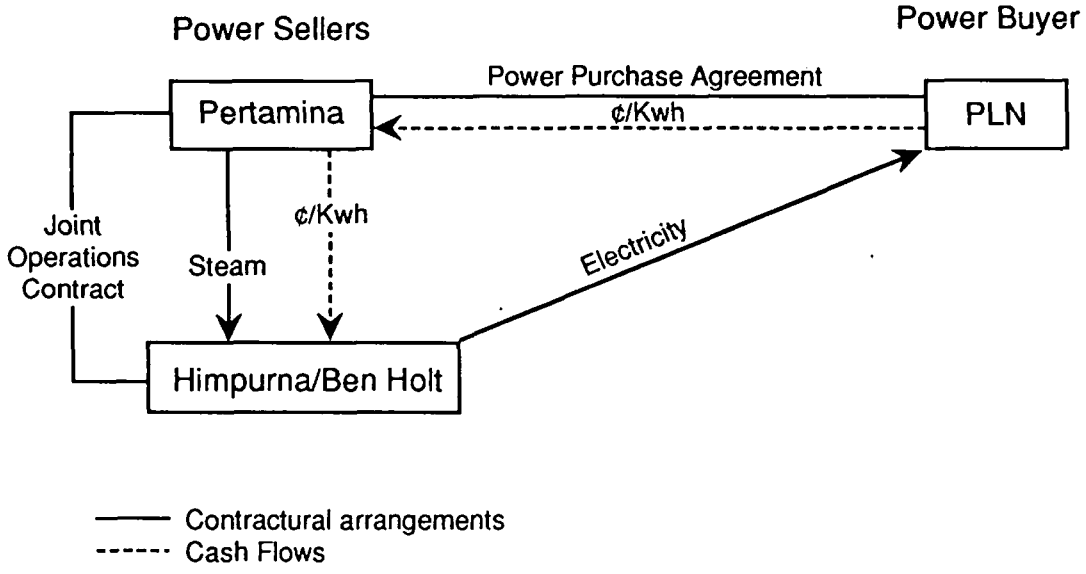
2) Take or Pay Provision should be required of PLN;

3) A requirement for an uninterrupted steam supply should be required from Pertamina.

Pertamina was informed that we would be open with them concerning the power pricing and we would show them all figures

Business Confidential

Figure 1



including debt service, operation and maintenance, profit and taxes. It should be clear to the Government of Indonesia that reduction of taxes will reduce their electricity costs, lead to a more timely transfer of the power plant, and increase the rate at which additional exploration and development was done in the area.

Pertamina will pay H/BH for the power delivered. DDJ has proposed an 85% (H/BH)/15% (Pertamina) split until the power plant is paid off and transferred to Pertamina but this payment relationship clearly requires detailed analysis. Pertamina seems happy with the concept that the portion of the revenue from PLN that they retain would be compensation for steam delivery to H/BH. The value of this revenue retention should at least compensate them for O&M of the wells. It is not clear that they require a return on their investment in the well field.

The second option discussed for the revenue stream to H/BH is that part will amortize the plant and gathering system while a portion will be used to carry out additional development in the Sikidung area and exploration in the Sileri, Siglagah and Pukawaja areas. If GOI's objectives are to maximize the amount of geothermal power on line in the minimum amount of time, then this would necessarily lengthen the amount of time required to complete the transfer of the first power unit(s) to Pertamina. (But it would also extend debt service.)

3.3 Himpurna

Himpurna is the Indonesian company awarded the opportunity to make a proposal for the Dieng area. They will be Ben Holt Co.'s partner. Although they have no experience in energy projects, they are well connected within the government. Our agent suggests Himpurna is capable of taking a 5-10% equity position in the Dieng project if their comfort level is sufficient.

Himpurna's equity position and revenue expectations for this project need to be addressed.

3.4 P.T. Royal Perintis Abadi

RPA will serve as the required Indonesian agent for the Ben Holt Company. No compensation arrangements were discussed.

4.0 CONCLUSIONS

1. The three concession areas do not offer a viable project. Only the inclusion of the Sikidang area and the existing wells present an attractive option.

2. The business arrangements should be those outlined in Figure 2.

3. Risk associated with the resource should be transferred to Pertamina by having them own and manage the resource and supply steam to the H/BH power plant. This puts them in a position of maintaining the well field and drilling makeup wells if needed. H/BH should offer assistance in drilling and well field management on a contract basis. The arrangement should also transfer the risk of liability for phreatic eruptions to Pertamina. Note that the presidential decree institutes criminal penalties for injury associated with the generation of power. It is not clear that this would not extend to phreatic explosions and gas eruptions.

4. A Take or Pay provision must be in the contract with PLN in order to assure the marketability of power generated by H/BH.

5. It appears that the initial power plant should be about 10 MWe. This option should be re-assessed when the results of the present drilling are known.

6. Pertamina needs immediate technical assistance in drilling and testing.

U.S. GEOTHERMAL INDUSTRIES CORPORATION

FACSIMILE TRANSMISSION

TO....Holt, Kennis, Wright.....

COMPANY....USGIC.....

FROM...G.W. Huttrer.... DATE...5/28/92.....

TIME ..1700.... TOTAL PAGES INCLUDING COVER SHEET .3.....

USGIC PRESIDENT PHONE NUMBER IS:(303) 668-3465

USGIC PRESIDENT FAX NUMBER IS: (303) 668-3074

MESSAGE:

Gentlemen:

Here is WWANAL6.WK3, the new Proforma mentioned in our telecon. call —

Comments?

A

720 Granite Street #7 • P.O. Box 2425 • Frisco, CO 80443

Phone: (303) 668-3465 Fax: (303) 668-3074

WAYAN WINDU ECONOMIC ANALYSIS — GWH-5/28/92 — WWANAL6.WKS — All Figures in $US x 1000

ASSUMPTIONS

PP GROSS CAPACITY IN KW	40,000		INT. RATE	8.00%		STBY WELLS	2		PERT RYLTY	5.0%		EQUITY AMT	$6
CAPACITY FACTOR	90%		LOAN YEARS	15		INJ WELLS	2.50		INS %ofCC	1.50%		DEBT+INT	$69
ANNUAL OPERATING HOURS	7884		PP COST/KW	$1.20		TOT WELLS	10		INFL RATE	5.0%		P+I PYMT	$8
POWER PRICE $US/KWH	$0.128		G&I CST/KW	$0.17		WELL COST	$18,696		CONSTR YRS	3			
EQUITY PORTION	10%		TL CST/KM	$150		PP COST	$48,000		LOAN AMT	$60,026			
DEBT PORTION	90%		KM of TL	0		S2 PLT CST	$0		IDC	$9,604			
WELL COST PER FOOT	$0.30		TL COST	$0		PROJ COST	$66,696		FIN FEES	$1,501			
WELL DEPTHS IN FEET	6560		S2 PLNT/KW	$0.00		O&M %ofCC	4.00%		G & A	$150			
AVERAGE WELL COST	$1,968		P:I RATIO	2		DEPREC SL	$4,446		LEGAL	$60			
AVERAGE MW PER WELL	8		PROD WELLS	5		INDO TX RT	34%		AGNT %ofGR	20.00%			

YEAR	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	
REVENUES														
KW SOLD	0	0	0	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,
ANNUAL OPERATING HOURS	0	0	0	7884	7884	7884	7884	7884	7884	7884	7884	7884	7884	7
POWER PRICE-$US/KWH	0	0	0	$0.128	$0.1285	$0.1290	$0.1295	$0.1300	$0.1305	$0.1310	$0.1315	$0.1320	$0.1325	$0.1
ANNUAL GROSS REVENUE	0	0	0	$40,366	$40,524	$40,681	$40,839	$40,997	$41,154	$41,312	$41,470	$41,628	$41,785	$41,
CUMULATIVE GROSS REVENUE	0	0	0	$40,366	$80,890	$121,571	$162,410	$203,407	$244,562	$285,874	$327,344	$368,971	$410,756	$452,
EXPENSES														
EXPL, DEVEL & PP (DEBT)	$20,009	$20,009	$20,009											
CUMULATIVE DEBT	$20,009	$40,018	$60,026											
EXPL, DEVEL & PP (EQUITY)	$2,223	$2,223	$2,223											
CUMULATIVE EQUITY	$2,223	$4,446	$6,670											
CONSTRUCTION INTEREST	$1,601	$3,201	$4,802											
CUM CONST INT + LOAN AMT	**********	$69,631	**********	$69,631	$67,066	$64,297	$61,305	$58,075	$54,586	$50,818	$46,748	$42,353	$37,607	$32,
PRINC + INTEREST PYMT				$8,135	$8,135	$8,135	$8,135	$8,135	$8,135	$8,135	$8,135	$8,135	$8,135	$8,
INTEREST PAYMENT				$5,570	$5,365	$5,144	$4,904	$4,646	$4,367	$4,065	$3,740	$3,388	$3,009	$2,
PRINCIPLE PAYMENT				$2,564	$2,770	$2,991	$3,230	$3,489	$3,768	$4,069	$4,395	$4,747	$5,126	$5,
G & A	$150	$158	$165	$174	$182	$191	$201	$211	$222	$233	$244	$257	$269	$
PERTAMINA ROYALTY	$0	$0	$0	$2,018	$2,026	$2,034	$2,042	$2,050	$2,058	$2,066	$2,073	$2,081	$2,089	$2,
LEGAL	$60	$63	$66	$69	$73	$77	$80	$84	$89	$93	$98	$103	$108	$
AGENT FEES	$4,446	$4,446	$4,446	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
O & M	0	0	0	$2,668	$2,801	$2,941	$3,088	$3,243	$3,405	$3,575	$3,754	$3,942	$4,139	$4,
INSURANCE	$333	$667	$1,000	$1,000	$1,050	$1,103	$1,158	$1,216	$1,277	$1,341	$1,408	$1,478	$1,552	$1,
FINANCING COSTS	$1,501													
TOTAL EXPENSES	$30,323	$30,767	$32,712	$14,065	$14,268	$14,481	$14,705	$14,939	$15,185	$15,442	$15,712	$15,995	$16,292	$16,
DEPRECIATION				$4,446	$4,446	$4,446	$4,446	$4,446	$4,446	$4,446	$4,446	$4,446	$4,446	$4,
TAXABLE INCOME	($30,323)	($30,767)	($32,712)	$21,855	$21,809	$21,754	$21,688	$21,611	$21,523	$21,424	$21,311	$21,186	$21,047	$20,
TAXES	$0	$0	$0	$7,431	$7,415	$7,396	$7,374	$7,348	$7,318	$7,284	$7,246	$7,203	$7,156	$7,
NET INCOME	($30,323)	($30,767)	($32,712)	$18,871	$18,841	$18,804	$18,760	$18,710	$18,652	$18,586	$18,512	$18,429	$18,337	$18,
CUMULATIVE NET INCOME	($30,323)	($61,091)	($93,803)	($74,932)	($56,092)	($37,288)	($18,527)	$183	$18,834	$37,420	$55,932	$74,361	$92,699	$110,
IRR	15.107%													

,670				
,631				
,735				

11	12	13	14	15
000	40,000	40,000	40,000	40,000
884	7884	7884	7884	7884
330	$0.1335	$0.1340	$0.1345	$0.1350
943	$42,101	$42,258	$42,416	$42,574
699	$494,800	$537,058	$579,474	$622,048
480	$26,944	$20,964	$14,507	$7,532
135	$8,135	$8,135	$8,135	$8,135
598	$2,156	$1,677	$1,161	$603
536	$5,979	$6,458	$6,974	$7,532
283	$297	$312	$327	$344
097	$2,105	$2,113	$2,121	$2,129
113	$119	$125	$131	$138
$0	$0	$0	$0	$0
346	$4,563	$4,791	$5,031	$5,282
630	$1,711	$1,797	$1,886	$1,981
603	$16,930	$17,272	$17,631	$18,008
446	$4,446	$4,446	$4,446	$4,446
893	$20,724	$20,540	$20,338	$20,119
104	$7,046	$6,984	$6,915	$6,841
236	$18,125	$18,003	$17,870	$17,725
335	$129,059	$147,062	$164,931	$182,657

WWANAL6.WKS 5/28/92

Changes:

1. Agent fees only in Yso
   -3, -2, & -1 on USGIC 5/H
   ~~Exported~~ Revenues ie
   The Debt + Equity x Agent(s) %

2. In calc. Taxable Income,
   The Principle Payment
   was not subtracted
   from Gross revenues

3. The net result was
   about 3% increase in IRR
   @ $.120/KWH

IRR = 15% when price is
now $.128. ie 256 Rp/kwh

CONFIDENTIALITY AGREEMENT
CONCERNING ACCESS TO AVAILABLE GEOTHERMAL EXPLORATION AND PRODUCTION DATA

This is to certify that the undersigned, representing U.S. GEOTHERMAL INDUSTRIES CORPORATION, agrees to observe that :

a. The Geothermal exploration and production data borrowed from PERTAMINA shall be used solely for the purpose of pre-evaluation of the Area of Interest (Attachment No.1) and the data borrowed are listed in Attachment No.2.

b. The data shall not be published and not be reproduced in whole or in part without written permission from PERTAMINA.

c. The data shall be kept in strict confidence.

d. Upon completion of the data evaluation, the undersigned will submit a report as conclusion and recommendation to PERTAMINA, resulting from the geological, geochemical, geophysical, production and technical assessment of the data borrowed.

e. Any expense in inccured in the Access to Exploration Data process is not allowed to be recovered directly or indirectly as exploration / production cost in contractor's exsisting JOC or its affiliates in Indonesia.

Agrred by : Lew Hattres

Position : President

Date : Feb 4 1992

MEMORANDUM

To : PERTAMINA , Director of Exploration & Production

From : GERALD W. HUTTRER, PRESIDENT
US GEOTHERMAL INDUSTRIES CORPORATION.

Subject : Authorized Representatives

Dear Sir :

Please be informed that following representatives area authorized to review the geothermal exploration and production data for :
WAYANG WINDU
PATUHA

on our behalf of : US GEOTHERMAL INDUSTRIES CORPORATION

	Name	Function
1.	P. M. WRIGHT	PROJECT MANAGER
2.	D. DAHLO-JOHNSON	PROJECT COORDINATOR
3.		
4.		
5.		
6.		

Signed : Gerald Huttrer

Position : President.

Dated : Feb. 4, 1992

U.S. GEOTHERMAL INDUSTRIES CORPORATION

FACSIMILE TRANSMISSION

TO BRIDWELL, HANSON, HOLT, KOENIG, WRIGHT, Dahlo-Johnson

COMPANY USGIC ExCom + UURI + InterTrade

FROM G.W. Huttrer DATE April 1, 1992

TIME 1520 TOTAL PAGES INCLUDING COVER SHEET 4

USGIC PRESIDENT PHONE NUMBER IS: (303) 668-3465

USGIC PRESIDENT FAX NUMBER IS: (303) 668-3074

MESSAGE:

To: DDJ, Mike Wright and USGIC ExCom
From: G.W. Huttrer
Date: April 1, 1992
Re: ESA Agreement renewal

On April 5, 1991, Jim Koenig and Fadel Muhammad signed a letter agreement (herewith transmitted). It expires 30 April 1992 and needs to be extended and modified until a formal Agreement can be generated and signed. DDJ sent me a draft of a new letter agreement yesterday which I redrafted today and now send to all of you for comments. PLEASE CALL OR FAX THEM TO ME BY MONDAY, APRIL 9 so that the draft can be finalized timely.

720 Granite Street #7 • P.O. Box 2425 • Frisco, CO 80443

Phone: (303) 668-3465 Fax: (303) 668-3074

U.S. GEOTHERMAL INDUSTRIES CORPORATION

DRAFT

DRAFT

TO WHOM IT MAY CONCERN

WHEREAS: PT. Enerindo Supra Abadi (ESA) and U. S. Geothermal Industries Corporation (USGIC) (Together, "the parties") on 5 April 1991 signed a letter (appended hereto and hereby made part of this document) expressing the mutual intent of the parties to enter into an Agreement regarding the development of geothermal resources for electric power generation in Indonesia, and

WHEREAS: Said letter will no longer be valid after 30 April 1992 without said Agreement being signed, and

WHEREAS: The parties desire to maintain valid until 1 July 1993 said letter despite the lack of a signed Agreement, and

WHEREAS: The parties desire to expand the scope of said letter in light of recent project-related events,

NOW, THEREFORE, The parties, by their signatures in the spaces provided below, do: 1) extend the validity of the 5 April 1991 letter until 1 July 1993 or until an Agreement is signed, unless its validity is earlier terminated or extended by mutual written consent and 2) expand the 5 April 1991 letter by addition of terms as follows:

1. In order to cost effectively develop Indonesian geothermal resources for generation of electric power, USGIC and ESA will enter into a Joint Venture (or other business relationship, as may be determined to be most appropriate) under terms to be negotiated. It is anticipated that the parties will initially hold shares in the venture whose value, at a minimum, will equal the value of their paid-in equity contributions

2. The parties agree to pursue the development of the ~~Wayan~~ Wayang Windu and Patuha geothermal sites exclusively with each other, governed, initially, by the following stipulations:

a. That USGIC will immediately proceed with funding proposal(s), field survey(s) and feasibility study(ies) and support efforts by the parties to negotiate contracts with Pertamina, the Government of Indonesia (GOI) and/or private entities as may be required.

DRAFT

720 Granite Street #7 • P.O. Box 2425 • Frisco, CO 80443

Phone: (303) 668-3465 Fax: (303) 668-3074

DRAFT

b. That ESA will make every effort to promptly transmit to USGIC all available project-related information, maintain the momentum of development activities and make staff and office space available in Indonesia so as to help accomplish required tasks.

c. That USGIC and ESA will organize and staff an "operation team" qualified to undertake project development.

d. That, until all contracts are successfully negotiated, USGIC and ESA will pay their own shares of project costs.

e. That, after successful negotiation of contracts, USGIC will be responsible, at a minimum, for the continued technical development aspects of the project(s).

f. That USGIC will diligently pursue feasibility and project financing and that they will, towards these ends, work with private banks, International Finance Corporation (IFC) and other financial entities as may be deemed appropriate by USGIC, in cooperation with ESA.

g. That ESA will diligently conduct marketing and negotiations for power sales agreement(s) with advice from USGIC.

U.S. GEOTHERMAL INDUSTRIES CORP.	PT. ENERINDO SUPRA ABADI
By _____	By _____
Title- President	Title-
_____	_____
Date: _____	Date: _____

DRAFT

usgicesa.agr

U.S. GEOTHERMAL INDUSTRIES CORPORATION

TO WHOM IT MAY CONCERN :

This Letter expresses the mutual intentions of U.S. Geothermal Industries Corporation (USGIC), incorporated in the United States of America, and PT. Enerindo Supra Abadi (ESA), an Indonesian company, to enter into an Agreement regarding the development of geothermal resources for electric power generation in Indonesia. This Agreement will call for USGIC to provide Services to ESA in the exploration, drilling, wellfield development, power plant design and construction, and wellfield and plant operation at such geothermal fields as will be awarded to ESA for development. Under terms to be determined, USGIC will provide all such Services to ESA, and ESA will employ the Services of USGIC.

This Letter will remain valid until 30 April 1992, unless an Agreement is signed prior to that date by USGIC and ESA, in which case this Letter will remain valid as long as the Agreement between USGIC and ESA remains valid.

Jakarta, 5 April 1991

U.S. Geothermal Industries Corp.

By JAMES B. KOENIG
Director/Executive Committee

PT.Enerindo Supra Abadi

By FADEL MUHAMMAD
President Director

27972 Meadow Drive, #340 • P.O. Box 2980 • Evergreen, CO 80439

Phone: (303) 670-3454 Fax: (303) 674-1971

ALDIRON GROUP 12 K-N JALAN GAJAH MADA, JAKARTA 10130.- INDONESIA

Phone : (021) 365909 • Fax : (021) 363927 • Telex : 45390 ERON IA • P.O. BOX. 3330.

FAX NO. : (021) 363927

FACSIMILE MESSAGE

TO : US. GEOTHERMAL INDUSTRIAL CORP.
ATTENTION : MR. DON JOHNSON
FAX NO. : (303) 668-3074
FROM : ALDRIN L. TANDO

DATE : March 24, 1992
REF. NO. : 2768/III/92
PAGE : 1 (one)

Dear Mr. Johnson,

We were reffered to you by Mr. Harris Hasyim of Lampung Governor's Office. We understood that you are looking for a partner in the field of geothermal electricity.

We are interested in pursuing the possibilities further. Would you please give us detailed information about your company and what type of operation you interested in Indonesia.

We are looking forward to hearing from you.

Sincerely yours,

ALDRIN L. TANDO

FAX/SK

DD will take care of this in Jakarta.

To: Mike Wright
Please respond & request return info re their firms capabilities, objectives etc.
Larry 3/27/92 0815

Mike:

Some matters on which to check (or have ESA/Royal check) while in Indonesia. Purpose: to facilitate generation of Feasibility Study Budget.

1. Field work (non-drilling)
   a) Geologic mapping
   b) Geochem (water, gas, soils (?)
   c) Air Photo
   d) Land control - ownership, royalties, means of leasing (if applicable)
   e) Access for Resistivity, Seismic, Gravity, Mag, AMT, etc (non disruptive)
   f) Access for drills
      1. Road adequacy
      2. Upgrade cost
      3. Water availability
   g) Environmental information/laws/permits
2. Drilling Related
   a) Terrain
   b) Dozer work cost
   c) ~~Waste & water disposal~~
   d) ~~Permits needed — lead time~~
   e) Docks, cranes, longshoreman matters,
   f) Labor availability - salary ranges
   g) Unloading fees, warehousing, security (costs for all)

(2)

h) ~~Import duties/taxes~~

i) ~~export~~ " after drilling

j) AVAILABILITY OF LOCAL RIGS??
CAN WE HAVE PERTAMINA DRILL FOR US
(DO WE WANT TO??)

k) ~~General permitting process & cost~~

3) Local Partners/Investors/Subcontractors.

a) ~~Environmental firms~~

b) Land/Legal firms

c) Risk-oriented Banks or other entities

d) US Govt. offices

1. ~~Commerce~~
2. US AID
3. ~~Chamber of Commerce~~
4. ~~Embassy~~

e) ~~Asian Development Bank (ADB) local Bank.~~

f) ~~City Bank Branch~~

4) Need for USGIC office space, phone, secretary? Probably not w/ Royal ≠ ESA there.

5) ~~Get real feel for~~ "under-the-table payments" ≠ how we can stay clean.

P.T. ROYAL PERINTIS ABADI CORP.

Address : Cika Bldg. 4th Floor, Jl. Cikini Raya 84-86 Jakarta 10330 Indonesia
Phone : 320158, 327855, 322758, Fax : (021) 327850, Telex : (021) 61328 RPA IFF IA

1

Ref : /313 /RYL/SS/92
Jakarta, February 4, 1992.

FACSIMILE TRANSMISSION

Attn. : Gerald Huttrer
Fax :

From : Dan D. Johnson

Pages transmitted : 2 pages incl this cover letter.

Good to hear Mike will make it on time for data meetings.
Today meeting with ESA went OK. They are arranging visits with Geo Officials this week.

I met with Aid Director yesterday and he is generally supportive of our efforts. 22
We are drafting letter now for him to sign supporting our application to Aid Washington for Feasibility Study.

We are going apply for all datas on Wayang Windu Site. You will have to wire your share US$ 5.000,- to Pertamina direct - please note following :

1 Wire funds to Pertamina account as per letter Pertamina no.

w/ Gerry Huttner 3 Feb 92

1. Money + Rep. – has set up a meeting –
   – Koenig can't –

   – If I can do to go, ~~FT~~ it could be better than Dave alludes of CDA.

   – 3–4 days to get ticket
   – Andrea cold –

2. Prepare to wire funds by Feb 6.
   – need to come up w/ $5K

3. Huttner's FAX
   1. FAX
   2. 9 status report
   3. $300 allow by wire to see if or promissory note.
      added to 1/2 share us sec stock.

4. Take PSED apple – make an plane –
   get some answers –

w/ Andrea

1. Gruda airlines → will ticket whomever —

2. Visa ? —

3. Schedules ?
   airline # — leave Fri or wed

   Fri ⇒ 16th Dan coming back
   Back — direct — to Jakarta — arrive Sunday —

   leave —

Garuda —
   213 - 387 - 0149 — no picks up seats —

Fred up hip-beat night club. Fred — horse called him SSB out of his ass. Let's try it, but strong feelings against. Horse on stage turned horse around, horse shit.

w/ Ben Hoch —

- He talked w/ DOJ Friday morning —

- Told him that:
  - he knows Ben can't go for a month
  - wasn't sure he should go anyway
  - would pony up his share of fee.

- ~~at first~~ then
- he said "USGIC will raise money, will send Mike Wright over"
- That sounded fine to Ben — "Thought

- most of wells are
  - no drilling
  - 2 well - productive
  - 2 well - non-productive

has 3 sets

- reproduction / printing charged at cost

  - They will release data on loan basis, but its unclear —
    - return it at end of 3 months.

- he will pay part of any expenses if I ask for him, too.

- Need logistics info
  - what is avail drilling
  - what is not
  - card working performance? or for drilling?
  - what can be brought in?

-1. what's Ben doing
2. what else needs
3. Schedule/budget in quick way.

4. what do docs look like?
   shipping fees?

5. Need list of info to give to partners for them to dig up --

Pargeoper or Mahmud =

- what shots etc needed? Kalnig

Dan's 5th @ 3rd Pmic -

Possible itinerary:

Time difference:
4:AM
4:20 AM Jakarta @
2:20PM on Wed.

Friday - 7 Feb 92:
Leave SLC 2:47P or 3:35P DL1645
LA Jak
1:PM = 4AM correct
2:PM = 4AM

Leave for Jakarta @ 8:00 PM -
Is it possible to upgrade to business class?
What is the cost

arrive in LA on 16 Feb 92 arrives 5:30P

Leave LA for Sacramento
by 7:55 P or 9:2 P DL1180

5PM +13h
12 18

Leave for SLC 19 Feb 92
by 4:30 P or 6:55P DL1886

15 hrs ahead of LA
14 hrs ahead of SLC

B/W lmtd WS. 900 Pm

805-658-1299 Jakarta = +12 from EST
#348 W/ tax RT

Jakarta = +12 from EST
= +10 from MST

GRCDSCV. BUL
GRCBULL 1. 92

So
2:20 PM
2:00 P +2 = 4:00 P EST
+12 = 16
12
4:00A

Garuda Indonesia
3457 Wilshire Blvd
LA 90010
Attn: Sheryl
upgrade to business class for Phillip Michael Wright

1. Justification + logic to document

~~$~~375 → $355 now available $40K

alloc of $0
+ alloy

July 21 Teleconf
2 hrs 1 PM - 3 PM EDT.
2 parts 1. utilities -

303-668-3965

Apply for Patuha as well

1. Dahlo Johnson FAX
   - AID director is "generally supportive"
   - They will apply for all data on Wayang Windu for $8,000 -

ideal invoice?

   - Sign data agreements,

2. Funding - telephone follow-up --
   4 do. phasing -
   Hansen or Koenig - line them up

Hansen	Koenig	Wright
Sorhan - Ch	Kevan Steel	Willis
Energy Leg	Indy Power	AmerLine
Foster	Mesquite	Dames Saloon
GD Associates	Alabars	Grace Drilling
Stuchman	Ormat	

Gaffner
Air
Boller
Bidwell
S-Cubed

= MMRI/Hunter Contract
USGEC meeting March - =

Karl Albrand

1. Congrats for nice doc I wrote up

2. Saw participants – hope no problems w/ competition –

3. Feels we have a good chance

4. Another quest:
   - They put in Cementos Proposal. Good financial standing / big company.
   - How about their financial partner
   - Know consultants in LSC etc. Put me in contact to set up financing package –
     - One guy leaving soon for Manila –

Unocal Stigma – they are an oil company -- not interested in local co-financing -- but afraid of Unocal because of its size.

From - Ben Holt

- talked over things w Ben -

- kind of things Ben needs is
  - info on infrastructure
  - road maps
  - transmission line maps / descriptions
  - access to areas

- Ben will send me his info tonight

- local cats -

12 Dec 91

W/ Dan Dabbs - Schubra

1. Has talked w/ Schubra ©
   Being - he's made mention
   w/ acz guy to Portsmouth -

- Dan don't believe Port will - want
  Boo or Boot, not sure plant sell
  electric.

2. Dan has located diesel in industrial
   states in Iowa 3-yr diesel 70 mw
   4-yr " 230 mw
   in last 1 state. There are 3 such
   and states. PCN want power
   Power - most are leased diesel, which
   Port said promise to deliver -
   Dan wants to bring gt power to
   end states - as provide out plant
   as interim power.

phases: 1. Tech - can handle
2. political - actually first
3. Business plan/ Fees / financing phase
est of resource
4. Market agreement

Tender must spring for ~~Pegerat~~ to arise.

Sinar Mas Group - large Cos building industrialist
PT Astra ~~Group~~ International
Bakrie Brothers
- of 10 major such groups, we are dealing w/
7 on Bringing of energy -
Hinpurnam - etc
- ~~Pepabri~~ = assoc of retired generals =

- ESA = Electro Indo Supra Abadi Corp
an Indones PT Co
60% Fidel Muha - Des Bakaha group
- a few shares now open for people in each group
Swardy & Priyanto -

Fidel is adept San dan Gunajar

Also formed co-ventures
PT Harapan Energindo Abadi —
retired generals major & tech holdings

So creating cos to do geothe projects
out of -

Both cos have got approved for Cenagar -
OK to develop certain reserves.

- Concocal - handicap - all partnerships are
new fixed - can't make any study -
- also screwed up
drilled Salak field 1982, came to
Pwr Purch of Pert. - price based on Singapore
oil price -
— total reason for ~~Stein~~ Hadapan Ltd.

ESA –

on Way Wardy

Pator

is —

sites already situated al assoc

and

Hunpand

Vrag
Soleh sites } Cement plant + and esfate

Bakirce

Dajorot tedbr

(5)

[illegible] — [illegible] approval
— [illegible] can go thru System —

now Nayan is main expl/prod man

(?) Bohme — they are waiting for us & tender

Next Step

Looking for first right to proceed = agree w/ govt for feasibility study + develop plan --

What more do Indo's want?

maybe want info need [Technical capabilities / Financial capabilities] at this point we are [illegible] that we can do this.

They are looking @ political situation -- who is backing our case.

Brochure is for tech cap.

If get first right to proceed FRTP

Jim Sullivan is good for $400K.
This will come of FRTP.

A&D's $400K is a non-recourse loan--
if proj doesn't go, don't have to pay.--

Also we need matching $400K
matching will have to come on overbilled
hours. Billing both double detail pay -
- staff already done will be billed

- of $400K, DDS wants 60K for office -
- our travel business / travel cash --

- will have to be also come up at
$50-60K cash for working capital.

where $ come from? people also wait to
play.

(7)

USGIC
~~the~~ needs to specify proj team.

Set up proj partnership or Corp –

team!!

LICART 3%
Geothy 2%
HoH 20%
etc.

governs how much people high in [illegible] of capital

or only divide up $400K into 1/2 to determine orig % for GOC

want more $ on feasib. –

Only power plant feasibility: Dieng is already well along – owned by Pertamina; Salak field is owned by Unocal

Dieng is Boss –

Then after feasibility review

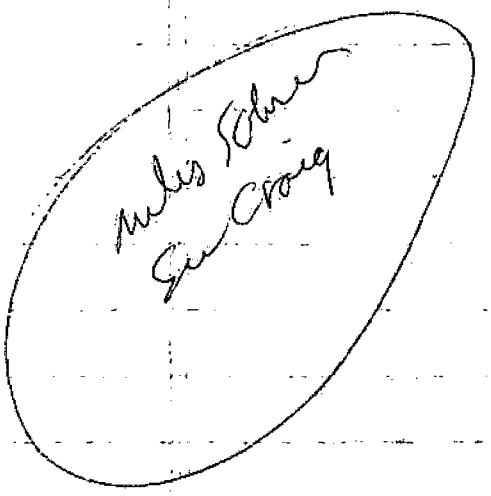
Financing

PT Joint Co could
- Borrow
- Export Credits & PIC Loans
- sell bonds etc -

DOJ thinks financing is work, but should be straightforward —

Needs

Book 1



Jalan Tebet Barat Dalam Raya #16
West Tebet Inside Highway -
approach on Saharjo, left @ Post Office Ktor Pos

M P Hargano, agly
Statoe - Papug Superwok
↗ Left @ Gelad ①
Close to Post Office - Flows

washington office
Bob MacDonough

1. Dames & Moore office in Jakarta
PT Environ Nusa Geotechnica
Ian Loveday, a Brit., runs office
62-21-830-1646
Do mostly environmental work

- Paul Besoi
- USGIC

2. Amoseas Indonesian Inc.
Texaco owned
Chris Swarbrick, head of O&G exploration
knows folks That run geothermal
380-5655

3. Concessions are
Ben Holt / Himpurna Feb 11
USGIC / ESA Feb 13

4. Holt - Project history

25 Nov 91 - Holt agreement w/ Himpurna EA
PT Himpurna Enersindo Abadi
- Holt to provide services to Himpurna on concessions granted to Himpurna. Holt may subcontract USGIC. Terms to be agreed later. Duration until 15 Dec 92

- 9 Dec 91 Letter Royal to Holt
  "Mr. M. Slamet, pres of Hamparma, signed agreement" need more copies of Co profile"
  Signed by Bob Pangeropan

- 27 Nov 91 to Pertamina / Nayoan
  from ~~Pertamina~~ Mohamad Slamet
  - power plant to be running in about 2 years

- 4 Jan 92 Slamet to Wiroyudo
  - agree to accept 3 locations Sileri, Pakuwaja and Siglagah.
  - expect to receive Pertamina Letter of Intent
  - willing to handle as Total Project BOO.

- 12 Jan 92 Wiroyudo to Slamet
  - Mt. Salak has been developed
  - 55 mwe in Dieng will be developed by Pertamina
  - Open are Sileri, Pakuwaja, Siglagah:
  do you want them?

- 10 Jan 92 Pangerapan to Holt.

- 11 Oct 91 - Report "Evaluation of the Dieng geothermal field; review of development strategy" - Proc Indonesian Petro Assoc. M Boedhardi, Suwarko, S. Sudarman
  - Dave Rhas Wheal acknowledged.

- 2 "Smiths" in phone book

- PT Royal Peruntis Abody - secretary = Suzy

- For 3 mo during feas study,
  help 1-2 people in Jakarta at
  all times. High level interest, etc
  So need to schedule people in and get
  their comments. ask pay costs of large
  only out of study; team is cy-lead
  Caribbatria.
  get ticket, place to stay + $100/day —

- How about operating costs →

Dames & Moore
Mesquite
Geothermex
Am Line Builders
Mobers Drilling
Grace Drilling
Barber Nichols
Eastman

Resource outline
- Level II
- Geothermex
- Geothermal Energy

Res Eng
- Mesquite
- Geothermex

Plant
- Barber Nichols
- Ben Holt
- Gary Shulman

Power Line
- Am Line Mbrs
- Fed Power Coop

-9 mw

280
22
560
56
6160

6200
9
55,800 → 60

$80K

Needs for A.I.D Application

1. Env. standards of (1) IBRD (WB) and of (2) Indonesia
   - (1) get in U.S.
   - (2) Dames & Moore
2. II A 1. - have w/ PLN plans/projections
   2. - OK
   3. - OK
   B. 1. - OK
   2. - OK
   3. ~~-~~ - use ces experience, add Kamojang + Dieng experience
      - can we get a narrative on Kamojang?
   4 - OK
   5. - OK
   6. Need list/assessment of infrastructure for each site.
   C. 1. Need financial plan of all participants?
   2. Need letters from potential Lenders in Indonesia
   3. Need my "list of needs" answered.
   4. Need experience list for project financing
   5. Need good estimate of price we can sell power for
   D. OK
   E. OK
   F. 1. Summary of Laws/Regs/procedures/institutions for private power development in Indonesia
   2. Agreements/approvals from Indonesian institutions

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ZNR UUUUU ZZH
R 031001Z MAY 95
FM AMEMBASSY JAKARTA
TO RUEHC/SECSTATE WASHDC 6256
INFO RUCPCIM/CIMS NTDB WASHDC
RUEHML/AMEMBASSY MANILA 2067
RUEHKO/AMEMBASSY TOKYO 1243
RUCPDC/USDOC WASHDC
RHEGDOE/USDOE WASHDC
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UNCLAS SECTION 01 OF 07 JAKARTA 003921

DEPARTMENT FOR EB/OGE AND EAP/IMBS

USDOC FOR 4430/IEP/OPB

USDOE FOR 0I-141 TOM CUTLER

TOKYO FOR RRO

E.O. 12356: N/A
TAGS: ENRG, EINV, KNTB, ID

SUBJECT: GEOTHERMAL ENERGY IN INDONESIA: A GUIDE FOR INVESTORS

1. SUMMARY. INDONESIA IS ATTEMPTING TO DEVELOP ITS EXTENSIVE GEOTHERMAL RESOURCES, ESTIMATED AT 16,000 MW. ENERGY PLANNERS ARE LOOKING OF THIS RESOURCE TO HELP INDONESIA MEET ITS RAPIDLY GROWING DEMAND FOR ELECTRICITY. TO THIS END, THE GOVERNMENT HAS LIBERALIZED REGULATIONS GOVERNING THE ROLE OF THE PRIVATE SECTOR IN THIS SECTOR. HOWEVER, THE PRICING OF GEOTHERMAL STEAM REMAINS AN ISSUE. CURRENT UTILIZATION IS ONLY ONLY 310 MW. HOWEVER, THE OBJECTIVE OF THE INDONESIAN GOVERNMENT IS TO INSTALL 1,000 MW IN THE NEXT FIVE YEARS AND 5,000 MW BY THE YEAR OF 2020. THIS WOULD MAKE INDONESIA THE LARGEST PRODUCER OF GEOTHERMAL ENERGY IN THE WORLD. SEVERAL U.S. COMPANIES, UNOCAL, AMOSEAS, CALIFORNIAN ENERGY AND CAITHNESS, ARE INVOLVED IN DEVELOPING GEOTHERMAL POWER PROJECTS. END SUMMARY

RESOURCES
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2. INDONESIA'S TECTONIC SETTING ASSURES EXCELLENT GEOTHERMAL PROSPECTS. THE STATE OIL COMPANY PERTAMINA HAS IDENTIFIED 217

PROSPECTIVE SITES FOR GEOTHERMAL POWER: 71 IN SUMATRA, 62 IN JAVA, 52 IN SULAWESI, 15 IN NUSA TENGGARA, TWO IN IRIAN JAYA AND ONE LOCATION IN MALUKU. MANY OF THESE SITES, WITH FURTHER EXPLORATION, MAY PROVE COMMERCIAL. PERTAMINA ESTIMATES THAT THE INDICATED RESOURCES BASE COULD SUPPORT 16,000 MW IN GENERATING CAPACITY. JAVA AND BALI, THE MOST POPULOUS ISLANDS WITH THE HIGHEST DEMAND FOR ELECTRICITY HAVE POTENTIAL RESOURCES OF ABOUT 8,000 MW.

3. PERTAMINA AND THE DIRECTORATE GENERAL OF GEOLOGY HAVE CONDUCTED GEOLOGICAL SURVEYS AT 214 LOCATIONS, GEOCHEMICAL SURVEYS AT 200 LOCATIONS AND GEOPHYSICAL SURVEYS AT 45 LOCATIONS. PERTAMINA HAS DRILLED 100 WELLS AT 10 GEOTHERMAL PROSPECTS:

JAVA: KAMOJANG - 60 WELLS, DIENG - 22 WELLS, GUNUNG SALAK - 20 WELLS, DARAJAT - 12 7 WELLS, LAHENDONG - 12 WELLS, BANTEN - 1 WELL, CISOLOK - 1 WELL, AND CIHARIUS - 1 WELL

SUMATRA : SARULLA - 3 WELLS, SIBAYAK - 3 WELLS AND KERINCI 1 WELL.

THESE SURVEYS HAVE REVEALED A POSSIBLE RESERVE POTENTIAL OF ABOUT 4,888 MW AT THESE SITES.

CURRENT UTILIZATION AND EXISTING PLANTS
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4. THE TOTAL AMOUNT OF ELECTRICITY GENERATED FROM GEOTHERMAL ENERGY IS CURRENTLY 309.75 MW, LESS THAN TWO PERCENT OF THE ESTIMATED POTENTIAL. STILL, INDONESIA IS NOW THE FIFTH LARGEST DEVELOPED PRODUCER OF GEOTHERMAL POWER IN THE WORLD. THE COUNTRY PASSED JAPAN AND NEW ZEALAND IN 1994, WHEN INSTALLED CAPACITY JUMPED FROM 145 MW THE YEAR BEFORE. THE CAPACITY DERIVES FROM TWO PERTAMINA FIELDS (KAMOJANG, 140 MW AND LAHENDONG, 2.5 MW) AND TWO CONTRACTOR'S FIELDS, UNOCAL'S GUNUNG SALAK 110 MW AND AMOSEAS' DARAJAT 55 MW). BOTH CONTRACTORS ARE AMERICAN FIRMS. THIS ENERGY PRODUCTION OFFSETS THE CONSUMPTION OF FUEL OF ABOUT 13,700 BARRELS PER DAY, OR ABOUT USD 70 MILLION PER YEAR.

KAMOJANG: THE DUTCH UNDERTOOK THE FIRST GEOTHERMAL SURVEYS IN THE KAMOJANG AREA, ABOUT 40 KM SOUTHEAST OF BANDUNG IN WEST JAVA IN 1918. THEY DRILLED FIVE EXPLORATION WELLS BETWEEN 1926 AND 1928. HOWEVER, ONLY IN 1978 DID PERTAMINA

INSTALL A 0.25 MW MONOBLOCK POWER PLANT THERE FOR THE COMPANY'S OWN USE. THEN, SUPPORTED BY A NEW ZEALAND GOVERNMENT GRANT OF USD 24 MILLION UNDER THE COLOMBO PLAN, PLN COMPLETED THE CONSTRUCTION OF A 30 MW COMMERCIAL PLANT IN LATE 1982. UNITS TWO AND THREE (2X55 MW) BEGAN OPERATIONS IN 1987. A USD 61 MILLION WORLD BANK LOAN FINANCED THE PLN OPERATED PROJECT, WHICH MITSUBISHI HEAVY INDUSTRIES OF JAPAN UNDERTOOK. THE AREA HAS AN ESTIMATED POTENTIAL OF 240 MW. PERTAMINA DEVELOPED AND OPERATES THE STEAM FIELD.

LAHENDONG: A CONSORTIUM OF THREE FRENCH COMPANIES, ENERSYSTEM, BERIN AND FROMATOME, CONSTRUCTED INDONESIA'S FIRST BINARY CYCLE POWER PLANT IN LAHENDONG, NORTH SULAWESI, WITH THE ASSISTANCE OF A USD 5 MILLION SOFT LOAN FROM FRANCE. THE 2.5 MW PLANT, WHICH PERTAMINA OPERATES, IS A PILOT SCHEME TO GATHER EXPERIENCE IN THE DEVELOPMENT

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INFO RUCPCIM/CIMS NTDB WASHDC
RUEHML/AMEMBASSY MANILA 2068
RUEHKO/AMEMBASSY TOKYO 1244
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DEPARTMENT FOR EB/OGE AND EAP/IMBS

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OF OTHER SMALL SCALE GEOTHERMAL POWER STATIONS.

GUNUNG SALAK: UNOCAL GEOTHERMAL OF INDONESIA (UGI), PERTAMINA AND PLN ENTERED INTO JOINT OPERATIONS AND ENERGY SALES CONTRACTS FOR THE EXPLORATION AND EXPLOITATION OF THE GEOTHERMAL RESOURCES IN THE GUNUNG SALAK PROSPECT AREA IN WEST JAVA IN 1982. PLN INSTALLED TWO 55 MW POWER GENERATION UNITS FOR WHICH UGI/PERTAMINA SUPPLIES GEOTHERMAL STEAM. THESE UNITS BECAME COMMERCIAL IN MID TO LATE 1994 AND WERE INAUGURATED INTO THE PLN SYSTEM IN DECEMBER 1994. RESOURCE EXPLORATION AND DEVELOPMENT COSTS THROUGH THE FIRST 110 MW HAVE BEEN APPROXIMATELY 200 MILLION DOLLARS. WITH THIS INVESTMENT UNOCAL HAS PROVEN GEOTHERMAL RESERVES OF APPROXIMATELY 330 MW. PLN AND UNOCAL HAVE REACHED AN AGREEMENT ON PRICING OF GEOTHERMAL STEAM AT US CENT 4.7 PER KWH. THIS ENABLES UNOCAL TO RECOVER ITS EXPLORATION AND DEVELOPMENT ACTIVITIES WITHIN SEVEN TO 10 YEARS.

THE ORIGINAL CONTRACTS WERE AMENDED AND RESTATED IN 1994 TO BRING THEM INTO CONFORMANCE WITH CHANGES IN THE TAX LAW AND TO PROVIDE FOR EXPANSION OF THE PROJECT UP TO 495 MW. THERE ARE CURRENTLY PLANS IN PLACE TO INCREASE THE PROJECT CAPACITY TO 330 MW. PLN WILL CONSTRUCT THE NEXT 55 MW AND UGI/PERTAMINA WILL CONSTRUCT THE FOLLOWING 165 MW OF POWER GENERATION UNITS UNDER A "BUILD OPERATE TRANSFER" (BOT) PLAN.

DARAJAT: IN 1984, CHEVRON AND TEXACO SIGNED A JOC WITH PERTAMINA AND AN ENERGY SALES CONTRACT WITH PLN TO DEVELOP GEOTHERMAL ENERGY AT THE DARAJAT FIELD, WEST JAVA, WITH THE AID OF ADB FINANCING. AMOSEAS ACTS AS THE OPERATOR FOR THE STEAM FIELD WHILE PLN OWNS AND OPERATES THE 55 MW POWER PLANT, WHICH OPENED IN 1994. THE COMPANY EXPECTS THAT THE FIELD HAS A POTENTIAL FOR MORE THAN 165 MW.

6. IN ADDITION, UNTIL RECENTLY, PERTAMINA OPERATED TWO MONOBLOCKS AT THE DIENG FIELD IN CENTRAL JAVA TO SUPPLY 2.5 MW OF POWER FOR ITS OWN OPERATIONS. HOWEVER, PERTAMINA HAS NOW MOVED THE MONOBLOCKS TO PROVIDE ELECTRICITY IN SULAWESI. PERTAMINA HAS ESTIMATED, BASED ON AN EXPLORATION PROGRAM OF 27 WELLS, THAT DIENG COULD PRODUCE 285 MW OF ELECTRICITY.

LEGAL FRAMEWORK
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7. THE GOVERNMENT PLAYS A KEY ROLE IN THE DEVELOPMENT OF INDONESIA'S GEOTHERMAL RESOURCES, ESPECIALLY THROUGH PERTAMINA AND PLN. PRESIDENTIAL DECREE NO 22 OF YEAR 1981 AUTHORIZED PERTAMINA TO UNDERTAKE GEOTHERMAL EXPLORATION AND TO SELL GEOTHERMAL ENERGY, AND ALLOWED PLN TO CONSTRUCT POWER PLANTS. HOWEVER, UNTIL 1991, ONLY TWO CONTRACTORS SIGNED CONTRACTS FOR FIELD DEVELOPMENT. REALIZING THE NEED TO ATTRACT MORE INVESTORS, THE GOVERNMENT ENACTED PRESIDENTIAL DECREE NO. 45 OF YEAR 1991, AMENDING THE EARLIER DECREE. THE NEW LEGISLATION IMPROVED AND SIMPLIFIED GEOTHERMAL UNDERTAKINGS AND INTRODUCED A TOTAL PROJECT SYSTEM. PERTAMINA AND ITS CONTRACTORS ARE NOW ALLOWED NOT ONLY TO UNDERTAKE EXPLORATION AND EXPLOITATION BUT ALSO TO CONSTRUCT POWER PLANTS AND SELL ELECTRICITY TO PLN AND TO OTHER CONSUMERS.
PRODUCING GEOTHERMAL ENERGY. PRESIDENTIAL DECREE NO. 23 OF 1981 HAD REQUIRED PERTAMINA TO PAY AS TAXES 46 PERCENT OF ITS NET OPERATING INCOME ORIGINATING FROM GEOTHERMAL ENERGY PROJECTS. SUBSEQUENTLY, PRESIDENTIAL DECREE NO. 49 YEAR OF 1991 LOWERED THE TAX TO 34 PERCENT TAX, TO BE PAID BY THE

CONTRACTOR. THIS MOVE HAS ENCOURAGED GEOTHERMAL DEVELOPMENT.

9. PRESIDENTIAL DECREE NO. 45 OF 1991 OUTLINES TWO ALTERNATIVE PATHS FOR GEOTHERMAL ENERGY DEVELOPMENT IN INDONESIA. UNDER THE FIRST, PERTAMINA OR ITS JOINT OPERATION CONTRACTORS DEVELOP AND OPERATE THE STEAM FIELD, SELLING THE STEAM TO PLN OR OTHER PARTIES FOR ELECTRICITY GENERATION. THE SECOND ALTERNATIVE ALLOWS PERTAMINA OR ITS CONTRACTORS TO DEVELOP AND OPERATE THE STEAM FIELD AND GENERATE ELECTRICITY, WHICH IS THEN SOLD TO EITHER PLN OR OTHER CONSUMERS.

10. JOINT OPERATION CONTRACT (JOC): A JOC IS A LEGAL AGREEMENT BETWEEN THE CONTRACTORS AND PERTAMINA, REPRESENTING THE GOVERNMENT. PERTAMINA IS RESPONSIBLE FOR THE MANAGEMENT OF THE OPERATION AND THE CONTRACTOR IS RESPONSIBLE FOR THE PRODUCTION OF GEOTHERMAL ENERGY FROM THE CONTRACT AREA, THE CONVERSION OF ENERGY TO ELECTRICITY AND THE DELIVERY OF
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RUEHML/AMEMBASSY MANILA 2069
RUEHKO/AMEMBASSY TOKYO 1245
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USDOE FOR 0I-141 TOM CUTLER

TOKYO FOR RRO

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GEOTHERMAL ENERGY OR ELCTRICITY. SEE BELOW FOR SOME BASIC TERMS AND PRVISIONS OF THE JOC AGREEMENT.

11. ENERGY SALESCONTRACT (ESC): AN ESC IS AN INTEGRAL PART OF TH JOC. AN ESC IS AN AGREEMENT AMONG PERTAMINA AS SLLER, THE CONTRACTOR AS DELIVERER AND PLN AS PURHASER OF GEOTHERMAL ENERGY. UNDER THIS AGREEMEN, THE PRODUCTION PERIOD FOR DELIVERY OF GEOTHERMAL ENERGY FROM EACH UNIT IS 30 YEARS COMMENCING FROM THE DATE OF COMMERCIAL GENERATION FOR EACH UNIT. THE TERM OF AN ESC IS 42 YEARS.

12. THE INDONESIAN GOVERNMENT ALSO PERMITS OTHER AGENCIES AND PRIVATE DEVELOPERS TO UNDERTAKE GEOTHERMAL DEVELOPMENT ON A SMALL SCALE BASIS (LESS THAN 10 MW) FOR POWER GENERATION OR OTHER UTILIZATION, WITHOUT A PARTNERSHIP WITH PERTAMINA. THE DIRECTOR GENERAL FOR OIL AND GAS IN THE DEPARTMENT OF MINES AND ENERGY SUPERVISES THIS PROGRAM.

THE PRICING PROBLEM

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13. THE PRICING OF STEAM IS THE MAIN OBSTACLE TO THE DEVELOPMENT OF GEOTHERMAL ENERGY IN INDONESIA. THE PRICE NEEDS TO BE COMPETITIVE WITH OTHER ENERGY ALTERNATIVES, AND AT THE SAME TIME OFFER THE CONTRACTOR OR PRODUCER AN ATTRACTIVE RATE OF RETURN. IN 1983, THE DEPARTMENT OF MINES AND ENERGY SET FOR KAMOJANG AND DIENG A PRICE BASED ON 80 PERCENT OF THE DOMESTIC FUEL OIL PRICE. CURRENTLY, FOUR DIFFERENT BASE RESOURCE PRICES ARE ADOPTED, NAMELY : UNOCAL, GUNUNG SALAK (USD 0.0430/KWH), AMOSEAS, DARAJAT (USD 0.04687/KWH), PERTAMINA, KAMOJANG (USD 0.04480/KWH) AND UNOCAL, SARULLA (USD 0.04307/KWH). THE PRICES ALL HAVE DIFFERENT BASE YEARS AND ARE ESCALATED ACCORDING TO INFLATION FORMULAS.

CURRENT CONTRACTS

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14. GUNUNG SALAK 3,4,5,6: A THIRD 55 MW UNOCAL PLANT MAY COME ON LINE IN MID-1997. THE ITALIAN COMPANY, ANSALDO, WILL CONSTRUCT THE FACILITY. SUBSEQUENTLY, THREE MORE PLANTS (3 X MW) WILL GO INTO OPERATION. UNOCAL WILL OPERATE ALL THE NEW PLANTS FOR 15 YEARS, AND THEN TRANSFER OPERATORSHIP TO PLN UNDER A BOT MECHANISM. UNOCAL WILL CONTINUE TO SELL GEOTHERMAL STEAM FOR THE POWER PLANTS FOR THE FULL 30 YEAR LIFE OF THE PLANTS. UNOCAL EXPECTS TO SPEND APPROXIMATELY USD 380 MILLION TO DEVELOP THE GEOTHERMAL RESOURCES FOR THE FOUR NEW POWER PLANTS.

15. SARULLA: IN FEBRUARY 1993, UNOCAL SIGNED A CONTRACT TO EXPLOIT GEOTHERMAL RESOURCES AT SARULLA, NORTH SUMATRA. UNLIKE ITS PREVIOUS CONTRACT FOR GUNUNG SALAK, THIS AGREEMENT IS A TOTAL PROJECT CONTRACT (JOC AGREEMENT WITH PERTAMINA AND ELECTRICITY SALES CONTRACT WITH PLN). PURSUANT TO THE TERMS OF THE JOC, UNOCAL HAS AGREED TO SPEND AT LEAST USD 28 MILLION DURING THE FIRST SEVEN YEARS OF EXPLORATION PERIOD. UNOCAL WILL OPERATE AND MAINTAIN THE FIELD FACILITIES AND ELECTRICITY GENERATION FACILITIES, UNDER A BOT FOR THE FIRST 15 YEARS. AS A FIRST STAGE UNOCAL PLANS TO CONSTRUCT 2X55 MW POWER STATIONS.

16. IN DECEMBER 1994, THREE U.S. INDONESIAN JOINT VENTURE COMPANIES SIGNED POWER PURCHASE AGREEMENTS AND JOINT OPERATING CONTRACTS, HALLMARKING THE INCEPTION OF THE COUNTRY'S FIRST EVER INDEPENDENT GEOTHERMAL POWER PROJECTS. THE CONTRACTS ALLOW OPERATIONS FOR 42 YEARS, INCLUDING A PRODUCTION PERIOD OF 30 YEARS. THE BUILD OWN OPERATE CONTRACTS HAVE IN EACH CASE, A PARTNERSHIP EQUITY SPLIT OF 90-10. PERTAMINA PRESENTLY HAS NO

EQUITY STAKE IN ANY OF THE PROJECTS, ITS ROLE BEING TO COLLECT COMPENSATION AS THE RESOURCE HOLDER. THE FOUR PROJECTS ARE AS FOLLOWS:

DIENG: HIMPURNA CALIFORNIA ENERGY LIMITED, A JOINT VENTURE BETWEEN PT HIMPURNA ENERSINDO ABADI (TEN PERCENT) AND CALIFORNIA ENERGY INTERNATIONAL OF THE U.S. (90 PERCENT) WILL UNDERTAKE THIS PROJECT IN CENTRAL JAVA. HIMPURNA, THE INDONESIAN PARTNER, IS A RETIRED SERVICEMEN'S ORGANIZATION HEADED BY SEVERAL RETIRED GENERALS. THE CONTRACT IS FOR A TOTAL POWER CAPACITY OF 400 MW, WITH 220 MW TO BE COMPLETED BY 2001. HIMPURNA CALIFORNIA IS COMMITTED TO SPENDING USD 12 MILLION, AND DRILLING 48 EXPLORATION AND DEVELOPMENT WELLS. THE ENERGY PRICE FOR THE CONTRACT IS AS FOLLOWS:

THE FIRST 14 YEARS: USD 0.07643/KWH)
THE FOLLOWING 8 YEARS: USD 0.05545/KWH

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THE REMAINING 8 YEARS: USD 0.04858/KWH

WAYANG WINDU: THE JOC FOR WAYANG WINDU WAS ORIGINALLY NEGOTIATED AND AWARDED TO PT MANDALA MAGMA NUSANTARA BV, A JOINT VENTURE BETWEEN THE INDONESIAN COMPANIES FIGEARS AND OKO SATRYA MANDALA (BOTH OWNED BY PRESIDENT SOEHARTO'S YOUNGEST SON HUTOMO MANDALA PUTRA), AND MAGMA POWER COMPANY. HOWEVER, AFTER THE MERGER BETWEEN CALIFORNIA ENERGY AND MAGMA POWER COMPANY, THE CONTRACT PRINCIPLE PARTY WAS CHANGED TO ASIA POWER LTD OF NEW ZEALAND. AT THE INITIAL STAGE,THE CONTRACTOR WILL BUILD A 220 MW CAPACITY PLANT AT A COST OF USD 520 MILLION, LATER TO BE INCREASED TO 400 MW, WITH AN ESTIMATED TOTAL INVESTMENT OF USD 800 MILLION. A CAPACITY OF 40 MW MUST BE COMPLETED BY 1998. THE ENERGY PRICE FOR THE CONTRACT IS AS FOLLOWS:

THE FIRST 14 YEARS: USD 0.07.879/KWH)
THE FOLLOWING 8 YEARS: USD 0.05.694/KWH
THE REMAINING 8 YEARS: USD 0.04.973/KWH

KARAHA: KARAHA BODAS COMPANY WILL EXECUTE THIS PROJECT IN WEST JAVA. THE LOCAL PARTNER IS PT SUMARAN DAYA SAKTI; THE U.S. PARTNER IS CAITHNESS RESOURCES INC OF NEW YORK. THE CONTRACT IS FOR A TOTAL PROJECT CAPACITY OF 220 MW WITH 55 MW TO BE COMPLETED BY 1998. THE POWER PRICE FOR THE CONTRACT IS AS FOLLOWS:

THE FIRST 14 YEARS: USD 0.07597/KWH)
THE FOLLOWING 8 YEARS: USD 0.05750/KWH
THE REMAINING 8 YEARS: USD 0.05208/KWH

PATUHA: PATUHA POWER LIMITED IS THE CONTRACTOR FOR THIS WEST JAVA PROJECT. CALIFORNIA ENERGY IS TEAMED WITH PT ENERINDO SUPRA ABADI, WHOSE PRESIDENT IS ENTREPRENUER FADEL MUHAMMAD. THE CONTRACT IS FOR A TOTAL PROJECT CAPACITY OF 220 MW WITH 40 MW TO BE COMPLETED BY 1998. TOTAL INVESTMENT COULD BE AS MUCH AS USD 650 MILLION. THE ENERGY PRICE FOR THE CONTRACT IS AS FOLLOWS:

THE FIRST 14 YEARS: USD 0.07909/KWH)
THE FOLLOWING 8 YEARS: USD 0.05706/KWH
THE REMAINING 8 YEARS: USD 0.04985/KWH

DEVELOPMENT PLANS
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17. PLANNERS EXPECT INDONESIA'S GEOTHERMAL CAPACITY TO INCREASE TO 1,000 MW BY 2000, MAKING IT THE SECOND LARGEST PRODUCER AFTER THE UNITED STATES. THEY FURTHER ANTICIPATE A RISE TO 4,000 MW BY 2020 MAKING THE COUNTRY THE LARGEST PRODUCER OF GEOTHERMAL ENERGY IN THE WORLD. PERTAMINA ESTIMATES THAT THE USE OF GEOTHERMAL ENERGY IN INDONESIA OVER THE 1995 TO 2020 PERIOD WILL BE AS FOLLOWS:

AREA	1995	2000	2005	2010	2015	2020
SUMATRA	2.0	212.0	1,607.0	2,202.0	2,222.0	2,450.0
JAVA-BALI	325.0	952.0	1,667.0	1,930.0	2,120.0	2,450.0
SULAWESI	2.5	42.5	142.5	170.0	190.0	210.0
TOTAL	329.5	1,206.5	3,416.5	4,302.0	4,532.0	5,110.0

18. SOME OF THE PLANNED PROJECTS HAVE BEEN NEGOTIATED WITH INTERESTED PARTIES AND SOME ARE STILL IN THE PLANNING STAGE. THE PLAN INCLUDES THE FOLLOWING PROJECTS:

DARAJAT-2: AMOSEAS IS ATTEMPTING TO CONCLUDE A TOTAL PROJECT CONTRACT FOR THE CONSTRUCTION OF 55 MW GEOTHERMAL POWER PLANT IN DARAJAT, WEST JAVA. THE COMPANY WILL INVEST ABOUT USD 70 MILLION.

KAMOJANG 4,5,6: PERTAMINA AND PLN PLAN TO ADD THREE ADDITIONAL UNITS WITH A COMBINED CAPACITY OF 80 MW. PT LATOKA TRIMASBINA ENERGY, A LOCAL COMPANY, HAS SUBMITTED A PROJECT PROPOSAL FOR THIS PROJECT. DRILLERS HAVE DEFINED RESOURCES SUFFICIENT TO INCREASE THE EXISTING PLANT BY AN ADDITIONAL 110 MW.

ULUUMBU-1: PLN PLANS TO DEVELOP A SMALL SCALE (3MW) GEOTHERMAL POWER PLANT IN ULUUMBU, FLORES. THE NEW ZEALAND GOVERNMENT HAS AGREED TO PROVIDE USD 1.1 MILLION IN AID TO

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INDONESIA AND THE GOI WILL PROVIDE USD 4.1 MILLION FOR THE COST OF THE PROJECT.

SARULLA: UNOCAL IS ALSO EXPLORING THE HIGHLY PROSPECTIVE SARULLA AREA OF NORTH SUMATRA, WHERE THE COMPANY HAS A CONTRACT WITH PERTAMINA TO DEVELOP GEOTHERMAL RESOURCES AND BUILD POWER PLANTS TO GENERATE UP TO 1,000 MW FOR PLN TO DISTRIBUTE TO THE MEDAN POWER GRID. IF THE FIELD PROVES EXPLOITABLE, POWER GENERATION COULD BEGIN AROUND 2000.
LAMPUNG: PERTAMINA IS ALSO LOOKING INTO ESTABLISHING A GEOTHERMAL PLANT IN LAMPUNG, SUMATRA. THE EXPLORATORY STAGE WILL TAKE ABOUT THREE TO FIVE YEARS DURING WHICH THREE WELLS WILL BE DRILLED FOR PRODUCTION. THE ENTIRE PROJECT WILL BE COMPLETED IN 1998. THE PLANT WILL THEN YIELD 20 MW OUT OF THE 300 MW FIELD POTENTIAL.

BALI: CALIFORNIA ENERGY AND THE PANUTAN GROUP, 60 PERCENT OWNED BY SIGIT, PRESIDENT SOEHARTO'S ELDEST SON, ENDORSED A MEMORANDUM OF UNDERSTANDING TO BUILD A USD 220 MILLION 110

MW GEOTHERMAL PLANT IN BALI. THIS CONTRACT IS CURRENTLY UNDER NEGOTIATION.

PT GEOTHERMAL

19. PLN IS CONSIDERING ESTABLISHING A NEW COMPANY, PT GEOTHERMAL INDONESIA, TO HANDLE GEOTHERMAL POWER PROJECTS AND SEEKING TO LOWER THE SELLING RATES OF GEOTHERMAL ELECTRICITY. THE COMPANY WOULD ALSO INVOLVE PRIVATE COMPANIES IN ITS OPERATION. AN INITIAL OPERATION FOR THE COMPANY WILL BE THE CONSTRUCTION OF THE THIRD AND FOURTH UNITS OF THE KAMOJANG PLANT. SUBSEQUENTLY, PT GEOTHERMAL WILL UNDERTAKE THE FOLLOWING PROJECTS: SIBAYAK (2 X 20 MW), LAHENDONG (2 X 20 MW), DARAJAT (2 X 55 MW), AND GUNUNG SALAK (55 MW). VINCENT RADJA, HEAD OF PLN'S GEOTHERMAL DIVISION, HAS TOLD THE PRESS THAT PT GEOTHERMAL WILL ENDEAVOR TO OBTAIN MUCH LOWER SELLING RATES, PERHAPS AS LOW AS SIX TO SEVEN CENTS PER KWH.

APPENDIX: SOME MAJOR TERMS AND PROVISIONS OF A JOC

A. EXPLORATION PERIOD INCLUDING FEASIBILITY STUDY: SEVEN YEARS COMMENCING ON THE EFFECTIVE DATE

B. PRODUCTION PERIOD FOR DELIVERY OF GEOTHERMAL ENERGY TO OR ELECTRICITY FROM EACH UNIT IS 30 YEARS STARTING ON THE DATE OF COMMERCIAL GENERATION

C. THE RUNNING OF THE CONTRACT TERM IS FOR A PERIOD ENDING 42 YEARS AFTER THE EFFECTIVE DATE

D. CONTRACT AREA SHOULD BE SURRENDERED 20 PERCENT AT THE END OF THE THIRD CONTRACT YEAR

E. A FURTHER 30 PERCENT OF THE ORIGINAL CONTRACT AREA SHOULD BE SURRENDERED AT THE END OF THE SEVENTH CONTRACT YEAR

F. CONTRACTOR SHOULD COMMENCE GEOTHERMAL OPERATION WITHIN SIX MONTHS OF THE EFFECTIVE DATE

G. CONTRACTOR SHOULD SPEND A SPECIFIED AMOUNT OF MONEY DURING THE FIRST SEVEN YEARS EXPLORATION PERIOD

H. CONTRACTOR SHOULD PREPARE AND SUMMIT TO PERTAMINA FOR APPROVAL A WORK PROGRAM AND ESTIMATE OF THE EXPENDITURES REQUIRED FOR THE CONTRACT AREA.

I. CONTRACTOR SHOULD OPERATE AND MAINTAIN THE FIELD FACILITIES AND ELECTRICITY GENERATION FACILITIES

J. ALL ELECTRICITY PRODUCED PURSUANT TO GEOTHERMAL OPERATIONS SHOULD BE DELIVERED TO THE POINT OF INTERCONNECTION AND SOLD TO BUYER UNDER THE TERMS OF ENERGY SALES CONTRACT

K. CONTRACTOR SHOULD PAY TO THE GOVERNMENT CORPORATE TAX IN RESPECT OF ANNUAL PROFITS

L. CONTRACTOR SHOULD PAY TO PERTAMINA A PRODUCTION ALLOWANCE EQUIVALENT TO FOUR PERCENT OF NET OPERATING INCOME
M. PERTAMINA OR A LOCAL FIRM IS ABLE TO TAKE UP TO 15 OR 25 PERCENT EQUITY AFTER NOTICE OF DEVELOPMENT IS PROVIDED.

(NOTE: MANY OF THE MOST PROSPECTIVE SITES HAVE ALREADY BEEN
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USDOE FOR 0I-141 TOM CUTLER

TOKYO FOR RRO

E.O. 12356: N/A
TAGS: ENRG, EINV, KNTB, ID

SUBJECT: GEOTHERMAL ENERGY IN INDONESIA: A GUIDE FOR INVESTORS

ALLOCATED TO LOCAL COMPANIES. THESE FIRMS ARE LOOKING FOR FOREIGN PARTNERS TO ASSIST IN DEVELOPING THE SITES.)

TABLE 1: INDONESIA'S GEOTHERMAL POTENTIAL (IN MW)

AREA	INSTALLED	PROVEN	PROBABLE	RESOURCE
JAVA/BALI:	197.2	895	4,920	8,100
KAMOJANG	142	210	300	462
DIENG	2.2	285	575	1,430
SALAK	55	280	370	600
DARAJAT	-	120	250	420
WAYANG WINDU	-	-	260	420
PATUHA	-	-	-400	685
TELAGA BODAS	-	-	-200	300
KARAHA	--	-	200	250
WILIS	-	-	100	170
BALI	-	-	215	325
OTHERS	-	-	2,050	3,400

SUMATRA	-	-	3,595	4,885	
SIBAYAK	-	-	140	240	
SARULLA	-	-	280	380	
SIBUALBUALI	-	-	600	750	
KERINCI	-	-	75	115	
OTHERS	-	-	2,500	3,400	
SULAWESI:	2.5	65	955	1,500	
LAHENDONG	2.5	65	175	300	
TOMPASO	-	-	230	400	
KOTAMOBAGU	-	-	200	300	
OTHERS	-	-	550		500
OTHERS	-	-	1,050	1,550	
GRAND TOTAL	199.7	960	10,520	16,035	

SOURCE: PERTAMINA (1994)

TABLE 2: GEOTHERMAL DEVELOPMENT PROJECTS

PROJECT/CAPACITY	DEVELOPER	STATUS
A. LARGE SCALE:		
1. SALAK-3 (55 MW)	PLN	UNDER DEVELOPMENT
2. SALAK-4,5,6 (165MW)	UNOCAL	UNDER DEVELOPMENT
3. SIBAYAK-1 (22 MW)	PLN	UNDER NEGOTIATION
4. ULUUMBU-1,2 (40 MW)	PLN	UNDER NEGOTIATION
5. KAMOJANG-4,5,6 (80 MW)	PT. LATOKA ENERGY	PROPOSAL
6. DARAJAT-2 (55 MW)	AMOSEAS	PROPOSAL
7. DIENG-1,2,3 (165 MW)	HIMPURNA/CE	EXPLORATION STARTED
8. PATUHA-1 (55 MW)	PT ESA/CE	EXPLORATION STARTED
9. KARAHA-1 (55 MW)	PT SUMARAH	EXPLORATION STARTED
10. WAYANG WINDU-1,2 (40 MW)	HUMPUS	INITIAL APPROVAL
11. BEDUGUL-1,2 (110 MW)	PT PANDAN WANGI	CONTRACT NEGOTIATION
12. LUMUT BALAI-1,2 (40 MW)	N/A	TENDERING
B. SMALL SCALE:		
1. PATUHA-1 (10 MW)	TEKNOSA COOPERATIVE	
2. AMBON-1 (5 MW)	PLN	
3. SEMBALUN-1 (3 MW)	PLN	
4. ULUUMBU-1 (3 MW)	PLN	

5. SUMBAWA-1 (2.5 MW) PLN
6. LEMPUR-1 (0.4 MW) PLN

SOURCE: GEOTHERMAL DEVELOPMENT TEAM

TABLE 3: KEY CONTACTS FOR GEOTHERMAL DEVELOPMENT

GEOTHERMAL DEVELOPMENT TEAM:

CHAIRMAN:
DR. IR. POERNOMO YUSGIANTORO
EXPERT STAFF TO THE MINISTER OF MINES AND ENERGY ON
ENERGY AFFAIRS
JL. MERDEKA SELATAN 18, JAKARTA
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INFO RUCPCIM/CIMS NTDB WASHDC
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RUEHKO/AMEMBASSY TOKYO 1249
RUCPDC/USDOC WASHDC
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E.O. 12356: N/A
TAGS: ENRG, EINV, KNTB, ID

SUBJECT: GEOTHERMAL ENERGY IN INDONESIA: A GUIDE FOR INVESTORS

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FOCUS ON

DRAFT

INDONESIA

A GEOTHERMAL INTERNATIONAL SERIES

SPONSORED BY:

U.S. DEPARTMENT OF ENERGY
GEOTHERMAL TECHNOLOGY DIVISION (GTD)

PREPARED FOR:

LOS ALAMOS NATIONAL LABORATORY
UNDER CONTRACT NO. 9-X36-3652C

PREPARED BY:

MERIDIAN CORPORATION
4300 KING STREET, SUITE 400
ALEXANDRIA, VIRGINIA 22302-1508

PREFACE

The *Focus on* Series is prepared to give the U.S. Geothermal Industry a quick profile of several foreign countries. The countries depicted were chosen for both their promising geothermal resources and for their various stages of geothermal development, which can translate into opportunities for the U.S. geothermal industry. The series presents condensed statistics and information regarding each country's population, economic growth and energy balance with special emphasis on the country's geothermal resources, stage of geothermal development and most recent activities or key players in geothermal development. The series also offers an extensive list of references and key contacts, both in the U.S. and in the target country, which can be used to obtain detailed information.

The series is available for the following countries:
Argentina, Azores (Portugal), China, Costa Rica, Ecuador, El Salvador, Ethiopia, Guatemala, Honduras, Indonesia, Jordan, Mexico, St. Lucia, Thailand.

Additional countries might be available in the future.

The series is to be used in conjunction with four other publications specifically designed to assist the U.S. geothermal industry in identifying and taking advantage of geothermal activities and opportunities abroad, namely:

- The *"Review of International Geothermal Activities and Assessment of U.S. Industry Opportunities."* Final Report, August 1987. Prepared for Los Alamos National Laboratory.

- The *"Summary Report"* of the above publication.

- *"Equipment and Services for Worldwide Applications,"* U.S. Department of Energy.

- The *"Listing of U.S. Companies that Supply Goods and Services for Geothermal Explorers, Developers and Producers Internationally,"* August 1987, prepared by GRC.

Copies of these publications can be obtained from the Geothermal Technology Division of the U.S. Department of Energy. Correspondence should be addressed to:

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Washington, DC 20585
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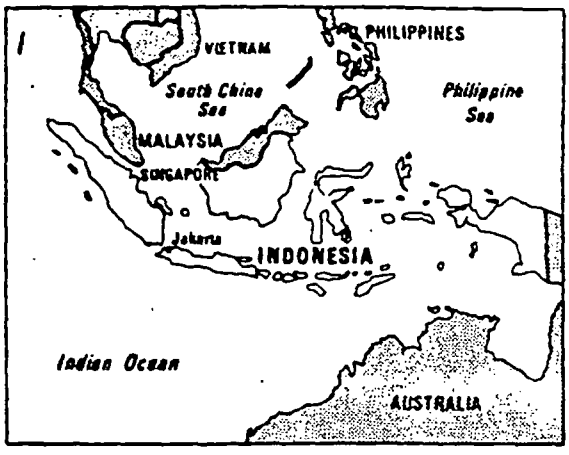
FOCUS ON INDONESIA



Official Name: Republic of Indonesia

Area: 2.0 million sq. km. (736,000 sq. mi.)

Capital: Jakarta

Population (1985): 162.2 million

Population Growth Rate: 2.1%

Languages: Indonesian

Economic Indicators:

Real GDP (1984): $90 billion
Real Annual Growth Rate (1984): 3%
Per Capita Income (1984): $566
Avg. Inflation Rate (1984): 8.8%

Trade and Balance of Payments:

(1984) Exports: $21.9 billion; Major Markets: Japan, U.S., Singapore
(1984) Imports: $13.8 billion; Major Suppliers: Japan, U.S., Thailand

(December 1985) Official Exchange Rate: 1,125 rupiahs = U.S. $1

Energy Profile: (Based on 1982 data unless otherwise indicated)

- Commercial Fuel Energy Consumption:

  Total: 24.908 million ton of oil equivalent (mtoe)
  1-Yr. Growth: 5.3%

- Commercial Fuel Breakdown:

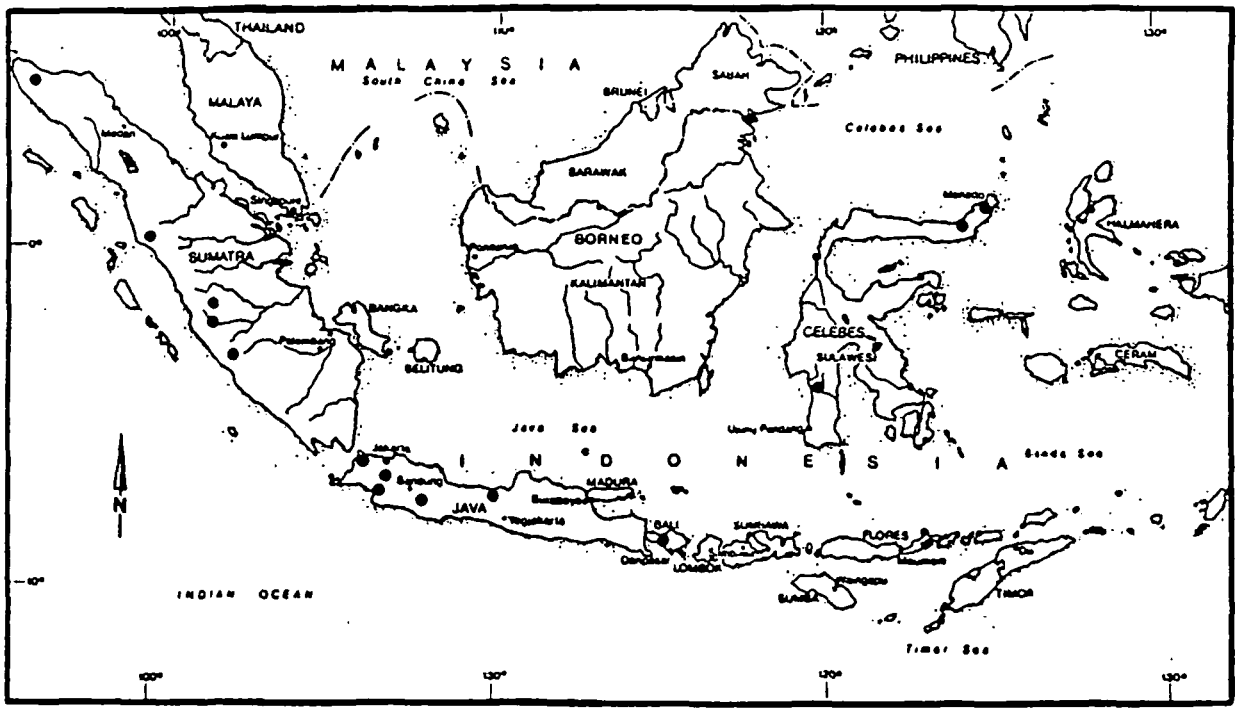
  Liquid Fuels Pct: 79%
  Solid Fuel Pct: 1%
  Natural Gas Pct: 17%
  Electric Pct: 4%
  Commercial Fuel Consumption Growth Rate (1970-1980): 8.8%

GEOTHERMAL RESOURCES

The Indonesian archipelago is the result of subduction of oceanic crust and island arc volcanism that has created an extensive chain of volcanic islands in the Indian Ocean. Since it is one of the most active volcanic countries in the world, geothermal studies began as early as 1918 by the predecessor agency to the Volcanological Survey of Indonesia (VSI). These investigations resulted in the drilling of five exploration wells in the Kamojang area of West Java during the period of 1926 to 1928. Although these wells were never utilized and the project was abandoned, a new energy resource had been assessed.

Between 1964 and 1974, several foreign geothermal teams helped Indonesia realize its geothermal potential. Groups such as the UNESCO Volcanological Mission, the U.S. Geological Survey, EURAFREP (France), and GENZL (New Zealand) helped advance Indonesian geothermal exploration. The Geological Survey of Indonesia, the Indonesian Power Research Institute, and the Geothermal Division of Pertamina (the government oil and gas company) have also conducted surveys to evaluate the geothermal potential of Indonesia.

Geothermal energy potential in Indonesia has been estimated to be 10,000 MWe for a 25 year period, primarily concentrated in Java. Presently, geothermal systems provide dry steam to one central plant (30 MWe) and two wellhead units (2.25 MWe). Units 2 and 3 at Kamojang, (55 MWe) each, are under construction and will be on-line by mid-1987 and early 1988. Advanced plans call for an additional 855 MW of geothermal power on-line by 1994.



Source: GENZL, 1986, Geothermal Fields in Indonesia.

Indonesia's Ministry of Mines and Energy and Japan's state-owned New Energy Development Organization (NEDO) will explore jointly Central Sumatra over a 3-year period. The project will concentrate in Rokan, Cerenti and Sinamax. Exploration cost will be shared. NEDO estimates its budget to be around $1.8 million. Japan will provide technology if the fields prove to be commercial.

Other geothermal field currently undergoing various stages of exploration include: Bali, Palabuhan Ratu, Gunung Patuha, Gunung Ijen, Gunung Wayang Windu, Gunung Tampomas, Cilayu-Bungbulang, Kawah Karaha, Gunung Endut, Gunung Slamet, Gunung Ungaran, Gunung Muria, Gunung Wilis, Gunung Arjuno-Welirang, and Gunung Lamongan.

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Soetantri, B., 1986, "The Status of Geothermal Development in Indonesia," Geothermal Resources Bulletin, April, pp. 3-14.

World Solar Markets, 1984, "Indonesia Studies Geothermal Potential." July, p. 12.

Marsuan, 1986, "Methodology of Geothermal Exploration and Development in Indonesia." A country paper presented at the U.N. Workshop on the Development and Exploitation of Geothermal Energy in Developing Countries. Iceland and Italy, 15-24 September 1986.

REFERENCES

AND

KEY CONTACTS

B. Geothermal-Related Sources of Information

The following reports and documents are suggested for further information regarding geothermal energy and export opportunities overseas:

Los Alamos National Laboratory:

- Review of International Geothermal Activities and Assessment of U.S. Industry Opportunities

U.S. Department of Energy

- Equipment and Services for Worldwide Applications
- Guide to the International Development and Funding Institutions for the U.S. Renewable Energy Industry
- Federal Export Assistance Programs Applicable to the U.S. Renewable Energy Industry
- International Data Base for the U.S. Renewable Energy Industry
- Committee on Renewable Energy Commerce and Trade: CORECT's Second Year - October 1985-November 1986

California Energy Commission (CEC)

- Foreign Geothermal Energy Market Analysis
- Small Scale Electric Systems Using Geothermal Energy: A Guide to Development

U.S. Department of Commerce - International Trade Administration

- A Competitive Assessment of the U.S. Renewable Energy Equipment Industry

U.S. Export Council for Renewable Energy

- International Renewable Energy Industry Trade Policy

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Indonesia

USIND.BP
Topics for Discussion on Organization of USGIC

Dennis L. Nielson
July 25, 1993

U.S. Geothermal Industries Corporation (USGIC)

USGIC is the parent organization and provides the Certificate of Review with the US Department of Commerce under which all USGIC firms operate. It is viewed that, when successful, USGIC will be the catalyst for project generation, providing initial marketing and project definition expertise.

USGIC will derive income from separate operating companies that are established as outlined in the following sections. Although the following plan is specifically written to cover Indonesian projects, it is viewed that it will become a model for USGIC operations.

USGIC INDONESIA, INC.

Objectives

1. Establish a separate, subsidiary company that will limit the liability of USGIC.

2. Form a management team and Board that is knowledgeable about the project and who can act and react quickly.

3. Establish a company that will enter into business relationships with financial partners and foreign corporations.

4. Percentage of profits will be assigned to USGIC.

5. Utilize expertise, products and resources of member companies.

6. Maintain confidentiality of business relationships, resource data, etc.

7. Provide a mechanism for shareholder companies to invest and participate in projects which they would/could not undertake on their own.

Procedure

1. Establish USGIC INDONESIA as a Delaware Corporation and subsidiary of USGIC.

2. Board of Directors

The Board will be made up of a select group of people with expertise in the project. It is expected that financial partners may eventually be represented on the Board. The President of USGIC will be a Board member *(ex officio)*. Board member will receive compensation for their services as soon as possible.

3. Officers and Management

The management will be initially staffed from member companies. If successful, these will become full-time paid positions as soon as possible.

4. Agreement with USGIC

A formal agreement will be signed with USGIC to provide for the following:

a. Sharing of profits
b. Pay-back of start-up costs to USGIC shareholders
c. Utilize USGIC shareholder companies' products and services whenever possible.

5. Agreement between start-up participants

Commitment on the front-end of projects is highly valued. Those companies that start projects have a preferred interest. They should be represented on the project team/Board/Officers of the new company.

At company formation, agreement should be made concerning the allocation of responsibilities/work amongst parties. Disputes should be resolved via negotiations. Stock and positions/work should be allocated to compensate for front-end, uncompensated activities.

DEPARTMENT OF ENERGY
WASHINGTON, DC 20585

FACSIMILE TRANSMISSION

DATE: March 6, 1995

TO: Dr. Phillip M. Wright
University of Utah, ESRI
391 Chipeta Way, Suite C
Salt Lake City, UT 84108-1295

TELEFAX: 801-584-4453

6 PAGES FOLLOW.

There will be a meeting in Jakarta in August for the Bilateral Agreement. I am working with Tom Cutler, International, to get the Secretary to go and to visit geothermal fields.

Marshall Reed
Geothermal Division
EE-122

202-586-8076

Telefax: 202-586-8185

Department of Energy
Washington, DC 20585

February 3, 1995

ACTION MEMORANDUM

TO: Lowell Miller
Donna Bobbish
Len Coburn
Dave Meyer
John Brodman

FROM: Susan F. Tierney

SUBJECT: Follow-Up to December 13-14, 1994, U.S.-Indonesia Bilaterals

As you can see from the attached letter from Mr. Soemarso of Indonesia, the Indonesians wish to pursue several of the issues we discussed during the bilaterals. We need to provide Mr. Soemarso with a substantive response, and in some cases, with an action plan for follow-up activities.

I would appreciate it if you could provide me with your plans for follow-up to the Indonesia bilaterals by March 1, 1995 as outlined below:

Clean Coal Technology:	Lowell Miller
Domestic Gas Regulation:	Donna Bobbish
Removing Offshore Oil Platforms:	Len Coburn
Integrated Resource Planning & Demand Side Management	Dave Meyer
Energy Technology Cooperation	John Brodman

Thanks!

If you have any questions, please call Tom Cutler at 586-6156. Thank you for your assistance.

Attachment
Letter from Mr. Soemarso to Tom Cutler

REPUBLIC OF INDONESIA
DEPARTMENT OF MINES AND ENERGY
18, Jalan Merdeka Selatan - Jakarta

Telex : 44369IA
Cable Address : Deperambon. P.O. BOX 344/Jkt. Phone : 3804242

January 9, 1995

U.S. Department of Energy
Attn. Mr. Tom Cutler
Office of International Affairs
Washington, D.C.
U.S.A.

Subject : Issues for follow up

Dear Tom :

Thank you for all nice arrangements during our recent Bilateral meeting. Happy New Year, Hope things are getting better in 1995.

If I could summarize, from our last meeting there are at least 4 (four) issues needing our attention :

1. Clean Coal Technology (CCT)

As a follow up ot the meeting we have assigned Mineral Technology R&D Centre (MTRDC) in Bandung as a coordinator in the subject of CCT within the MME.

The address is :
MTRDC
Jl. Jen. Sudirman 623
Bandung
Fax No. : (022) 614 158
Director : Dr. Ukar W. Soeliscijo M.Sc

As noted in the mission report on CCT there will be some activities from your side. If you have any plan, please coordinate through MTRDC, with a copy to me.

2. Domestic Gas Regulation

The follow up on this issue may be the sending of your team to discuss further with Directorate General of Oil & Gas (DGOG) and PGN. If you have any plan, please let me know.

3. Obsolete Offshore Platforms

Your Team should discuss further with DGOG, Pertamina and Representatives of Petroleum Production Contractors.

4. IRP and DSM

At this moment a total of 12 experts from PLN is attending seminar on this subject in the U.S. under the arrangement with USAID.
If you have any further plan please let me know.

I would like to propose that we update our business at least every three months, so that we will have better results to be reported in the next bilateral meeting in Indonesia. I think the meeting will be after August, because of the big celebration on half a century of Indonesian Independence.

I left some books with Embassy to be sent by diplomatic bag. Could you check with Mr. Rahardjo its status.

With my best regard,

Sincerely yours,

Chris Soemarso

P

RECORD OF DISCUSSION

BETWEEN

MINISTER GINANDJAR KARTASASMITA

DEPARTMENT OF MINES AND ENERGY

AND

JAMES D. WATKINS, ADMIRAL U.S. NAVY (Retired)

SECRETARY OF ENERGY

U.S. DEPARTMENT OF ENERGY

CONCERNING THE ESTABLISHMENT OF ENERGY CONSULTATIONS

BETWEEN

THE GOVERNMENT OF THE REPUBLIC OF INDONESIA

AND

THE GOVERNMENT OF THE UNITED STATES OF AMERICA

JUNE 20, 1990

PARAGRAPH I

Within the framework of common interest and mutual benefit of both countries, the Indonesian Minister of Mines and Energy and the U.S. Secretary of Energy have agreed to establish an Indonesian-American Sub-Ministerial Working Group on Energy which will conduct energy consultations between the two countries (hereafter referred to as the "group"). The purpose of this group is to enhance the objectives of long-term consultations and understanding on energy issues, and to promote the exchange of information on energy, including renewable energy resource development, by consultations through their national agencies responsible for energy, namely the Department of Mines and Energy of the Republic of Indonesia and the Department of Energy of the United States of America (hereafter referred to as the "executing agencies").

PARAGRAPH II

The objectives of this group include consultations:

a) To discuss current and prospective energy developments in both countries, the ASEAN and Pacific Rim region, and the world at large.

b) To facilitate an exchange of information and assessments on energy demand and supply forecasts for the two countries.

c) To exchange views on energy policies and to discuss programs of both countries relating to the exploration, development, management, and environmental concerns of major energy resources such as, but not limited to, petroleum, coal, natural gas, geothermal, and nuclear.

d) To review and exchange information on energy technologies and applied energy research and development.

PARAGRAPH III

For the purpose of promoting closer contacts and mutually beneficial consultations, the arrangement will be as follows:

a) The group will consist of senior sub-ministerial officials from the executing agencies.

b) Each executing agency will appoint an administrative secretary who will make preparations for meetings and who shall have responsibility for maintaining mutual contact during the time when meetings are not held.

PARAGRAPH IV

The work program of the group will adhere to the following procedures:

a) The meeting will be held at least annually, alternately in Indonesia and the United States of America.

b) Special meetings may be held if both executing agencies so decide.

c) The time of the meetings will be determined at least one month in advance according to consultations between the executing agencies.

d) The matters to be discussed at the meetings will be mutually determined by the executing agencies.

PARAGRAPH V

These consultations will be held in accordance with the laws and regulations in force in the respective countries of the signatory governments.

PARAGRAPH VI

These consultations will not affect existing arrangements in place or under discussion between American and Indonesian organizations, or involving the executing agencies as of the date on which this has been agreed.

PARAGRAPH VII

The purposes of the group's energy consultations may be amended at any time with the mutual consent in writing of the two governments.

Signed in duplicate at Washington, D.C., this 20th day of June 1990.

FOR THE DEPARTMENT OF ENERGY OF THE UNITED STATES OF AMERICA

John D. Watkins

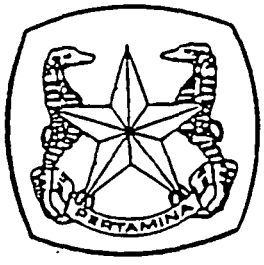
SECRETARY OF ENERGY

FOR THE GOVERNMENT OF THE REPUBLIC OF INDONESIA

Kaltum

MINISTER OF MINES AND ENERGY

PERTAMINA



INDONESIA
GEOTHERMAL RESOURCE AND DEVELOPMENT
1992

DIRECTORATE OF EXPLORATION & PRODUCTION
PERTAMINA

JL. KRAMAT RAYA 59
JAKARTA 10450, INDONESIA
PO BOX 307

CONTENTS

FOREWORD

Indonesia is fortunate to be potentially rich in natural resources with a variety of energy sources namely: Oil, Gas, Coal, Hydro, Geothermal etc.

In terms of geothermal energy the total potential is estimated to be more than 16,000 MW spread over the country along the volcanic belt.

The increasing development of industries in Indonesia leads to an increasing demand of electricity. With those huge potential, geothermal is a significant alternative energy to be developed to meet the domestic energy demand.

Under the Government regulation, PERTAMINA, the State Oil and Gas Company, has the right to carry out exploration and exploitation of the geothermal resources for energy / electricity generation in Indonesia.

In this context, third interested parties are allowed to operate the fields under Joint Operation Contracts (JOC's) with PERTAMINA in carrying out exploration, exploitation and energy / electricity generation.

1. GOVERNMENT REGULATION

Recently, the Government has issued a Presidential Decree (Kep.Pres) No. 45 / 1991 as an improvement of the old regulation, the Presidential Decree (Kep.Pres) No. 22 / 1981.

Based on this new regulation PERTAMINA is allowed to sell the geothermal products which are steam or electricity not only to PLN, the State Electricity Company, but also to other bodies, i.e. Government or Private Companies (Industries) including Cooperative Bodies.

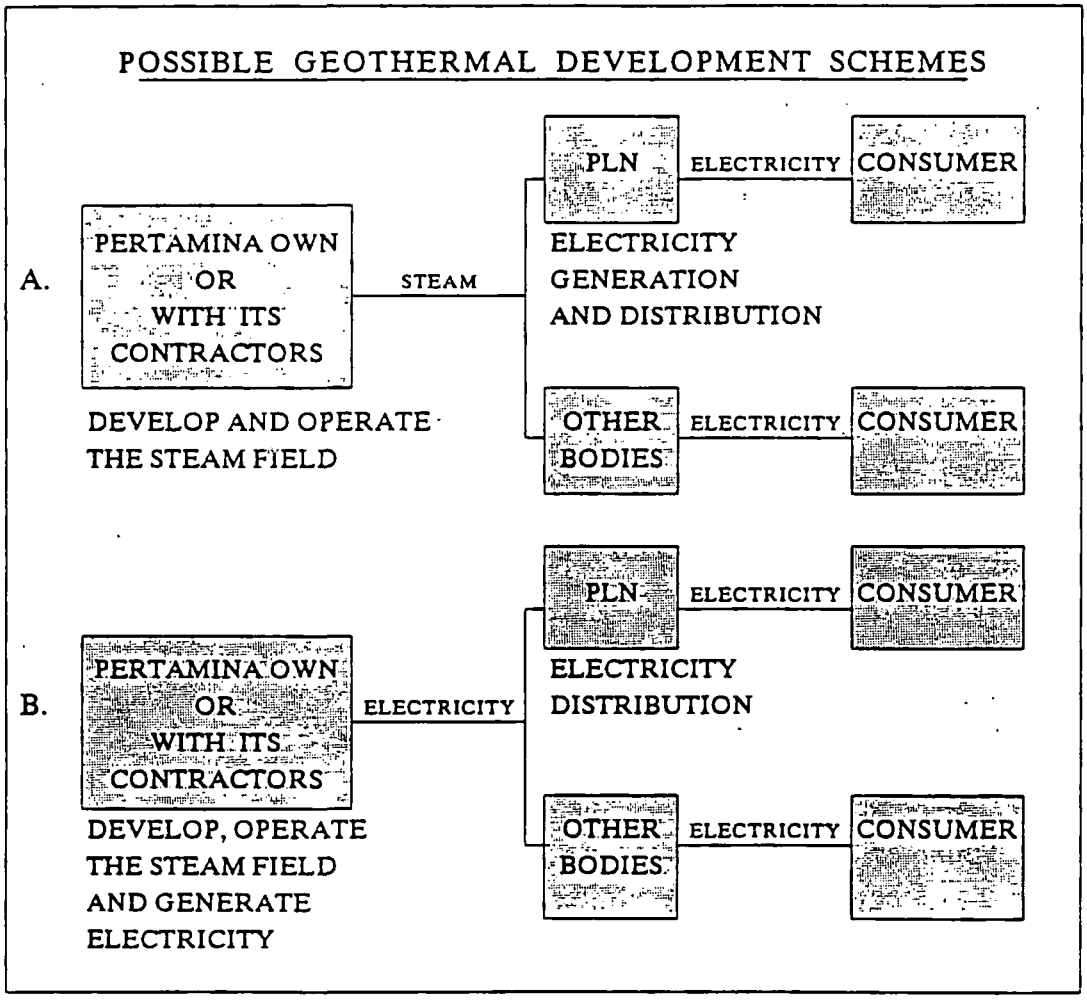
From the fiscal aspect, the Government has also issued another Presidential Decree (Kep.Pres) No. 49 / 1991 which gives incentives to any company developing geothermal energy. The total payment (taxes) to the Government under this regulation is 34 % of the Net Operating Income.

2. DEVELOPMENT SCHEME

Some possible schemes could be applied in the geothermal energy development in Indonesia.

A. PERTAMINA - own or with its Contractors develop and operate the steam field to produce geothermal steam. The steam could be sold to PLN or to other bodies which will generate the electricity and distribute it to the costumers.

B. PERTAMINA - own or with its Contractors develop, operate the steam field and generate electricity.
The produced electricity could be sold to either PLN or other bodies which will distribute it to the consumers.



3. PRESENT STATUS (1991)

Geothermal exploration and exploitation have been intensively carried out in Java, Sumatera and Sulawesi.

Scientific Survey works indicated a possible reserves of about 10,520 MW or about 66 % of the total estimated potential of 16,000 MW.
However, exploration drillings are still limited in some fields in Java and North Sulawesi, giving a proven reserve of about 1,155 MW.

GEOTHERMAL EXPLORATION
1991 STATUS

(IN MW)

ISLAND	RESOURCES	POSSIBLE RESERVE	PROVEN RESERVE
JAVA	8,100	4,920	1,090
SUMATERA	4,885	3,595	-
SULAWESI	1,500	955	65
OTHERS	1,550	1,050	-
TOTAL	16,035	10,520	1,155

The total installed geothermal power plant up to now is only 142.25 MW from two developed fields in Java namely; Kamojang in West Java (140.25 MW) and Dieng in Central Java (2 MW). The 140 MW unit at Kamojang is operated commercially. Those fields are operated by PERTAMINA - Own.

4. EXISTING J.O.C

The first JOC was signed in 1982 between PERTAMINA and UNOCAL as the Contractor to develop Salak field in West Java. This was followed by another JOC between PERTAMINA and AMOSEAS in 1984 for development of Darajat field, also in West Java.

Under those two JOC'S, PERTAMINA and its Contractors will develop and operate the steam fields, and sell the steam to PLN which will generate and distribute electricity.

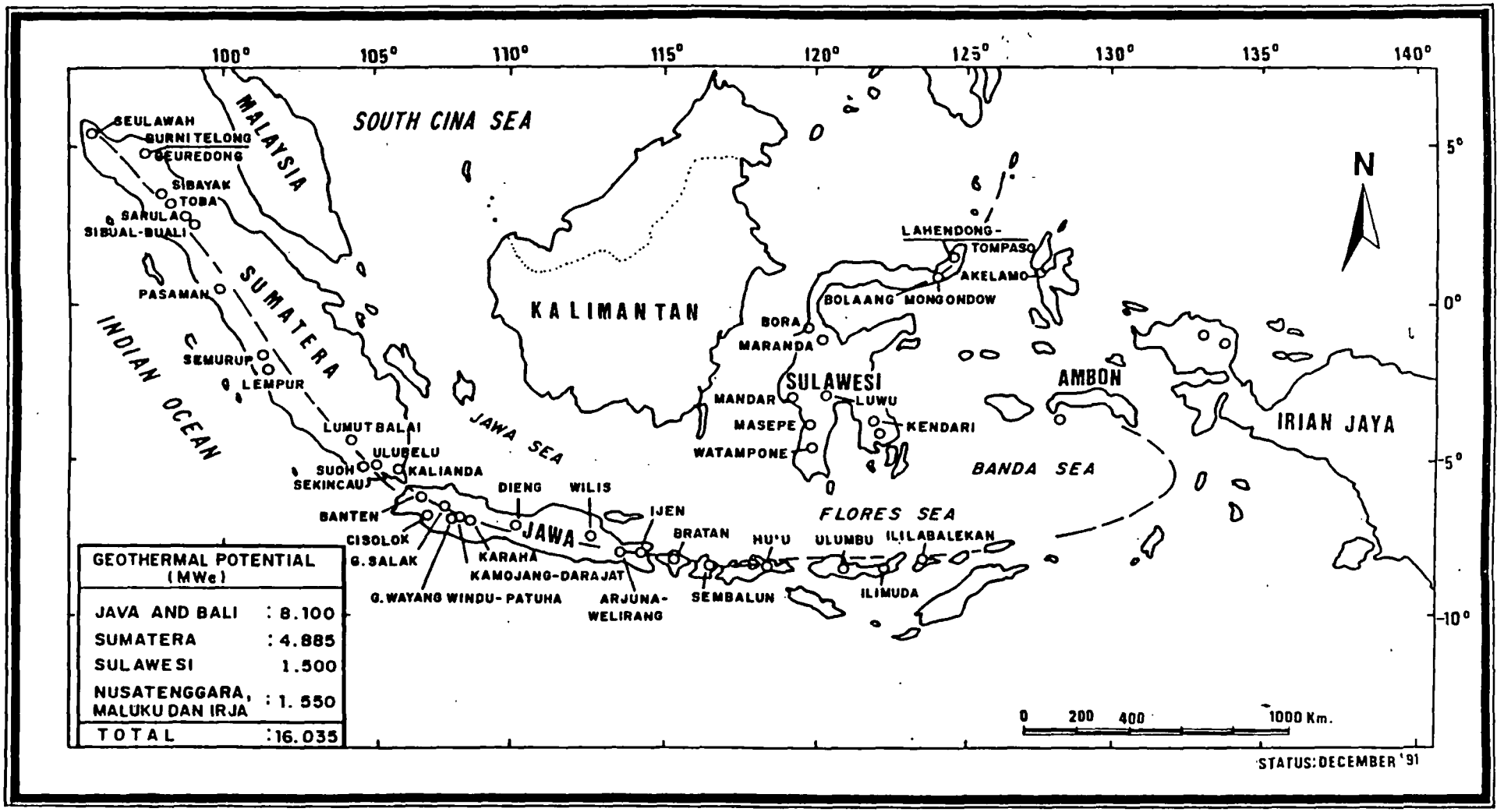
For the first stage it is scheduled to develop Salak and Darajat fields for generation of 2 x 55 MW and 1 x 55 MW respectively.

GEOTHERMAL RESOURCES IN INDONESIA (DECEMBER 1991)

AREA	INSTALLED CAPACITY (MW)	RESERVES (MWe)		RESOURCES (MWe)
		PROVEN	POSSIBLE	
SUMATERA				
1. SIBAYAK	-	-	140	240
2. SARULLA	-	-	280	380
3. SIBUAL-BUALI	-	-	600	750
4. KERINCI	-	-	75	115
5. OTHERS	-	-	2500 *	3400 **
SUB TOTAL	-	-	3595	4885
JAVA AND BALI				
1. KAMOJANG	140.25	205	200	300
2. DIENG	2	285	575	1430
3. SALAK	-	230 + 50	370	600
4. DARAJAT	-	120	250	420
5. WAYANG-WINDU MALABAR	-	200	260	420
6. PATUHA	-	-	400	685
7. TALAGA BODAS	-	-	200	300
8. KARAHA	-	-	200	250
9. NGEBEL-WILIS	-	-	100	170
10. BALI	-	-	215	325
11. OTHERS	-	-	2150 *	3200 **
SUB TOTAL	142.25	1090	4920	8100
SULAWESI				
1. LAHENDONG	-	65	175	300
2. TOMPASO	-	-	230	400
3. KOTAMOBAGU	-	-	200	300
4. OTHERS	-	-	350 *	500 **
SUB TOTAL		65	955	1500
OTHER ISLANDS				
1. ULUMBU	-	-	200	350
2. OTHERS	-	-	850 *	1200 **
SUB TOTAL	-	-	1050	1550
TOTAL	142.25	1155	10520	16035

*) Asumption : A = 14 km2 and **) A = 20 km2 / prospect

GEOTHERMAL DISTRIBUTION MAP IN INDONESIA



GEOTHERMAL POTENTIAL (MWe)	
JAVA AND BALI	: 8.100
SUMATERA	: 4.885
SULAWESI	1.500
NUSATENGGARA, MALUKU DAN IRJA	: 1. 550
TOTAL	:16.035

5. COMMITTED PROGRAM TO 1995 / 1996

Within the next 4 - 5 years, a total additional plant of about 295 MW will be installed as shown in the Table below :

ADDITIONAL INSTALLED PLANT
SCHEDULED UP TO 1995 / 1996

PERTAMINA OWN	
KAMOJANG, WEST JAVA (UNIT - 4)	55 MW
DIENG, CENTRAL JAVA (UNIT - 1)	55 MW
LAHENDONG, NORTH SULAWESI (UNIT - 1)	20 MW
J . O . C	
SALAK, WEST JAVA (UNIT - 1,2)	110 MW
DARAJAT, WEST JAVA (UNIT -1)	55 MW
TOTAL	295 MW

6. FUTURE PLANNING PROGRAM TO THE YEAR 2000

In Sumatera, recent scientific survey works has indicated some "Giant" geothermal prospects. In relation with the trend of the industrial growth rate in Indonesia, Sumatera seems to be the next island for future geothermal development after Java.

PERTAMINA has anticipated this trend by carrying out intensive exploration, and the first deep exploratory well will be drilled at Sibayak prospect in North Sumatera in January 1992.

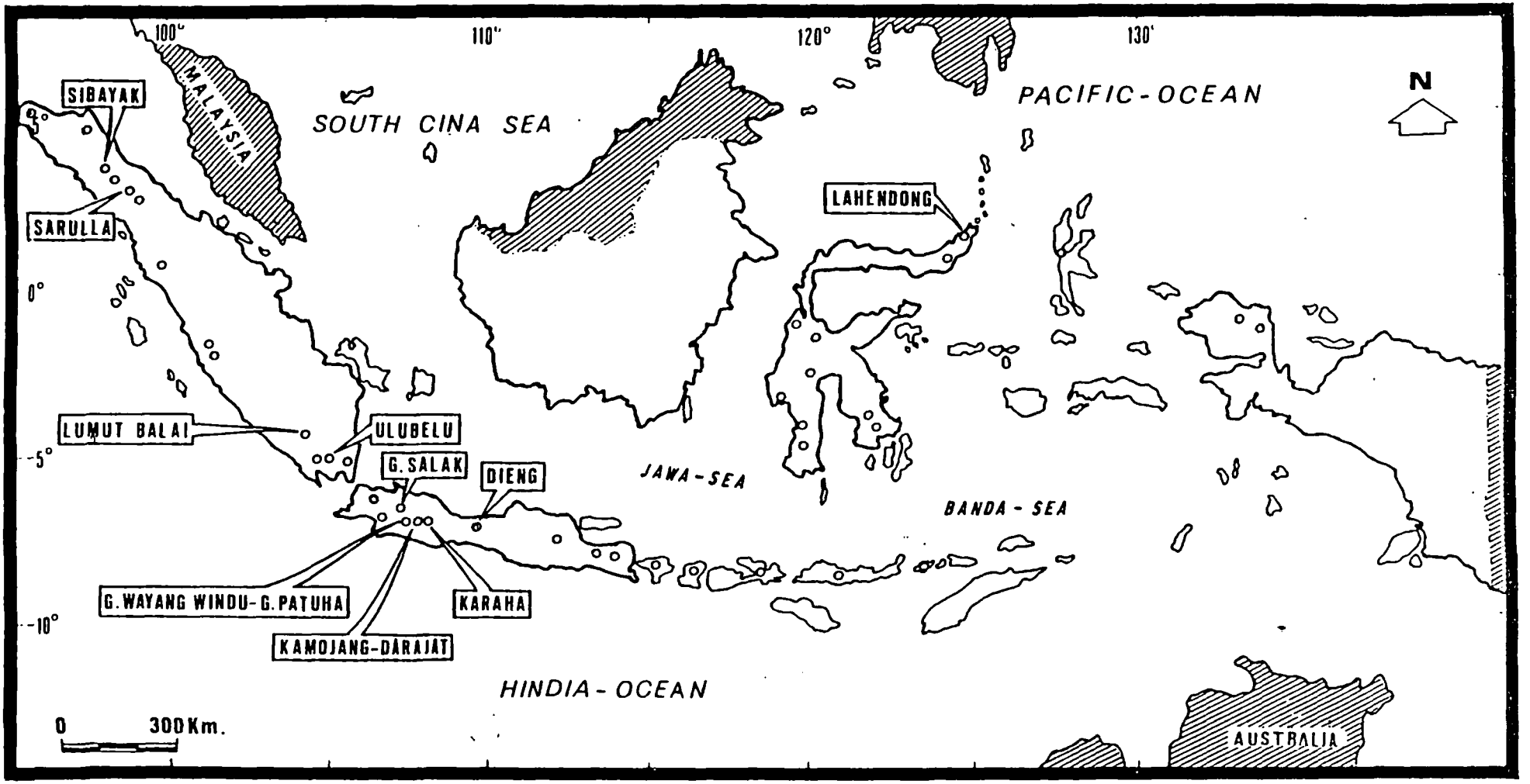
In the program to the year 2000, geothermal development in Sumatera will take a significant portion besides those in Java. Hopefully, a total plant of about 1200 MW will be installed by the year 2000.

GEOTHERMAL DEVELOPMENT PROGRAM
(MEGAWATT CUMULATIVE)
STATUS OCTOBER 1991

	1992	1993	1994	1995	1996	1997	1998	1999	2000
JAVA:									
KAMOJANG	140	140	140	195	195	250	250	250	250
G. SALAK (JOC)	-	-	110	110	110	220	220	220	220
DARAJAT (JOC)	-	-	-	55	55	110	110	110	110
DIENG	2	2	2	59.5	59.5	59.5	59.5	59.5	59.5
WAYANG - WINDU	-	-	-	-	-	40	40	80	80
PATUHA (JOC)	-	-	-	-	-	40	40	40	40
KARAHA (JOC)	-	-	-	-	-	-	110	110	110
SULAWESI:									
LAHENDONG	2.5	2.5	2.5	22.5	22.5	22.5	22.5	22.5	22.5
SUMATERA:									
SIBAYAK	-	-	-	-	-	40	40	40	40
SARULLA (JOC)	-	-	-	-	-	110	110	110	110
ULUBELU	-	-	-	-	-	-	40	40	80
LUMUTBALAI	-	-	-	-	-	-	40	40	80
TOTAL	144.5	144.5	254.5	442	442	892	1082	1122	1202

* ~~Total~~ Drilling and testing done. (Only high enthalpy)

LOCATIONS OF THE GEOTHERMAL DEVELOPMENT PROGRAM TO THE YEAR 2000



7. JOINT OPERATION TO OFFER

Any Parties or Companies interested in the development of geothermal energy in Indonesia is encouraged to participate under a joint operation with PERTAMINA.

To accelerate the development, a total project scheme which means a field development until electricity generation will be applied.

The term and condition of Joint operation will follow those in existing J.O.C, but there is a possibility to modify by applying the J.O.A / J.O.B concept of oil and gas.

For detailed information
please contact:

PERTAMINA
Directorate of Exploration & Production
Jl. Kramat Raya 59
Jakarta 10450, Indonesia
Phone : 62-21-3103370
Fax : 62-21-3106564
Telex : 44302 PTM JKT I A
46552 PTM JKT I A

WORLD BANK PRE-APPRAISAL STUDY

REII LOAN FOR MINI-HYDRO PROJECTS

OCTOBER 1993

ULUNG PELIANG

BAMBALO

KOLONDOM

LOKOMBORO

WERBA

CONTENTS

WORLD BANK REII MINI-HYDRO PRE-APPRAISAL STUDY
October 1993 Jakarta Mission

SUMMARY

A. Purpose

The purpose of this pre-appraisal study is to further review five mini-hydro projects which have already been identified in the August, 1993 World Bank mission in order to prepare the projects for Bank Appraisal in the first quarter of 1994.

The projects under study are:

PROJECT		COST	COST/kw
Ulung Peliang	1,090 KW	$2,679,783	$2,459
Bambalo	2,500 KW	$5,111,539	$2,045
Kolondom	1,400 KW	$3,677,279	$2,627
Lokomboro	860 KW	$2,279,393	$2,650
Werba	1,400 KW	$3,923,012	$2,802

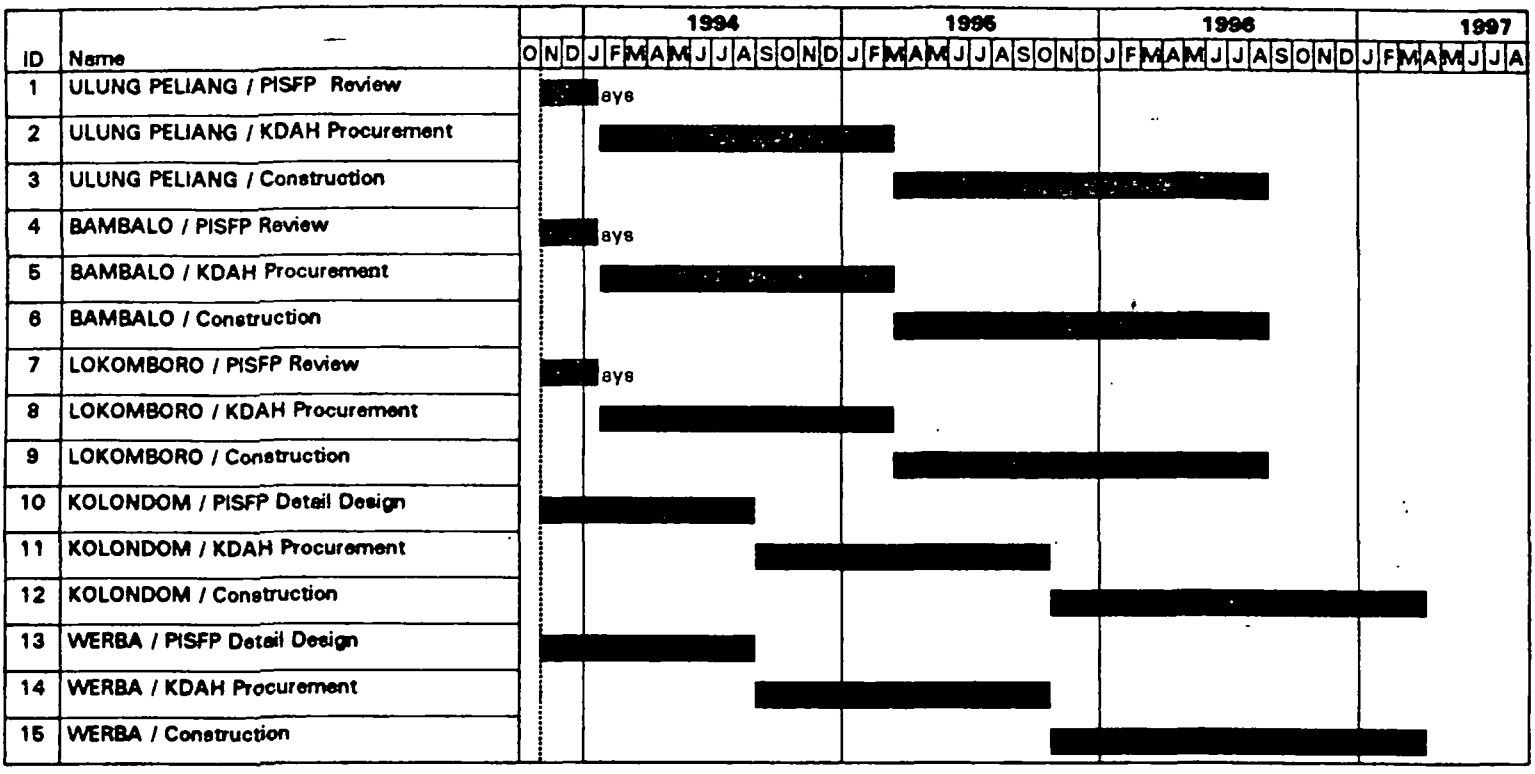
Total mini-hydro component cost - $17,671,000
Foreign component - $6,241,000

B. CURRENT PROJECT STATUS AND SCHEDULE

All five of the mini-hydro projects are currently being prepared for procurement by PLN PISFP (Project Planning and Investigations). Three of the projects, Ulung Peliang, Bambalo and Lokomboro, presently have a completed detailed engineering design which is in the process of review by PISFP. This process of review is necessary to prepare the project documentation for PLN KDAH (Hydro Procurement Division). PISFP plans to submit these three projects to KDAH by January 15, 1994.

Two of the mini-hydro projects, Werba and Kolondom, are in the process of detailed design completion by a PLN consultant. This work is being completed according to PLN directive No. 123.K/531/DIR/1991 dated 31 August 1993. The contracted consultants are PT Geo Ace, PT Wiratman and PT Citaconas. Estimated date of completion for both projects is August 39, 1994 at which time the projects will be submitted to KDAH for procurement.

IMPLEMENTATION SCHEDULE REII MINI-HYDRO PROJECTS



ULUNG PELIANG
Location - N. Sulewesi / Region 7
Capacity - 1,090 KW
Total Cost USD - $2,679,783 Foreign Cost - $1,106,000
Cost per installed KW - $2,459
Status - PISFP completion - Jan 15, 1994
KDAH Procurement completion - May 15, 1995
Construction completion - Aug 30, 1996

BAMBALO
Location - C. Sulewesi / Region 7
Capacity - 2,500 KW
Total Cost USD - $5,111,539 Foreign Cost - $2,366,000
Cost per installed KW - $2,045
Status - PISFP completion - Jan 15, 1994
KDAH Procurement completion - May 15, 1995
Construction completion - Aug 30, 1996

LOKOMBORO
Location - NTT Sumba / Region 11
Capacity - 860 KW
Total Cost USD - $2,279,393 Foreign Cost - $990,000
Cost per installed KW - $2,650
Status - PISFP completion - Jan 15, 1994
KDAH Procurement completion - May 15, 1995
Construction completion - Aug 30, 1996

KOLONDOM
Location - C. Sulewesi / Region 7
Capacity - 1,400 KW
Total Cost USD - $3,677,279 Foreign Cost - $1,378,000
Cost per installed KW - $2,627
Status - PISFP completion - Aug 30, 1994
KDAH Procurement completion - Nov 30, 1995
Construction completion - Apr 15 1997

WERBA
Location - Irian Jaya / Region 10
Capacity - 1,400 KW
Total Cost USD - $3,923,012 Foreign Cost - $1,410,000
Cost per installed KW - $2,802
Status - PISFP completion - Aug 30, 1994
KDAH Procurement completion - Nov 30, 1995
Construction completion - Apr 15 1997

C. PROJECT TECHNICAL AND ENVIRONMENTAL REVIEW

Design Changes

Technically, there has been no noted changes in the status of any of the five mini-hydro projects included in the August study. Design changes were recommended for two of the projects, Ulung Peliang and Lokomboro. PISPF has been consulted again during the October mission regarding these changes. An agreement which will incorporate the changes as a construction work order change was reached in a meeting with Mr. Djapri of PISFP on Oct 26. This procedure will keep the projects within the present time estimate and allow for the changes to be made during construction. No cost increase is anticipated as a result of the changes. Action required for design changes: PISFP to annotate the design documents to provide for a later construction change. KDAH to inform bidders of the proposed change and provide the change description, drawings and documents.

Turbine/Generator Standardization

As discussed in the August report, four of the five projects may be considered candidates for standardized turbine/generator sets. Some minor changes to the project design will be required such as an increase of penstock size. PLN has been appraised of the opportunity for standardization, but will need to follow up prior to submission of the detailed designs for tender document preparation by KDAH. A considerable savings in cost could be realized with the use of 5 prepackaged turbine/generator sets at four projects. (One project will use 2 units). A single supplier of the standardized units will simplify installation and training. Action required for this task: Supply to PISFP a recommendation and specification for standardized units including the turbine hydraulic data and penstock design criteria.

ENVIRONMENTAL

All five projects are run-of-river, small scale installations which have little impact other than during the construction phase. There is no competitive water usage at any of the projects. Land issues, specifically, replacement or compensation of improvements seems to be the main issue. Project implementation will require:

Ulung Peliang	- Removal of up to 5 small (garden?) homes.
Bambalo	- Replacement of a village owned water system. (Estimated value rp 5.000.000)
Kolondom	- Removal of up to 30 clove trees.
Werba	- Removal of a small garden and several trees.

PLN is capable of resolving all of the above improvements within their existing land acquisition procedures.

Institutional Simplification

Mini scale hydro projects, particularly projects of under 2,000 kilowatts in capacity could benefit from simplification of present procedures which require all hydro projects to be developed through the same survey / study / design / procurement / construction path.

A single department responsible for resource identification, project study and preparation of design documents could speed the process greatly from survey to procurement if standardized designs were utilized along with a simplified hydrologic, geo-technical, social and economic project study. Present PISFP studies for mini-hydro schemes specify the same level of as study applied to large schemes. The resulting study is costly and time consuming for mini scale projects. As an example, in several cases, geo-technical studies for mini projects have called for expensive boring and core sampling where hand dug test pits could have been used.

In developing streamlined institutional arrangements for the rapid and cost effective development of mini scale hydro projects, several steps can be considered:

1. Single agency survey/study/design responsibility. The use of in-house engineering with standardized designs.

2. Simplification of study requirements for mini projects.

3. Use of mini-hydro Standardized Designs for both civil works and elecro/mechanical components.

Parent agency to a Mini-Hydro unit would likely be PLN PISFP, which is currently responsible for hydro project study and design.

Implementation of the above steps would reduce the time required and the cost of producing a mimi-hydro project which is ready for funding, procurement and construction.

Procurement procedures currently take up to a year if the project includes international bidding procedures. Local bid procedures reduce the time somewhat. If local manufacturing and supply of the electro/mechanical equipment is possible, time and cost will be reduced. The licensing of local manufacturers by foreign turbine suppliers will be required.

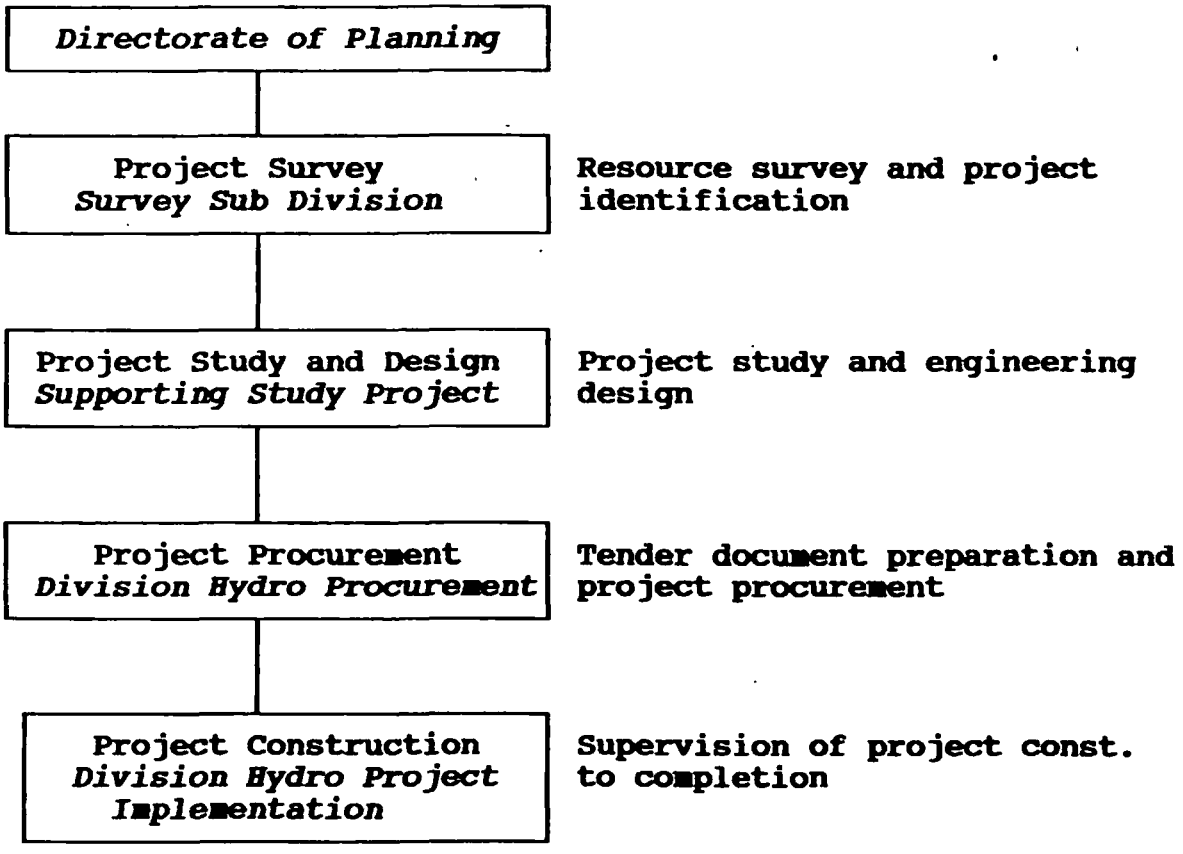
Project construction procedures are presently monitored by PLN Hydro Project Implementation Division. The project implementation responsibility is given to the Regional office. Mini-hydro projects can generally be constructed in a 12 to 18 month period of time.

D. PLN PLANNING AND PROCUREMENT PROCESS

The five mini-hydro projects selected for inclusion in the REII program were chosen based upon technical and economic basis, yet another important consideration was the level of project preparedness. The projects selected ranked highest in areas of technical, economic and preparedness.

Presently, all PLN hydro projects, large and small scale, are developed utilizing essentially the same procedure. There are some exceptions including a simplified environmental study for hydro projects of under 5,000 kilowatts in capacity.

A basic outline of the procedure:



E. MINI-HYDRO PROJECTS TASK SUMMARY - (Complete prior to 12/31/93)

1. Design Changes:

   Summarize changes in the design of Ulung Peliang and Lokomboro. Submit the changes to PISFP and KDAH with a recommendation based on Oct 26 PISFP meeting to implement the changes as a Construction Change Order. (Time required - 15 days, no field visit required)

2. Standardization:

   Submit to PISFP a specification for turbine hydraulic requirements and penstock specification for each project. Recommend that changes be implemented in the design specification prior to submittal to KDAH.
   (Time required - 15 days, no field visit required)

3. Procurement:

   Summarize discussion and recommendation to KDAH Procurement that a the foreign supplier of the turbine/generator system will provide an on-site consultant for coordination of powerhouse and penstock design in working with the local contractor. (Time required - 3 days)

F. PROJECT MONITORING AND SUPERVISION

All five REII mini-hydro projects are being implemented within roughly the same time period. PISFP and KDAH are and will be providing coordination of design and procurement services for all the projects. In addition, there are currently four U.K. funded mini-hydro projects in procurement by KDAH which may cause project "overload" and delay.

It is important that the REII consultant recommended design and standardization changes be incorporated into PLN planning for the REII projects. In addition, the continued monitoring and technical supervision of the geographically dispersed projects should be planned.

Accordingly, The following is a suggested consultant TOR for the REII mini-hydro component.

1. Work with PLN PISFP and KDAH in implementing all design and standardization changes recommended by the REII mini-hydro consultant.

2. Provide a technical review of all KDAH tender documents prior to bid advertizing. Recommend needed changes.

3. Provide PLN with a review and analysis of suppliers bid proposal equipment specifications for each project prior to supplier selection.

4. Monitor the construction phase progress of each project, submit, periodic progress/activity reports and appraise PLN Division of Hydro Implementation of any needed action in a timely manner.

5. Provide liaison between the foreign equipment supplier on-site consultant, PLN and the civil works contractor to insure electo/mechanical - civil works compatibility.

6. For each project, provide PLN with a station operator procedure and a maintenance schedule for system operation. Training program and documentation.

7. During implementation of the five REII mini-hydro projects, analyze existing PLN institutional arrangements for implementing mini-hydro projects. Devise and present recommendations of streamlining project implementation.

Consultant time required over the estimated 26 month lifetime of the five projects is a total of 520 days.

Consulting engineeer's qualifications should include:
- 4 years experience with micro or mini hydro project implementation in Indonesia.
- Fluency in Bahasa Indonesia.
- Experience with PLN institutional procedures.

ULUNG PELIANG MINI-HYDRO PROJECT

Location - North Sulewesi, PLN Region 7
Capacity - 1,090 KW
Project estimated cost (Oct 1993 USD) - $2,679,783
Project cost per KW in USD - $2,459
Foreign component cost - $1,106,000
(Turbine/Generator unit and consultant)

Current Status of Project:

1. PISPF Tender document review

Ulung Peliang Micro-Hydro Project was studied by Tecsult in 1986 to detailed engineering design phase. The project is presently being reviewed by PLN PISFP to finalize the submission of tender documents to PLN KDAH (Director of Hydro Procurement). The finalization of tender documents by PLN PISFP is expected to be completed by mid January of 1994 at which time KDAH will begin the procurement procedure.

2. Penstock position change

A change in the position of the penstock has been recommended by the World Bank REII consultant for mini-hydro projects. The penstock position change is recommended in order to eliminate two river crossings incorporated into the original Tecsult design. The construction of a road after the Tecsult work in 1986 has facilitated this change in the penstock route. The penstock will be straightened and shortened by nearly 200 meters if the recommended change is incorporated. The elimination of the two river crossings and the shorter penstock will reduce the overall project cost.

3. Method of penstock position change

In discussions with PLN PISFP (Mr. Djapri / Oct 26,1993) concerning the penstock route change, an agreement was reached whereby the original design tender documents will be submitted for bid with a notation concerning the anticipated change. The actual change of the route will be accomplished as a construction change of work order after the contract signing. The reason for not incorporating the penstock route change into the present PISFP submittal to KDAH is to save time. This design change will need follow up with both KDAH procurement and construction supervision offices.

4. Estimate of project cost change

The August 1993 Cost Estimate Summary has been amended to increase the cost of electro/mechanical equipment and some civil works areas. In reviewing the August 1993 data with PLN KDAH, there was concern on the part of procurement that the REII project electro/mechanical costs were low in comparison with 4 U.K. mini-hydro projects currently in KDAH for procurement. The U.K. projects will be installed utilizing an on site foreign contractor for electro/mechanical. The higher U.K. costs include foreign contractor mobilization costs and same country lender/supplier considerations. The U.K. electro/mechanical cost average is $1,000 USD per installed KW which is considered high by industry standards. The REII August estimates averaged $650 USD per installed KW. The current October estimate of electro/mechanical cost is $850 USD per installed KW. Suppliers consulted were Fuji Electric - Japan, Hydro West Group - USA, and American Hydro - USA.

5. Required on-site services by foreign supplier

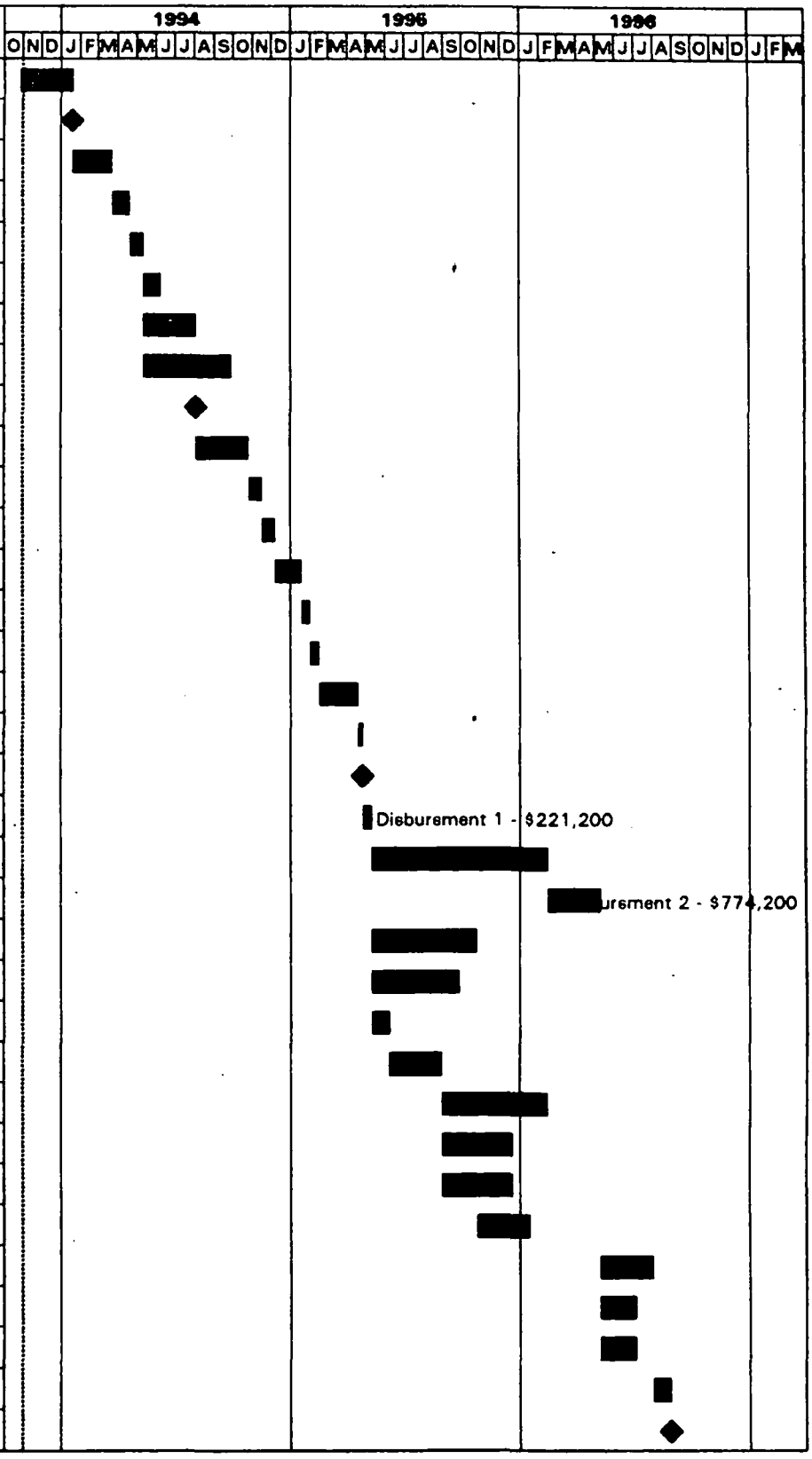
Foreign suppliers of pre-packaged turbine/generator units for the REII projects should supply on-site consulting with the local contractor to insure powerhouse, penstock and civil works integration and compatibility with the suppliers equipment design. Installation and commissioning will also require supplier consultant services with the local contractor.

6. Land procurement

PLN land procurement at the Ulung Peliang site will involve up to three houses located on or near the penstock and access road route. The houses are approximately 3 x 3 meters in size with grass roof, bamboo floor and walls. It is possible that the houses are temporary "garden houses" owned by people living in Tamako, several kilometers from the site.

IMPLEMENTATION SCHEDULE, MINI-HYDRO PROJECT - ULUNG PELIANG

ID	Name	Duration
1	PISFP Document Review	60d
2	Tender Docs. to KDAH	0d
3	KDAH Document Preparation	45d
4	Advertising	20d
5	Issue Bid Document	15d
6	Site Visit and Pre Bid Conference	20d
7	Bid Preparation by Suppliers	60d
8	Land Negotiation and Purchase	100d
9	Bid Submission by Suppliers	0d
10	KDAH Bid Evaluation	60d
11	KDAH Final Report	15d
12	Approval by PLN Board of Dir.	15d
13	Approval by Minister of Finance	30d
14	Approval by IBRD	10d
15	Issue Letter of Intent to Suppliers	10d
16	Contract Discussion / Finalization	45d
17	BAPPENAS Approval	5d
18	Contract Signing / Eff. Start Date	0d
19	Disbursement of Startup Funds	10d
20	Turbine/Generator Manufactured	200d
21	Turbine/Generator Shipping	60d
22	Electrical Equip. and Shipping	120d
23	Materials Aquisition and Shipping	100d
24	Construction Mobilization	20d
25	Access and Site Preparation	60d
26	Headworks Construction	120d
27	Headrace Canal Construction	80d
28	Powerhouse Construction	80d
29	Penstock Installation	60d
30	Turbine / Generator Installation	60d
31	Electrical Switchgear Installation	40d
32	Operator House / Fencing	40d
33	Testing and Commissioning	20d
34	Project Acceptance	0d



TOTAL PROJECT COST USD $2,679,783 / FOREIGN COMPONANT $1,106,000

COST ESTIMATE SUMMARY

MINI HYDRO DEVELOPMENT PROJECT
PROJECT: ULUNG PELIANG
DEMAND CENTER: TAHUNA
CAPACITY: 1 x 1,090 kW — TOTAL COST IN USD — $2,679,783
Date: Oct 26, 1993 — USD COST/KW — $2,459

CODE	DESCRIPTION	LOCAL CURRENCY TOTAL x1000 Rp	FOREIGN CURRENCY UNIT PRICE $ U.S.	FOREIGN CURRENCY TOTAL x1000	EQUIVALENT IN RUPIAHS EXCHANGE RATE	EQUIVALENT IN RUPIAHS TOTAL x1000Rp	TOTAL x 1000 Rp
0.0	LAND AND LAND RIGHTS	25,000		0		0	25,000
	PROJECT DIRECT COST						
	CIVIL WORK						
1.0	General	196,000		0		0	196,000
2.0	Land Clearing and Fencing	22,000		0		0	22,000
3.0	Access Road	10,000		0		0	10,000
4.0	Bridges	0		0		0	0
5.0	Headwork Water Control	180,000		0		0	180,000
6.0	Open canal 100 Meters	220,000		0		0	220,000
7.0	Headrace Penstock 870 meters	730,000		0		0	730,000
8.0	Powerhouse and Civil	62,000		0		0	62,000
9.0	Tail Race	8000		0		0	8,000
10.0	Switchyard Civil	5,000		0		0	5,000
11.0	Operator House and Yard	25,000		0		0	25,000
	SUB TOTAL CIVIL WORK	1,458,000		0		0	1,458,000
	GENERATING AND SWITCH YARD EQUIPMENT						
M-1	Prepackaged turbine/generator set	24,500		$926	2,100	1,944,600	1,969,100
E-1	Electrical equipment	219,000		0	2,100	0	219,000
E-2	Switchyard Equipment	120,000		0		0	120,000
	SUBTOTAL GENERATING AND SWITCHYARD EQUIPMENT	363,500		926		1,944,600	2,308,100
	SUBTOTAL PROJECT DIRECT COST	1,821,500		926		1,944,600	3,766,100
	PROJECT INDIRECT COST						
I-1	Project Management Services	125,000		80	2,100	168,000	293,000
I-2	Start Up and Commissioning	5,000		20	2,100	42,000	47,000
I-3	Engineering	134,000		80	2,100	168,000	302,000
	SUBTOTAL PROJECT INDIRECT COST	264,000		180		378,000	642,000
	TOTAL DIRECT AND INDIRECT COST	2,085,500		1,106		2,322,600	4,408,100
	Risk 10% PPN tax 10%	417,100		111	2,100	232,260	649,360
	CONTINGENCY	312,825		111	2,100	232,260	545,085
	TOTAL CONSTRUCTION COST	2,815,425		1,327		2,787,120	5,602,545
	TOTAL INVESTMENT COST	2,840,425		1,327		2,787,120	5,627,545

COST ANALYSIS OF COMPARABLE DIESEL
AND HYDRO GENERATED POWER SCHEMES
PROJECT: ULUNG PELIANG
DEMAND CENTER: TAHUNA
CAPACITY: 1090 kW
26-Oct-93

HYDRO GENERATED POWER SCHEME

*All costs are expressed in current Rupiahs		Cost x 1000 Rp
Capitalization Costs:	Initial capital expenditure	5,627,545
Annualized Costs:	Operation & Adm. Expense per year	20,000
	Maintenance Expense per year	10,000

Year	Capital Exp. x 1000Rp	Operation. Exp. x 1000 Rp	Main. Exp. x 1000 Rp	Total Cost x 1000 Rp	Present Value at 8%	Present Value at 10%	Present Value at 12%	Present Value at 14%
0	0	0	0	0				
1	2,251,018	0	0	2,251,018	2,084,276	2,046,380	2,009,838	1,974,577
2	3,376,527	0	0	3,376,527	2,894,828	2,790,516	2,691,747	2,598,128
3		20,000	10,000	30,000	23,815	22,539	21,353	20,249
4		20,000	10,000	30,000	22,051	20,490	19,066	17,762
5		20,000	10,000	30,000	20,417	18,628	17,023	15,581
6		20,000	10,000	30,000	18,905	16,934	15,199	13,668
7		20,000	10,000	30,000	17,505	15,395	13,570	11,989
8		20,000	10,000	30,000	16,208	13,995	12,116	10,517
9		20,000	10,000	30,000	15,007	12,723	10,818	9,225
10		20,000	10,000	30,000	13,896	11,566	9,659	8,092
11		20,000	10,000	30,000	12,866	10,515	8,624	7,099
12		20,000	10,000	30,000	11,913	9,559	7,700	6,227
13		20,000	10,000	30,000	11,031	8,690	6,875	5,462
14		20,000	10,000	30,000	10,214	7,900	6,139	4,791
15		20,000	10,000	30,000	9,457	7,182	5,481	4,203
16		20,000	10,000	30,000	8,757	6,529	4,894	3,687
17		20,000	10,000	30,000	8,108	5,935	4,369	3,234
18		20,000	10,000	30,000	7,507	5,396	3,901	2,837
19		20,000	10,000	30,000	6,951	4,905	3,483	2,488
20		20,000	10,000	30,000	6,436	4,459	3,110	2,183
21		20,000	10,000	30,000	5,960	4,054	2,777	1,915
22		20,000	10,000	30,000	5,518	3,685	2,479	1,680
23		20,000	10,000	30,000	5,109	3,350	2,214	1,473
24		20,000	10,000	30,000	4,731	3,046	1,976	1,292
25		20,000	10,000	30,000	4,381	2,769	1,765	1,134
Total costs discounted over the life of the hydro:					5,245,849	5,057,143	4,886,177	4,729,493

Observed Cost per kilowatt hour:			
Capacity Factor:	70%	60%	50%
Total Cost incurred over the life of the of the project:	6,317,545	6,317,545	6,317,545
Total Kilowatt hours produced over the 25 years:	139,300,000	119,400,000	99,500,000
Total Cost per kilowatt hour:	45.35	52.91	63.49

COST ANALYSIS OF COMPARABLE DIESEL
AND HYDRO GENERATED POWER SCHEMES
PROJECT: ULUNG PELIANG
DEMAND CENTER: TAHUNA
CAPACITY: 1090 kW

COMPARABLE DIESEL GENERATED POWER SCHEME

Number of Generators to produce a comparable output capacity of 1090 kW:

Multiplier	1.67
Number of 250 kW diesel units to meet a constant 1090kW capacity:	7

*All costs are expressed in current Rupiahs		Cost/ unit x 1000 Rp	# of units	Total Cost x 1000	Annual Real Cost Escalation
Capitalization Costs:	Initial capital expenditure per unit	241,115	7	1,687,805	*
	Major overhaul cost per unit	50,000	7	350,000	2%
Annualized Costs:	Diesel fuel costs per year/ unit	105,731	7	740,117	3%
	Lubrication cost per year/ unit	7,082	7	49,574	3%
	Operation & Administrative cost/year	20,000	1	20,000	0%

Year	Capital Exp. x 1000Rp	Major Overhaul x 1000 Rp	Diesel & lube Exp. x 1000 Rp	Operation Exp. x 1000 Rp	Total Cost x 1000 Rp	Present Value at 8%	Present Value at 10%	Present Value at 12%	Present Value at 14%
0	1,687,805				1,687,805	1,687,805	1,687,805	1,687,805	1,687,805
1			789,691	20,000	809,691	749,714	736,083	722,938	710,255
2			813,382	20,000	833,382	714,491	688,745	664,367	641,260
3			837,783	20,000	857,783	680,938	644,465	610,553	578,979
4			862,917	20,000	882,917	648,970	603,044	561,110	522,758
5		385,000	888,804	20,000	1,293,804	880,541	805,351	734,139	671,961
6			915,468	20,000	935,468	589,504	528,047	473,937	426,187
7			942,932	20,000	962,932	561,862	494,137	435,582	384,824
8			971,220	20,000	991,220	535,525	462,412	400,337	347,481
9		415,800	1,000,357	20,000	1,436,157	718,436	609,071	517,893	441,630
10			1,030,368	20,000	1,050,368	486,523	404,962	338,190	283,330
11			1,061,279	20,000	1,081,279	463,742	378,982	310,842	255,849
12			1,093,117	20,000	1,113,117	442,034	354,673	285,709	231,038
13		449,064	1,125,911	20,000	1,594,975	586,469	462,007	365,527	290,398
14			1,159,688	20,000	1,179,688	401,638	310,649	241,388	188,408
15			1,194,478	20,000	1,214,478	382,854	290,736	221,881	170,144
16			1,230,313	20,000	1,250,313	364,954	272,106	203,953	153,653
17		484,989	1,267,222	20,000	1,772,211	478,974	360,623	268,113	191,044
18			1,305,239	20,000	1,325,239	331,640	238,356	172,334	125,316
19			1,344,396	20,000	1,364,396	316,147	223,090	158,416	113,174
20			1,384,728	20,000	1,404,728	301,382	208,804	145,624	102,210
21		523,788	1,426,270	20,000	1,970,058	391,383	266,215	182,348	125,741
22			1,469,058	20,000	1,489,058	273,898	182,925	123,059	83,389
23			1,513,130	20,000	1,533,130	261,115	171,217	113,127	75,295
24			1,558,524	20,000	1,578,524	248,932	160,261	103,996	68,004
25			1,605,279	20,000	1,625,279	237,320	150,007	95,604	61,420
Total cost discounted over the life of the diesel generators:						10,584,760	8,570,136	7,053,660	5,892,211

Observed Cost per kilowatt hour:

Total Cost incurred over the life of the of the project:	33,237,999
Total Kilowatt hours produced over the 25 years:	199,000,000
Total Cost per kilowatt hour (Rp):	**167.03**

BAMBALO MINI-HYDRO PROJECT

Location - Central Sulewesi, PLN Region 7
Capacity - 2,500 KW
Project estimated cost (Oct 1993 USD) - $5,111,539
Project cost per KW in USD - $2,045
Foreign component cost - $2,366,000
(Turbine/Generator unit and consultant)

Current Status of Project:

1. PISPF Tender document review

Bambalo Micro-Hydro Project was studied by Tecsult in 1986 to detailed engineering design phase. The project is presently being reviewed by PLN PISFP to finalize the submission of tender documents to PLN KDAH (Director of Hydro Procurement). The finalization of tender documents by PLN PISFP is expected to be completed by mid January of 1994 at which time KDAH will begin the procurement procedure.

2. Estimate of project cost change

The August 1993 Cost Estimate Summary has been amended to increase the cost of electro/mechanical equipment and some civil works areas. In reviewing the August 1993 data with PLN KDAH, there was concern on the part of procurement that the REII project electro/mechanical costs were low in comparison with 4 U.K. mini-hydro projects currently in KDAH for procurement. The U.K. projects will be installed utilizing an on site foreign contractor for electro/mechanical. The higher U.K. costs include foreign contractor mobilization costs and same country lender/supplier considerations. The U.K. electro/mechanical cost average is $1,000 USD per installed KW which is considered high by industry standards. The REII August estimates averaged $650 USD per installed KW. The current October estimate of electro/mechanical cost is $850 USD per installed KW. Suppliers consulted were Fuji Electric - Japan, Hydro West Group - USA, and American Hydro - USA.

3. Required on-site services by foreign supplier

Foreign suppliers of pre-packaged turbine/generator units for the REII projects should supply on-site consulting with the local contractor to insure powerhouse, penstock and civil works integration and compatibility with the suppliers equipment design. Installation and commissioning will also require supplier consultant services with the local contractor.

4. Land procurement

PLN land procurement at the Ulung Peliang site will involve replaceing a domestic water system on the penstock and access road route. The value of the villager installed domestic water system is estimated to be Rp. 5.000.000. The water source for the domestic water system will not be involved, only the storage tank and pipeline. No houses, gardens or other impovements are involved the project land aquisition.

IMPLEMENTATION SCHEDULE, MINI-HYDRO PROJECT - BAMBALO

ID	Name	Duration
1	PISFP Document Review	60d
2	Tender Docs. to KDAH	0d
3	KDAH Document Preparation	45d
4	Advertising	20d
5	Issue Bid Document	15d
6	Site Visit and Pre Bid Conference	20d
7	Bid Preparation by Suppliers	60d
8	Land Negotiation and Purchase	100d
9	Bid Submission by Suppliers	0d
10	KDAH Bid Evaluation	60d
11	KDAH Final Report	15d
12	Approval by PLN Board of Dir.	15d
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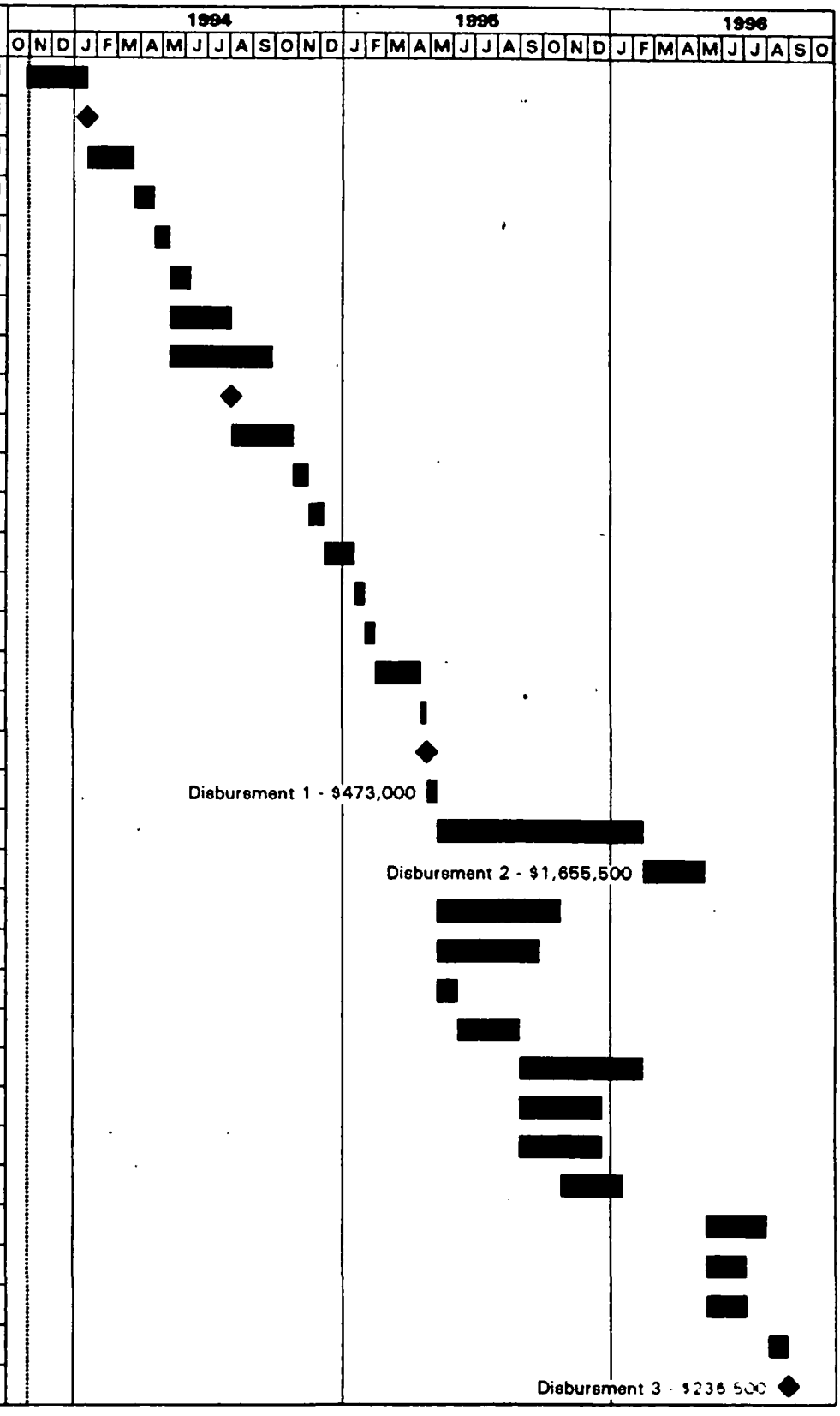
15	Issue Letter of Intent to Suppliers	10d
16	Contract Discussion / Finalization	45d
17	BAPPENAS Approval	5d
18	Contract Signing / Eff. Start Date	0d
19	Disbursement of Startup Funds	10d
20	Turbine/Generator Manufactured	200d
21	Turbine/Generator Shipping	60d
22	Electrical Equip. and Shipping	120d
23	Materials Aquisition and Shipping	100d
24	Construction Mobilization	20d
25	Access and Site Preparation	60d
26	Headworks Construction	120d
27	Headrace Canal Construction	80d
28	Powerhouse Construction	80d
29	Penstock Installation	60d
30	Turbine / Generator Installation	60d
31	Electrical Switchgear Installation	40d
32	Operator House / Fencing	40d
33	Testing and Commissioning	20d
34	Project Acceptance	0d



COST ESTIMATE SUMMARY

MINI HYDRO DEVELOPMENT PROJECT
PROJECT: BAMBALO
DEMAND CENTER: POSO
CAPACITY: 2 x 1,250 kW — TOTAL COST IN USD — $5,111,539
Date: Oct 28, 1993 — USD COST/KW — $2,045

CODE	DESCRIPTION	LOCAL CURRENCY TOTAL x1000 Rp	FOREIGN CURRENCY UNIT PRICE $ U.S.	FOREIGN CURRENCY TOTAL x1000	EQUIVALENT IN RUPIAHS EXCHANGE RATE	EQUIVALENT IN RUPIAHS TOTAL x1000Rp	TOTAL x 1000 Rp
0.0	LAND AND LAND RIGHTS	60,000		0		0	60,000
	(30,000 sq/m @ rp 2,000)						
	PROJECT DIRECT COST						
	CIVIL WORK						
1.0	General	450,000		0		0	450,000
2.0	Land Clearing and Fencing	30,000		0		0	30,000
3.0	Access Road	4,000		0		0	4,000
4.0	Bridges	0		0		0	
5.0	Headwork Water Control	310,000		0		0	310,000
6.0	Open canal	750,000		0		0	750,000
7.0	Headrace Penstock	756,000		0		0	756,000
8.0	Powerhouse Civil	88,000		0		0	88,000
9.0	Tail Race	7,000		0		0	7,000
10.0	Switchyard Civil	7,000		0		0	7,000
11.0	Operator House and Yard	25,000		0		0	25,000
	SUB TOTAL CIVIL WORK	2,425,000		0		0	2,425,000
	GENERATING AND SWITCH YARD EQUIPMENT						
M-1	Prepackaged turbine/generator set (2 units)	49,000	$2,125		2100	4,462,500	4,511,500
E-1	Electrical equipment	438,000	$0		2100	0	438,000
E-2	Switchyard Equipment	240,000	$0			0	240,000
	SUBTOTAL GENERATING AND SWITCHYARD EQUIPMENT	727,000	$2,125			4,462,500	5,189,500
	SUBTOTAL PROJECT DIRECT COST	3,152,000	$2,125			4,462,500	7,614,500
	PROJECT INDIRECT COST						
I-1	Project Management Services	145,000	$80		2100	168,000	313,000
I-2	Start Up and Commissioning	10,000	$40		2100	84,000	94,000
I-3	Engineering	185,172	$120		2100	252,000	437,172
	SUBTOTAL PROJECT INDIRECT COST	340,172	$240			504,000	844,172
	TOTAL DIRECT AND INDIRECT COST	3,492,172	$2,365			4,966,500	8,458,672
	Risk 10% PPN 10%	688,434	$237		2100	498,650	1,195,084
	CONTINGENCY	523,826	$237		2100	498,650	1,020,476
	TOTAL CONSTRUCTION COST	4,714,432	$2,838			5,959,800	10,674,232
	TOTAL INVESTMENT COST	4,774,432	$2,838			5,959,800	10,734,232

COST ANALYSIS OF COMPARABLE DIESEL
AND HYDRO GENERATED POWER SCHEMES
PROJECT: BAMBALO
DEMAND CENTER: POSO
CAPACITY: 2500 kW
26-Oct-93

HYDRO GENERATED POWER SCHEME

*All costs are expressed in current Rupiahs		Cost x 1000 Rp
Capitalization Costs:	Initial capital expenditure	10,734,232
Annualized Costs:	Operation & Adm. Expense per year	20,000
	Maintenance Expense per year	10,000

Year	Capital Exp. x 1000Rp	Operation. Exp. x 1000 Rp	Main. Exp. x 1000 Rp	Total Cost x 1000 Rp	Present Value at 8%	Present Value at 10%	Present Value at 12%	Present Value at 14%
0	0	0	0	0				
1	4,293,693	0	0	4,293,693	3,976,641	3,903,357	3,833,654	3,766,397
2	6,440,539	0	0	6,440,539	5,521,724	5,322,760	5,134,358	4,955,786
3		20,000	10,000	30,000	23,815	22,539	21,353	20,249
4		20,000	10,000	30,000	22,051	20,490	19,066	17,762
5		20,000	10,000	30,000	20,417	18,628	17,023	15,581
6		20,000	10,000	30,000	18,905	16,934	15,199	13,668
7		20,000	10,000	30,000	17,505	15,395	13,570	11,989
8		20,000	10,000	30,000	16,208	13,996	12,116	10,517
9		20,000	10,000	30,000	15,007	12,723	10,818	9,225
10		20,000	10,000	30,000	13,896	11,566	9,659	8,092
11		20,000	10,000	30,000	12,866	10,515	8,624	7,099
12		20,000	10,000	30,000	11,913	9,559	7,700	6,227
13		20,000	10,000	30,000	11,031	8,690	6,875	5,462
14		20,000	10,000	30,000	10,214	7,900	6,139	4,791
15		20,000	10,000	30,000	9,457	7,182	5,481	4,203
16		20,000	10,000	30,000	8,757	6,529	4,894	3,687
17		20,000	10,000	30,000	8,108	5,935	4,369	3,234
18		20,000	10,000	30,000	7,507	5,396	3,901	2,837
19		20,000	10,000	30,000	6,951	4,905	3,483	2,488
20		20,000	10,000	30,000	6,436	4,459	3,110	2,183
21		20,000	10,000	30,000	5,960	4,054	2,777	1,915
22		20,000	10,000	30,000	5,518	3,686	2,479	1,680
23		20,000	10,000	30,000	5,109	3,350	2,214	1,473
24		20,000	10,000	30,000	4,731	3,046	1,976	1,292
25		20,000	10,000	30,000	4,381	2,769	1,765	1,134
Total cost discounted over the life of the hydro:					9,764,111	9,446,362	9,152,605	8,878,971

Observed Cost per kilowatt hour:			
Capacity Factor:	**70%**	**60%**	**50%**
Total Cost incurred over the life of the of the project:	11,424,232	11,424,232	11,424,232
Total Kilowatt hours produced over the 25 years:	385,000,000	330,000,000	275,000,000
Total Cost per kilowatt hour:	**29.67**	**34.62**	**41.54**

COST ANALYSIS OF COMPARABLE DIESEL
AND HYDRO GENERATED POWER SCHEMES
PROJECT: BAMBALO
DEMAND CENTER: POSO
CAPACITY: 2500 kW

COMPARABLE DIESEL GENERATED POWER SCHEME

Number of Generators to produce a comparable output capacity of 2500 kW:

Multiplier	1.67
Number of 250 kW diesel units to meet a constant 2500kW capacity:	17

*All costs are expressed in current Rupiahs		Cost/ unit x 1000 Rp	# of units	Total Cost x 1000	Annual Real Cost Escalation
Capitalization Costs:	Initial capital expenditure per unit	241,115	17	4,098,955	*
	Major overhaul cost per unit	50,000	17	850,000	2%
Annualized Costs:	Diesel fuel costs per year/ unit	105,731	17	1,797,427	3%
	Lubrication cost per year/ unit	7,082	17	120,394	3%
	Operation & Administrative cost/year	20,000	1	20,000	0%

Year	Capital Exp. x 1000Rp	Major Overhaul x 1000 Rp	Diesel & lube Exp. x 1000 Rp	Operation Exp. x 1000 Rp	Total Cost x 1000 Rp	Present Value at 8%	Present Value at 10%	Present Value at 12%	Present Value at 14%
0	4,098,955				4,098,955	4,098,955	4,098,955	4,098,955	4,098,955
1			1,917,821	20,000	1,937,821	1,794,279	1,761,655	1,730,197	1,699,843
2			1,875,356	20,000	1,895,356	1,710,698	1,649,054	1,590,686	1,535,381
3			2,034,616	20,000	2,054,616	1,631,021	1,543,984	1,462,435	1,386,807
4			2,095,655	20,000	2,115,655	1,555,069	1,445,021	1,344,537	1,252,637
5		935,000	2,158,524	20,000	3,113,524	2,119,012	1,933,254	1,766,697	1,617,067
6			2,223,280	20,000	2,243,280	1,413,647	1,266,273	1,136,516	1,022,008
7			2,289,979	20,000	2,309,979	1,347,850	1,186,384	1,044,917	923,154
8			2,358,678	20,000	2,378,678	1,285,126	1,109,671	960,708	833,867
9		1,009,800	2,429,438	20,000	3,459,238	1,730,480	1,487,055	1,287,436	1,083,743
10			2,502,321	20,000	2,522,321	1,168,323	972,464	812,120	680,381
11			2,577,391	20,000	2,597,391	1,113,977	910,370	748,888	614,588
12			2,654,713	20,000	2,674,713	1,062,165	852,246	688,532	555,181
13		1,090,584	2,734,354	20,000	3,844,938	1,413,778	1,113,742	881,161	700,048
14			2,816,385	20,000	2,836,385	965,679	748,909	580,381	452,999
15			2,900,876	20,000	2,920,876	920,782	699,235	533,633	409,204
16			2,987,903	20,000	3,007,903	877,978	654,607	490,654	369,646
17		1,177,831	3,077,540	20,000	4,275,370	1,155,500	845,859	622,884	460,884
18			3,169,866	20,000	3,189,866	798,281	573,725	414,809	301,837
19			3,264,962	20,000	3,284,962	761,165	537,118	381,406	272,482
20			3,362,911	20,000	3,382,911	726,797	502,848	350,695	246,146
21		1,272,057	3,463,798	20,000	4,755,855	944,778	642,661	440,200	303,548
22			3,567,712	20,000	3,587,712	659,926	440,736	296,498	200,868
23			3,674,743	20,000	3,694,743	629,271	412,622	272,628	181,457
24			3,784,986	20,000	3,804,986	600,044	386,303	250,680	163,922
25			3,898,535	20,000	3,918,535	572,176	361,665	230,501	148,082
Total cost discounted over the life of the diesel generators:						25,451,603	20,603,431	16,954,516	14,160,334

Observed Cost per kilowatt hour:	
Total Cost incurred over the life of the of the project:	80,006,670
Total Kilowatt hours produced over the 25 years:	550,000,000
Total Cost per kilowatt hour (Rp):	145.47

LOKOMBORO MINI-HYDRO PROJECT

Location - NTT Sumba, PLN Region 11
Capacity - 860 KW
Project estimated cost (Oct 1993 USD) - $2,279,393
Project cost per KW in USD - $2,650
Foreign component cost - $990,000
(Turbine/Generator unit and consultant)

Current Status of Project:

1. PISPF Tender document review

Lokomboro micro-Hydro Project was studied by Tecsult in 1986 to detailed engineering design phase. The project is presently being reviewed by PLN PISFP to finalize the submission of tender documents to PLN KDAH (Director of Hydro Procurement). The finalization of tender documents by PLN PISFP is expected to be completed by mid January of 1994 at which time KDAH will begin the procurement procedure.

2. Change in headwork design.

The 1986 Tecsult design for Lokomboro utilizes a cliff side installation of a portion of the penstock near the headworks. In reviewing the design, it was determined that a short 25 to 30 meter tunnel through the easily excavated limestone rock would provide a alternate route for the penstock. The current cost figures include this modification to the original design. The installation of the penstock through the tunnel will provide a more efficient and safer installation of the pipeline. PISFP and KDAH will use the present tender documents and the change will be made as a construction work change.

3. Project cost change

The August 1993 Cost Estimate Summary has been amended to increase the cost of electro/mechanical equipment and some civil works areas. In reviewing the August 1993 data with PLN KDAH, there was concern on the part of procurement that the REII project electro/mechanical costs were low in comparison with 4 U.K. mini-hydro projects currently in KDAH for procurement. The U.K. projects will be installed utilizing an on site foreign contractor for electro/mechanical. The higher U.K. costs include foreign contractor mobilization costs and same country lender/supplier considerations. The U.K. electro/mechanical cost average is $1,000

USD per installed KW which is considered high by industry standards. The REII August estimates averaged $650 USD per installed KW. The current October estimate of electro/mechanical cost is $850 USD per installed KW. Suppliers consulted were Fuji Electric - Japan, Hydro West Group - USA, and American Hydro - USA.

4. Required on-site services by foreign supplier

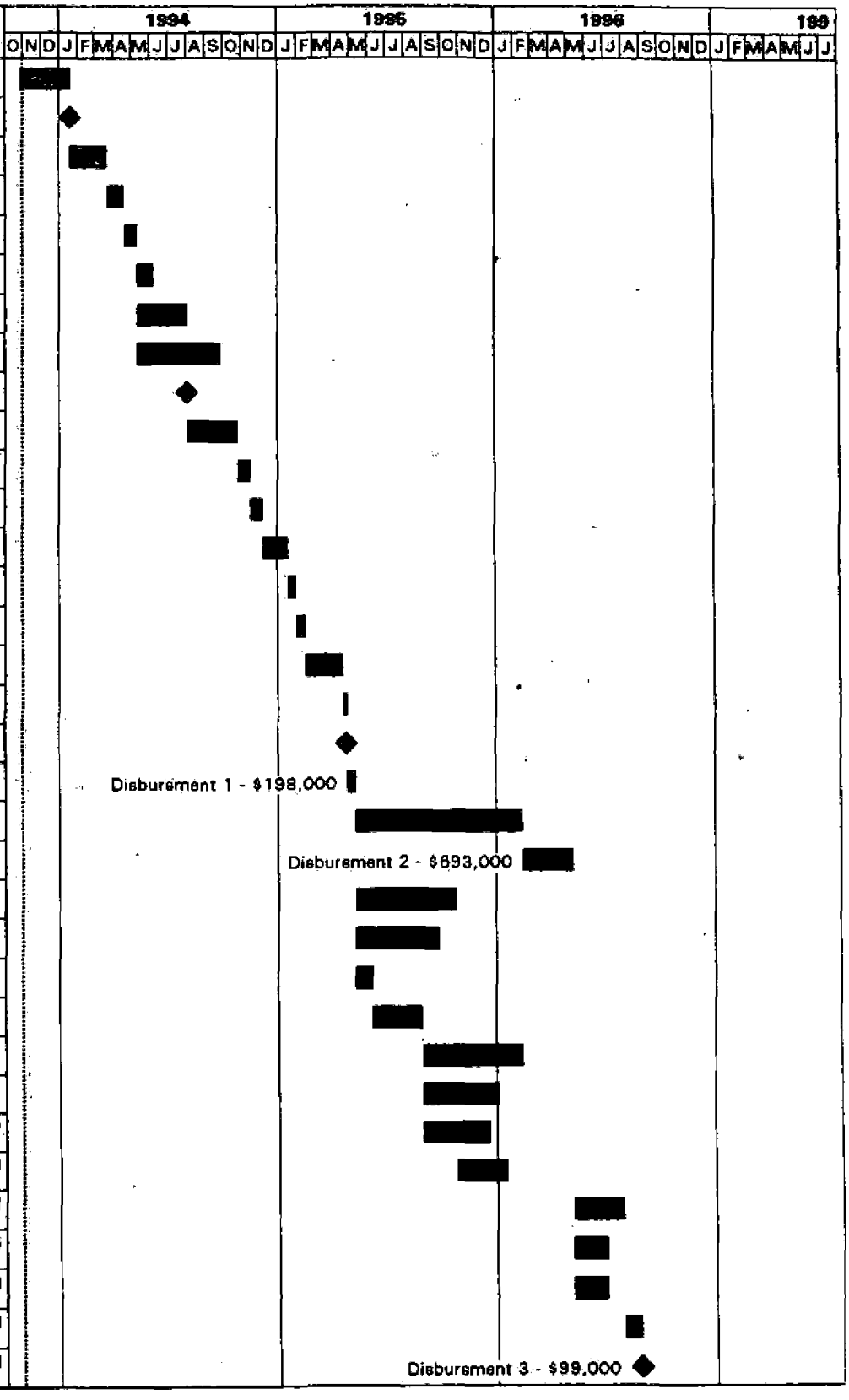
Foreign suppliers of pre-packaged turbine/generator units for the REII projects should supply on-site consulting with the local contractor to insure powerhouse, penstock and civil works integration and compatibility with the suppliers equipment design. Installation and commissioning will also require supplier consultant services with the local contractor.

5. Land procurement

The lokomboro mini-hydro project utilizes a short penstock and will require a minimal land acquisition. The project location is in an area of undeveloped and utilized land. An existing road will be upgraded to access the site.

IMPLEMENTATION SCHEDULE, MINI-HYDRO PROJECT - LOKOMBORO

ID	Name	Duration
1	PISFP Document Review	60d
2	Tender Docs. to KDAH	0d
3	KDAH Document Preparation	45d
4	Advertising	20d
5	Issue Bid Document	15d
6	Site Visit and Pre Bid Conference	20d
7	Bid Preparation by Suppliers	60d
8	Land Negotiation and Purchase	100d
9	Bid Submission by Suppliers	0d
10	KDAH Bid Evaluation	60d
11	KDAH Final Report	15d
12	Approval by PLN Board of Dir.	15d
13	Approval by Minister of Finance	30d
14	Approval by IBRD	10d
15	Issue Letter of Intent to Suppliers	10d
16	Contract Discussion / Finalization	45d
17	BAPPENAS Approval	5d
18	Contract Signing / Eff. Start Date	0d
19	Disbursment of Startup Funds	10d
20	Turbine/Generator Manufactured	200d
21	Turbine/Generator Shipping	60d
22	Electrical Equip. and Shipping	120d
23	Materials Aquisition and Shipping	100d
24	Construction Mobilization	20d
25	Access and Site Preparation	60d
26	Headworks Construction	120d
27	Penstock Tunnel - 30 M	90d
28	Powerhouse Construction	80d
29	Penstock Installation	60d
30	Turbine / Generator Installation	60d
31	Electrical Switchgear Installation	40d
32	Operator House / Fencing	40d
33	Testing and Commissioning	20d
34	Project Acceptance	0d



Total project cost in USD $2,279,393 / Foreign componant - $990,000

COST ESTIMATE SUMMARY

MINI HYDRO DEVELOPMENT PROJECT
PROJECT: LOKOBORO
DEMAND CENTER: WAIKABUBAK
CAPACITY: 1x 860 kW — TOTAL COST IN USD — $2,278,393
Date: Oct 26, 1993 — USD COST/KW — $2,650

CODE	DESCRIPTION	LOCAL CURRENCY TOTAL x1000 Rp	FOREIGN CURRENCY UNIT PRICE $ U.S.	FOREIGN CURRENCY TOTAL x1000	EQUIVALENT IN RUPIAHS EXCHANGE RATE	EQUIVALENT IN RUPIAHS TOTAL x1000Rp	TOTAL x 1000 Rp
0.0	LAND AND LAND RIGHTS	30,000		0		0	30,000
	PROJECT DIRECT COST						
	CIVIL WORK						
1.0	General	186,000		0		0	186,000
2.0	Land Clearing and Fencing	20,000		0		0	20,000
3.0	Access Road	65,000		0		0	65,000
4.0	Bridges	0		0		0	0
5.0	Headwork Water Control	243,000		0		0	243,000
6.0	Canal	0		0		0	0
7.0	Headrace Penstock	465,000		0		0	465,000
8.0	Powerhouse Civil	62,000		0		0	62,000
9.0	Tail Race	8,000		0		0	8,000
10.0	Switchyard Civil	5,000		0		0	5,000
11.0	Operator House and Yard	25,000		0		0	25,000
	SUB TOTAL CIVIL WORK	1,078,000		0		0	1,078,000
	GENERATING AND SWITCH YARD EQUIPMENT						
M-1	Prepackaged turbine/generator set	24,500	$810		2100	1,701,000	1,725,500
E-1	Electrical equipment	189,000	$0		2100	0	189,000
E-2	Switchyard Equipment	120,000	$0			0	120,000
	SUBTOTAL GENERATING AND SWITCHYARD EQUIPMENT	333,500	$810			1,701,000	2,034,500
	SUBTOTAL PROJECT DIRECT COST	1,411,500	$810			1,701,000	3,112,500
	PROJECT INDIRECT COST						
I-1	Project Management Services	125,000	$80		2100	168,000	293,000
I-2	Start Up and Commissioning	5,000	$20		2100	42,000	47,000
I-3	Engineering	134,000	$80		2100	168,000	302,000
	SUBTOTAL PROJECT INDIRECT COST	264,000	$180			378,000	642,000
	TOTAL DIRECT AND INDIRECT COST	**1,675,500**	**$990**			**2,079,000**	**3,754,500**
	Risk 10% PPN 10%	335,100	$99		2100	207,900	543,000
	CONTINGENCY	251,325	$99		2100	207,900	459,225
	TOTAL CONSTRUCTION COST	**2,261,925**	**$1,188**			**2,494,800**	**4,756,725**
	TOTAL INVESTMENT COST	**2,261,925**	**$1,188**			**2,494,800**	**4,756,725**

COST ANALYSIS OF COMPARABLE DIESEL
AND HYDRO GENERATED POWER SCHEMES
PROJECT: LOKOBORO
DEMAND CENTER: WAIKABUBAK
CAPACITY: 660 kW

COMPARABLE DIESEL GENERATED POWER SCHEME

Number of Generators to produce a comparable output capacity of 660 kW:

Multiplier	1.67
Number of 250 kW diesel units to meet a constant 2500kW capacity:	6

*All costs are expressed in current Rupiahs		Cost/ unit x 1000 Rp	# of units	Total Cost x 1000	Annual Real Cost Escalation
Capitalization Costs:	Initial capital expenditure per unit	241,115	6	1,446,690	*
	Major overhaul cost per unit	50,000	6	300,000	2%
Annualized Costs:	Diesel fuel costs per year/ unit	106,731	6	634,386	3%
	Lubrication cost per year/ unit	7,092	6	42,492	3%
	Operation & Administrative cost/year	20,000	1	20,000	0%

Year	Capital Exp. x 1000Rp	Major Overhaul x 1000 Rp	Diesel & lube Exp. x 1000 Rp	Operation Exp. x 1000 Rp	Total Cost x 1000 Rp	Present Value at 8%	Present Value at 10%	Present Value at 12%	Present Value at 14%
0	1,446,690				1,446,690	1,446,690	1,446,690	1,446,690	1,446,690
1			676,878	20,000	696,878	645,257	633,525	622,213	611,296
2			697,184	20,000	717,184	614,870	592,714	571,735	551,850
3			718,100	20,000	738,100	585,927	554,545	525,365	498,198
4			739,643	20,000	759,643	558,360	518,846	482,767	449,770
5		330,000	761,832	20,000	1,111,832	756,694	690,360	630,883	577,461
6			784,687	20,000	804,687	507,089	454,225	407,680	366,605
7			808,228	20,000	828,228	483,263	425,012	374,648	330,991
8			832,475	20,000	852,475	460,565	397,686	344,300	298,843
9		356,400	857,449	20,000	1,233,849	617,232	523,272	444,838	379,418
10			883,172	20,000	903,172	418,344	348,212	290,797	243,625
11			909,667	20,000	929,667	398,718	325,843	267,257	219,975
12			936,957	20,000	956,957	380,021	304,916	245,627	198,625
13		384,912	965,066	20,000	1,369,978	503,738	396,834	313,964	249,431
14			994,018	20,000	1,014,018	345,234	267,023	207,488	161,949
15			1,023,839	20,000	1,043,839	329,061	249,887	190,705	146,238
16			1,054,554	20,000	1,074,554	313,652	233,854	175,283	132,054
17		415,705	1,086,190	20,000	1,521,895	411,321	301,099	221,655	164,060
18			1,118,776	20,000	1,138,776	284,978	204,819	148,086	107,684
19			1,152,339	20,000	1,172,339	271,645	191,687	136,117	97,244
20			1,186,910	20,000	1,206,910	258,940	179,399	125,116	87,817
21		448,961	1,222,517	20,000	1,691,478	336,022	228,570	156,563	107,960
22			1,259,192	20,000	1,279,192	235,295	157,144	106,716	71,619
23			1,296,968	20,000	1,316,968	224,300	147,077	97,176	64,679
24			1,335,877	20,000	1,355,877	213,921	137,656	89,328	58,412
25			1,375,954	20,000	1,395,954	203,834	128,941	82,115	52,753
Total cost discounted over the life of the diesel generators:						9,098,058	7,368,807	6,083,575	5,066,399

Observed Cost per kilowatt hour:

Total Cost incurred over the life of the of the project:	28,561,142
Total Kilowatt hours produced over the 25 years:	112,425,000
Total Cost per kilowatt hour (Rp):	**254.05**

COST ANALYSIS OF COMPARABLE DIESEL
AND HYDRO GENERATED POWER SCHEMES
PROJECT: LOKOBORO
DEMAND CENTER: WAIKABUBAK
CAPACITY: 880 kW
26-Oct-93

HYDRO GENERATED POWER SCHEME

		Cost x 1000 Rp
***All costs are expressed in current Rupiahs**		
Capitalization Costs:	Initial capital expenditure	4,786,726
Annualized Costs:	Operation & Adm. Expense per year	20,000
	Maintenance Expense per year.	10,000

Year	Capital Exp. x 1000Rp	Operation. Exp. x 1000 Rp	Main. Exp. x 1000 Rp	Total Cost x 1000 Rp	Present Value at 8%	Present Value at 10%	Present Value at 12%	Present Value at 14%
0	0	0	0	0				
1	1,851,266	0	0	1,851,266	1,714,135	1,682,969	1,652,916	1,623,918
2	2,935,460	0	0	2,935,460	2,516,684	2,426,000	2,340,131	2,258,741
3		20,000	10,000	30,000	23,815	22,539	21,353	20,248
4		20,000	10,000	30,000	22,051	20,490	19,066	17,762
5		20,000	10,000	30,000	20,417	18,628	17,023	15,581
6		20,000	10,000	30,000	18,905	16,934	15,199	13,668
7		20,000	10,000	30,000	17,505	15,395	13,570	11,989
8		20,000	10,000	30,000	16,208	13,995	12,116	10,517
9		20,000	10,000	30,000	15,007	12,723	10,818	9,225
10		20,000	10,000	30,000	13,896	11,566	9,659	8,092
11		20,000	10,000	30,000	12,866	10,515	8,624	7,099
12		20,000	10,000	30,000	11,913	9,559	7,700	6,227
13		20,000	10,000	30,000	11,031	8,690	6,875	5,462
14		20,000	10,000	30,000	10,214	7,900	6,139	4,791
15		20,000	10,000	30,000	9,457	7,182	5,481	4,203
16		20,000	10,000	30,000	8,757	6,529	4,894	3,687
17		20,000	10,000	30,000	8,108	5,935	4,369	3,234
18		20,000	10,000	30,000	7,507	5,396	3,901	2,837
19		20,000	10,000	30,000	6,951	4,905	3,483	2,488
20		20,000	10,000	30,000	6,436	4,459	3,110	2,183
21		20,000	10,000	30,000	5,960	4,054	2,777	1,915
22		20,000	10,000	30,000	5,518	3,686	2,479	1,680
23		20,000	10,000	30,000	5,109	3,350	2,214	1,473
24		20,000	10,000	30,000	4,731	3,046	1,976	1,292
25		20,000	10,000	30,000	4,381	2,769	1,765	1,134
Total cost discounted over the life of the hydro:					4,497,564	4,329,214	4,177,639	4,039,447

Capacity Factor:		**70%**	**60%**	**50%**
Observed Cost per kilowatt hour:				
Total Cost incurred over the life of the of the project:		5,476,726	5,476,726	5,476,726
Total Kilowatt hours produced over the 25 years:		78,697,500	67,455,000	56,212,500
Total Cost per kilowatt hour:		**69.59**	**81.18**	**97.43**

KOLONDOM MINI-HYDRO PROJECT

Location - Central Sulewesi, PLN Region 11
Capacity - 1,400 KW
Project estimated cost (Oct 1993 USD) - $3,677,279
Project cost per KW in USD - $2,627
Foreign component cost - $1,378,000
(Turbine/Generator unit and consultant)

Current Status of Project:

1. Completion of project detailed design

A feasibility study for the Kolondom mini-hydro project was completed in 1989 by P.T. Indra Karya. PLN PISFP has contracted P.T. Geo Ace for the detailed design which is scheduled for completion by July 1994. A field team from P.T. Geo Ace is presently at the site location. After a review of the completed detailed design, PISFP will submit the tender documents to KDAH.

2. Estimate of project cost change

The August 1993 Cost Estimate Summary has been amended to increase the cost of electro/mechanical equipment and some civil works areas. In reviewing the August 1993 data with PLN KDAH, there was concern on the part of procurement that the REII project electro/mechanical costs were low in comparison with 4 U.K. mini-hydro projects currently in KDAH for procurement. The U.K. projects will be installed utilizing an on site foreign contractor for electro/mechanical. The higher U.K. costs include foreign contractor mobilization costs and same country lender/supplier considerations. The U.K. electro/mechanical cost average is $1,000 USD per installed KW which is considered high by industry standards. The REII August estimates averaged $650 USD per installed KW. The current October estimate of electro/mechanical cost is $850 USD per installed KW. Suppliers consulted were Fuji Electric - Japan, Hydro West Group - USA, and American Hydro - USA.

3. Required on-site services by foreign supplier

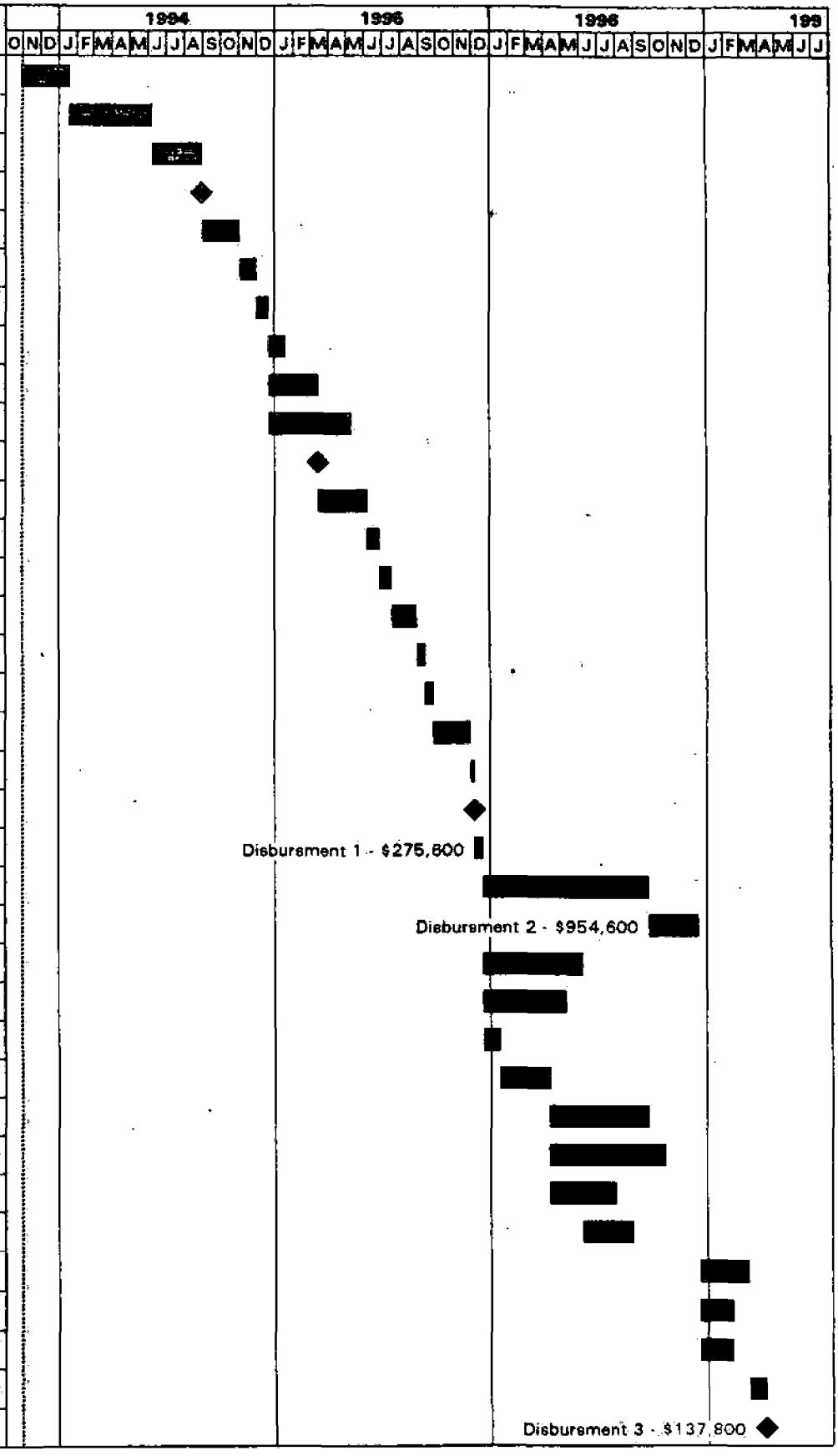
Foreign suppliers of pre-packaged turbine/generator units for the REII projects should supply on-site consulting with the local contractor to insure powerhouse, penstock and civil works integration and compatibility with the suppliers equipment design. Installation and commissioning will also require supplier consultant services with the local contractor.

6. Land procurement

The Kolondom project is sited primarily on unused land. The Headworks and all but 100 meters of headrace canal is located on unimproved property. Near the termination of the headrace canal, approximately 100 meters of canal, including the headrace pondage, will be located in a area of clove trees. Current PLN policy is to pay Rp. 2,500 cutting charge per tree removed, with no compensation payment. The estimated number of trees involved is less that 30.

IMPLEMENTATION SCHEDULE, MINI-HYDRO PROJECT - KOLONDOM

ID	Name	Duration
1	PISFP Consultant Field Work	60d
2	Consultant Preparation of Design	100d
3	PISFP Document Review	60d
4	Tender Docs. to KDAH	0d
5	KDAH Document Preparation	45d
6	Advertising	20d
7	Issue Bid Document	15d
8	Site Visit and Pre Bid Conference	20d
9	Bid Preparation by Suppliers	60d
10	Land Negotiation and Purchase	100d
11	Bid Submission by Suppliers	0d
12	KDAH Bid Evaluation	60d
13	KDAH Final Report	15d
14	Approval by PLN Boerd of Dir.	15d
15	Approval by Minister of Finance	30d
16	Approval by IBRD	10d
17	Issue Letter of Intent to Suppliers	10d
18	Contract Discussion / Finalization	45d
19	BAPPENAS Approval	5d
20	Contract Signing / Eff. Start Date	0d
21	Disburement of Startup Funds	10d
22	Turbine/Generator Manufactured	200d
23	Turbine/Generator Shipping	60d
24	Electrical Equip. and Shipping	120d
25	Materials Aquisition and Shipping	100d
26	Construction Mobilization	20d
27	Access and Site Preparation	60d
28	Headworks Construction	120d
29	Headrace canal Construction	140d
30	Powerhouse Construction	80d
31	Penstock Installation	60d
32	Turbine / Generator Installation	60d
33	Electrical Switchgear Installation	40d
34	Operator House / Fencing	40d
35	Testing and Commissioning	20d
36	Project Acceptance	0d



Total project cost in USD $3,677,279 / Foreign componant - $1,378,000

COST ESTIMATE SUMMARY

MINI HYDRO DEVELOPMENT PROJECT
PROJECT: KOLONDOM
DEMAND CENTER: TOLITOLI
CAPACITY: 1400 TOTAL COST IN USD $3,677,279
Date: Oct 26, 1993 USD COST/KW $2,627

CODE	DESCRIPTION	LOCAL CURRENCY TOTAL x1000 Rp	FOREIGN CURRENCY UNIT PRICE $ U.S.	FOREIGN CURRENCY TOTAL x1000	EQUIVALENT IN RUPIAHS EXCHANGE RATE	EQUIVALENT IN RUPIAHS TOTAL x1000Rp	TOTAL x 1000 Rp
0.0	LAND AND LAND RIGHTS (30,000 sq/m @ rp 2,000)	60,000		0		0	60,000
	PROJECT DIRECT COST						
	CIVIL WORK						
1.0	General	260,000		0		0	260,000
2.0	Land Clearing and Fencing	30,000		0		0	30,000
3.0	Access Road	40,000		0		0	40,000
4.0	Bridges	0		0		0	
5.0	Headwork Water Control	842,000		0		0	842,000
6.0	Canal 585 M	568,000		0		0	568,000
7.0	Headrace Penstock	540,000		0		0	540,000
8.0	Powerhouse Civil	62,000		0		0	62,000
9.0	Tail Race	8,000		0		0	8,000
10.0	Switchyard Civil	5,000		0		0	5,000
11.0	Operator House and Yard	25,000		0		0	25,000
	SUB TOTAL CIVIL WORK	2,380,000		0		0	2,380,000
	GENERATING AND SWITCH YARD EQUIPMENT						
M-1	Prepackaged turbine/generator set	24,500	$1,190		2100	2,499,000	2,523,500
E-1	Electrical equipment	219,000	$0		2100	0	219,000
E-2	Switchyard Equipment	150,000	$0			0	150,000
	SUBTOTAL GENERATING AND SWITCHYARD EQUIPMENT	393,500	$1,190			2,499,000	2,892,500
	SUBTOTAL PROJECT DIRECT COST	2,773,500	$1,190			2,499,000	5,272,500
	PROJECT INDIRECT COST						
I-1	Project Management Services	140,000	$80		2100	168,000	308,000
I-2	Start Up and Commissioning	10,000	$20		2100	42,000	52,000
I-3	Engineering	180,000	$88		2100	184,800	364,800
	SUBTOTAL PROJECT INDIRECT COST	330,000	$188			394,800	724,800
	TOTAL DIRECT AND INDIRECT COST	3,103,500	$1,378			2,893,800	5,997,300
	Risk 10% PPN 10%	620,700	$138		2100	289,380	910,080
	CONTINGENCY	465,525	$138		2100	289,380	754,905
	TOTAL CONSTRUCTION COST	4,189,725	$1,654			3,472,560	7,662,285
	TOTAL INVESTMENT COST	4,249,725	$1,654			3,472,560	7,722,285

COST ANALYSIS OF COMPARABLE DIESEL
AND HYDRO GENERATED POWER SCHEMES
PROJECT: KOLONDOM
DEMAND CENTER: TOLI TOLI
CAPACITY: 1400 kW
28-Oct-93

HYDRO GENERATED POWER SCHEME

*All costs are expressed in current Rupiahs		Cost x 1000 Rp
Capitalization Costs:	Initial capital expenditure	7,722,285
Annualized Costs:	Operation & Adm. Expense per year	20,000
	Maintenance Expense per year	10,000

Year	Capital Exp. x 1000Rp	Operation. Exp. x 1000 Rp	Main. Exp. x 1000 Rp	Total Cost x 1000 Rp	Present Value at 8%	Present Value at 10%	Present Value at 12%	Present Value at 14%
0	0	0	0	0				
1	3,088,914	0	0	3,088,914	2,860,106	2,808,104	2,757,959	2,709,574
2	4,633,371	0	0	4,633,371	3,972,369	3,829,232	3,693,695	3,565,229
3		20,000	10,000	30,000	23,815	22,539	21,353	20,249
4		20,000	10,000	30,000	22,051	20,490	19,066	17,762
5		20,000	10,000	30,000	20,417	18,628	17,023	15,581
6		20,000	10,000	30,000	18,905	16,934	15,199	13,668
7		20,000	10,000	30,000	17,505	15,395	13,570	11,989
8		20,000	10,000	30,000	16,208	13,995	12,116	10,517
9		20,000	10,000	30,000	15,007	12,723	10,818	9,225
10		20,000	10,000	30,000	13,896	11,566	9,659	8,092
11		20,000	10,000	30,000	12,866	10,515	8,624	7,099
12		20,000	10,000	30,000	11,913	9,559	7,700	6,227
13		20,000	10,000	30,000	11,031	8,690	6,875	5,462
14		20,000	10,000	30,000	10,214	7,900	6,139	4,791
15		20,000	10,000	30,000	9,457	7,182	5,481	4,203
16		20,000	10,000	30,000	8,757	6,529	4,894	3,687
17		20,000	10,000	30,000	8,108	5,935	4,369	3,234
18		20,000	10,000	30,000	7,507	5,396	3,901	2,837
19		20,000	10,000	30,000	6,951	4,905	3,483	2,488
20		20,000	10,000	30,000	6,436	4,459	3,110	2,183
21		20,000	10,000	30,000	5,960	4,054	2,777	1,915
22		20,000	10,000	30,000	5,518	3,685	2,479	1,680
23		20,000	10,000	30,000	5,109	3,350	2,214	1,473
24		20,000	10,000	30,000	4,731	3,046	1,976	1,292
25		20,000	10,000	30,000	4,381	2,769	1,765	1,134
Total cost discounted over the life of the hydro:					7,099,220	6,857,581	6,636,247	6,431,590

Observed Cost per kilowatt hour:			
Capacity Factor	**70%**	**60%**	**50%**
Total Cost incurred over the life of the of the project:	8,412,285	8,412,285	8,412,285
Total Kilowatt hours produced over the 25 years:	183,750,000	157,500,000	131,250,000
Total Cost per kilowatt hour:	**45.78**	**53.41**	**64.09**

COST ANALYSIS OF COMPARABLE DIESEL
AND HYDRO GENERATED POWER SCHEMES
PROJECT: KOLONDOM
DEMAND CENTER: TOLI TOLI
CAPACITY: 1500 kW

COMPARABLE DIESEL GENERATED POWER SCHEME

Number of Generators to produce a comparable output capacity of 1500 kW:

Multiplier	1.67
Number of 250 kW diesel units to meet a constant 1500kW capacity:	10

*All costs are expressed in current Rupiahs		Cost/ unit x 1000 Rp	# of units	Total Cost x 1000	Annual Real Cost Escalation
Capitalization Costs:	Initial capital expenditure per unit	241,115	10	2,411,150	*
	Major overhaul cost per unit	50,000	10	500,000	2%
Annualized Costs:	Diesel fuel costs per year/ unit	105,731	10	1,057,310	3%
	Lubrication cost per year/ unit	7,082	10	70,820	3%
	Operation & Administrative cost/year	20,000	1	20,000	0%

Year	Capital Exp. x 1000Rp	Major Overhaul x 1000 Rp	Diesel & lube Exp. x 1000 Rp	Operation Exp. x 1000 Rp	Total Cost x 1000 Rp	Present Value at 8%	Present Value at 10%	Present Value at 12%	Present Value at 14%
0	2,411,150				2,411,150	2,411,150	2,411,150	2,411,150	2,411,150
1			1,128,130	20,000	1,148,130	1,063,083	1,043,755	1,025,116	1,007,132
2			1,181,974	20,000	1,181,974	1,013,352	976,838	942,262	909,491
3			1,196,833	20,000	1,216,833	965,961	914,225	866,118	821,328
4			1,232,738	20,000	1,252,738	920,800	855,637	796,138	741,722
5		550,000	1,269,720	20,000	1,839,720	1,252,083	1,142,322	1,043,907	955,493
6			1,307,812	20,000	1,327,812	838,747	749,515	672,711	604,933
7			1,347,046	20,000	1,367,046	797,658	701,511	618,382	548,323
8			1,387,458	20,000	1,407,458	760,406	656,589	568,449	493,397
9		594,000	1,429,081	20,000	2,043,081	1,022,049	866,486	736,756	628,264
10			1,471,954	20,000	1,491,954	691,063	575,213	480,369	402,445
11			1,516,112	20,000	1,536,112	658,812	536,398	441,598	363,471
12			1,561,596	20,000	1,581,596	628,073	503,945	406,958	328,275
13		641,520	1,608,444	20,000	2,269,964	834,661	667,528	520,217	413,291
14			1,656,697	20,000	1,676,697	570,650	441,527	343,085	267,786
15			1,706,398	20,000	1,726,398	544,233	413,298	315,406	241,862
16			1,757,590	20,000	1,777,590	518,862	386,855	289,963	218,451
17		692,842	1,810,317	20,000	2,523,159	681,932	499,194	367,484	271,996
18			1,864,627	20,000	1,884,627	471,626	338,967	245,076	178,212
19			1,920,566	20,000	1,940,566	449,653	317,298	225,313	160,967
20			1,978,183	20,000	1,998,183	428,707	297,017	207,145	145,391
21		748,269	2,037,528	20,000	2,805,797	557,388	379,149	259,703	179,063
22			2,098,654	20,000	2,118,654	389,706	260,268	175,091	118,619
23			2,161,614	20,000	2,181,614	371,562	243,639	160,977	107,144
24			2,226,462	20,000	2,246,462	354,266	228,073	148,002	96,779
25			2,293,256	20,000	2,313,256	337,777	213,504	136,073	87,418
Total cost discounted over the life of the diesel generators:						15,044,873	12,180,125	10,023,917	8,372,648

Observed Cost per kilowatt hour:

Total Cost incurred over the life of the of the project:	47,268,570
Total Kilowatt hours produced over the 26 years:	262,500,000
Total Cost per kilowatt hour (Rp):	**180.07**

WERBA MINI-HYDRO PROJECT

Location - Irian Jaya, PLN Region 10
Capacity - 1,400 KW
Project estimated cost (Oct 1993 USD) - $3,923,012
Project cost per KW in USD - $2,802
Foreign component cost - $1,410,000
(Turbine/Generator unit and consultant)

Current Status of Project:

1. Completion of project detailed design

A feasibility study for the Werba mini-hydro project was completed in 1991 by P.T. Trikarsa Sarana Tekindo. PLN PISFP has contracted P.T. Geo Ace for the detailed design which is scheduled for completion by July 1994. A field team from P.T. Geo Ace is presently at the site location. After a review of the completed detailed design, PISFP will submit the tender documents to KDAH.

2. Estimate of project cost change

The August 1993 Cost Estimate Summary has been amended to increase the cost of electro/mechanical equipment and some civil works areas. In reviewing the August 1993 data with PLN KDAH, there was concern on the part of procurement that the REII project electro/mechanical costs were low in comparison with 4 U.K. mini-hydro projects currently in KDAH for procurement. The U.K. projects will be installed utilizing an on site foreign contractor for electro/mechanical. The higher U.K. costs include foreign contractor mobilization costs and same country lender/supplier considerations. The U.K. electro/mechanical cost average is $1,000 USD per installed KW which is considered high by industry standards. The REII August estimates averaged $650 USD per installed KW. The current October estimate of electro/mechanical cost is $850 USD per installed KW. Suppliers consulted were Fuji Electric - Japan, Hydro West Group - USA, and American Hydro - USA.

3. Required on-site services by foreign supplier

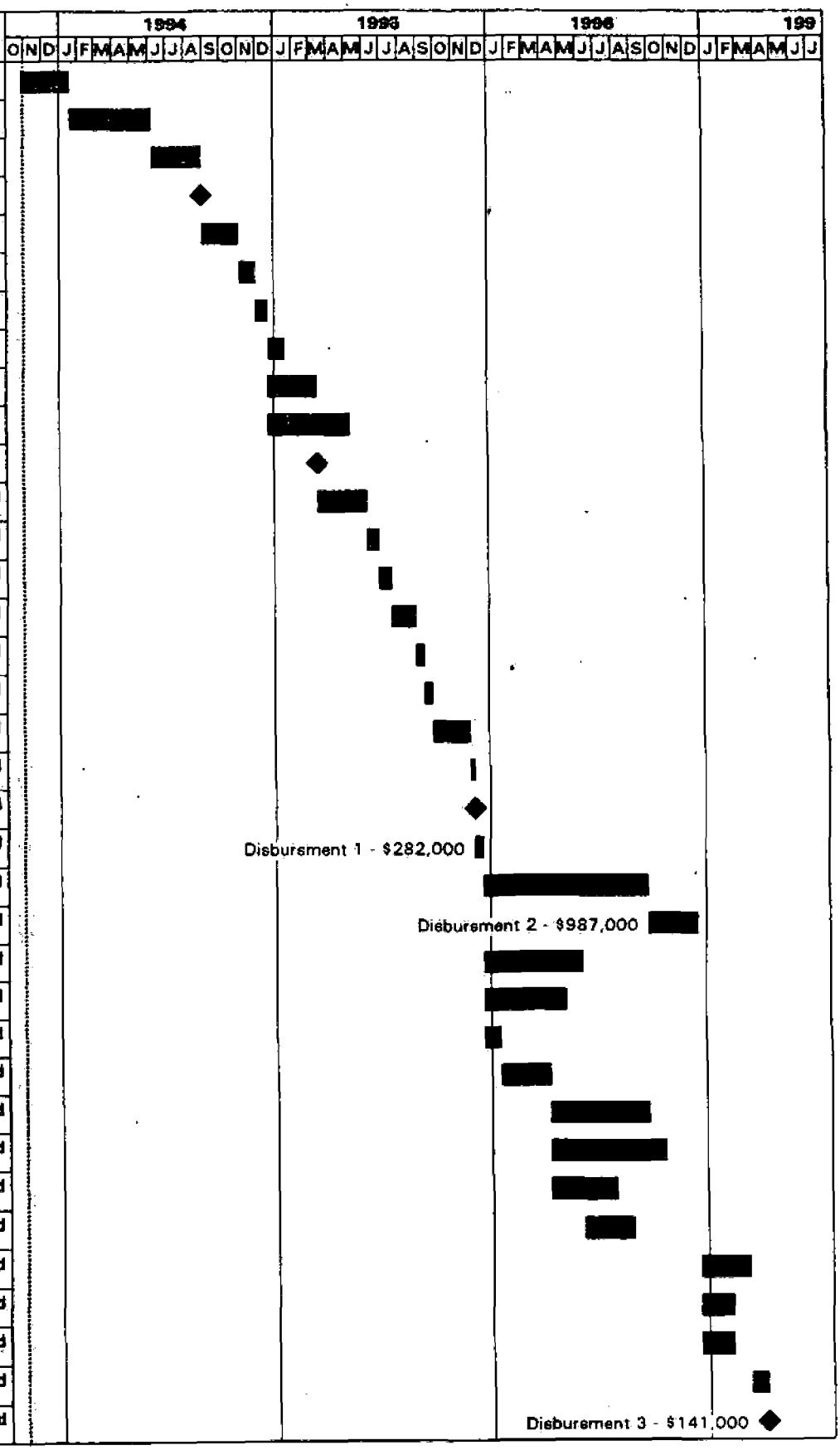
Foreign suppliers of pre-packaged turbine/generator units for the REII projects should supply on-site consulting with the local contractor to insure powerhouse, penstock and civil works integration and compatibility with the suppliers equipment design. Installation and commissioning will also require supplier consultant services with the local contractor.

4. Land procurement

The Werba project is sited primarily on unused land. The 1500 meter headrace canal is located in a forested area. Near the termination of the headrace canal, there is a garden area presently out of cultivation. Several trees are also located in the garden area. Current PLN policy is to pay Rp. 2,500 cutting charge per tree removed, with no compensation payment. The estimated number of trees involved is 5.

IMPLEMENTATION SCHEDULE, MINI-HYDRO PROJECT - WERBA

ID	Name	Duration
1	PISFP Consultant Field Work	60d
2	Consultant Preparation of Design	100d
3	PISFP Document Review	60d
4	Tender Docs. to KDAH	0d
5	KDAH Document Preparation	45d
6	Advertising	20d
7	Issue Bid Document	15d
8	Site Visit and Pre Bid Conference	20d
9	Bid Preparation by Suppliers	60d
10	Land Negotiation and Purchase	100d
11	Bid Submission by Suppliers	0d
12	KDAH Bid Evaluation	60d
13	KDAH Final Report	15d
14	Approval by PLN Board of Dir.	15d
15	Approval by Minister of Finance	30d
16	Approval by IBRD	10d
17	Issue Letter of Intent to Suppliers	10d
18	Contract Discussion / Finalization	45d
19	BAPPENAS Approval	5d
20	Contract Signing / Eff. Start Date	0d
21	Disbursment of Startup Funds	10d
22	Turbine/Generator Manufactured	200d
23	Turbine/Generator Shipping	60d
24	Electrical Equip. and Shipping	120d
25	Materials Aquisition and Shipping	100d
26	Construction Mobilization	20d
27	Access and Site Preparation	60d
28	Headworks Construction	120d
29	Headrace canal Construction	140d
30	Powerhouse Construction	80d
31	Penstock Installation	60d
32	Turbine / Generator Installation	60d
33	Electrical Switchgear Installation	40d
34	Operator House / Fencing	40d
35	Testing and Commissioning	20d
36	Project Acceptance	0d



Total project cost in USD $3,923,012 / Foreign componant - $1,410,000

COST ESTIMATE SUMMARY

MINI HYDRO DEVELOPMENT PROJECT
PROJECT: WERBA
DEMAND CENTER: FAK FAK
CAPACITY: 1400 KW — TOTAL COST IN USD — $3,923,012
Date: Oct 26, 1993 — USD COST/kw. — $2,802

CODE	DESCRIPTION	LOCAL CURRENCY TOTAL x1000 Rp	FOREIGN CURRENCY UNIT PRICE $ U.S.	FOREIGN CURRENCY TOTAL x1000	EXCHANGE RATE	EQUIVALENT IN RUPIAHS TOTAL x1000Rp	TOTAL x 1000 Rp
0.0	LAND AND LAND RIGHTS	86,000		0		0	86,000
	(30,000 sq/m @ rp 2,000)						
	PROJECT DIRECT COST						
	CIVIL WORK						
1.0	General	260,000		0		0	260,000
2.0	Land Clearing and Fencing	45,000		0		0	45,000
3.0	Access Road	40,000		0		0	40,000
4.0	Bridges	0		0		0	
5.0	Headwork Water Control	650,000		0		0	650,000
6.0	Open canal 1500 M	1,200,000		0		0	1,200,000
7.0	Headrace Penstock	450,000		0		0	450,000
8.0	Powerhouse Civil	62,000		0		0	62,000
9.0	Tail Race	8,000		0		0	8,000
10.0	Switchyard Civil	5,000		0		0	5,000
11.0	Operator House and Yard	25,000		0		0	25,000
	SUB TOTAL CIVIL WORK	2,745,000		0		0	2,745,000
	GENERATING AND SWITCH YARD EQUIPMENT						
M-1	Prepackaged turbine/generator set	24,500	$1,190		2100	2,499,000	2,523,500
E-1	Electrical equipment	219,000	$0		2100	0	219,000
E-2	Switchyard Equipment	150,000	$0			0	150,000
	SUBTOTAL GENERATING AND SWITCHYARD EQUIPMENT	393,500	$1,190			2,499,000	2,892,500
	SUBTOTAL PROJECT DIRECT COST	3,138,500	$1,190			2,499,000	5,637,500
	PROJECT INDIRECT COST						
I-1	Project Management Services	125,000	$90		2100	189,000	314,000
I-2	Start Up and Commissioning	10,000	$30		2100	63,000	73,000
I-3	Engineering	134,000	$100		2100	210,000	344,000
	SUBTOTAL PROJECT INDIRECT COST	269,000	$220			462,000	731,000
	TOTAL DIRECT AND INDIRECT COST	3,407,500	$1,410			2,961,000	6,368,500
	Risk 10% PPN 10%	681,500	$141		2100	296,100	977,600
	CONTINGENCY	511,125	$141		2100	296,100	807,225
	TOTAL CONSTRUCTION COST	4,600,125	$1,692			3,553,200	8,153,325
	TOTAL INVESTMENT COST	4,686,125	$1,692			3,553,200	8,239,325

COST ANALYSIS OF COMPARABLE DIESEL
AND HYDRO GENERATED POWER SCHEMES
PROJECT: WERBA
DEMAND CENTER: FAK FAK
CAPACITY: 1400 kw
26-Oct-93

HYDRO GENERATED POWER SCHEME

*All costs are expressed in current Rupiahs		Cost x 1000 Rp
Capitalization Costs:	Initial capital expenditure	8,238,325
Annualized Costs:	Operation & Adm. Expense per year	20,000
	Maintenance Expense per year	10,000

Year	Capital Exp. x 1000Rp	Operation. Exp. x 1000 Rp	Main. Exp. x 1000 Rp	Total Cost x 1000 Rp	Present Value at 8%	Present Value at 10%	Present Value at 12%	Present Value at 14%
0	0	0	0	0				
1	3,295,330	0	0	3,295,330	3,051,231	2,995,755	2,942,259	2,890,640
2	4,942,995	0	0	4,942,995	4,237,822	4,085,120	3,940,525	3,803,474
3		20,000	10,000	30,000	23,815	22,539	21,353	20,249
4		20,000	10,000	30,000	22,051	20,490	19,068	17,762
5		20,000	10,000	30,000	20,417	18,628	17,023	15,581
6		20,000	10,000	30,000	18,905	16,934	15,199	13,668
7		20,000	10,000	30,000	17,505	15,395	13,570	11,989
8		20,000	10,000	30,000	16,208	13,995	12,116	10,517
9		20,000	10,000	30,000	15,007	12,723	10,818	9,225
10		20,000	10,000	30,000	13,896	11,566	9,659	8,092
11		20,000	10,000	30,000	12,866	10,515	8,624	7,099
12		20,000	10,000	30,000	11,913	9,559	7,700	6,227
13		20,000	10,000	30,000	11,031	8,690	6,875	5,462
14		20,000	10,000	30,000	10,214	7,900	6,139	4,791
15		20,000	10,000	30,000	9,457	7,182	5,481	4,203
16		20,000	10,000	30,000	8,757	6,529	4,894	3,687
17		20,000	10,000	30,000	8,108	5,935	4,369	3,234
18		20,000	10,000	30,000	7,507	5,396	3,901	2,837
19		20,000	10,000	30,000	6,951	4,905	3,483	2,488
20		20,000	10,000	30,000	6,436	4,459	3,110	2,183
21		20,000	10,000	30,000	5,960	4,054	2,777	1,915
22		20,000	10,000	30,000	5,518	3,686	2,479	1,680
23		20,000	10,000	30,000	5,109	3,350	2,214	1,473
24		20,000	10,000	30,000	4,731	3,046	1,976	1,292
25		20,000	10,000	30,000	4,381	2,769	1,765	1,134
Total cost discounted over the life of the hydro:					7,556,798	7,301,119	7,067,377	6,850,903

Observed Cost per kilowatt hour:			
Capacity Factor:	70%	80%	50%
Total Cost incurred over the life of the of the project:	8,928,325	8,928,325	8,928,325
Total Kilowatt hours produced over the 25 years:	137,970,000	118,260,000	98,550,000
Total Cost per kilowatt hour:	64.71	75.50	90.60

COST ANALYSIS OF COMPARABLE DIESEL
AND HYDRO GENERATED POWER SCHEMES
PROJECT: WERBA
DEMAND CENTER: FAK FAK
CAPACITY:900 kW

COMPARABLE DIESEL GENERATED POWER SCHEME

Number of Generators to produce a comparable output capacity of 1200 kW:

Multiplier 1.67
Number of 250 kW diesel units to meet a constant 2500kW capacity: 8

*All costs are expressed in current Rupiahs		Cost/ unit x 1000 Rp	# of units	Total Cost x 1000	Annual Real Cost Escalation
Capitalization Costs:	Initial capital expenditure per unit	241,115	8	1,928,920	
	Major overhaul cost per unit	50,000	8	400,000	2%
Annualized Costs:	Diesel fuel costs per year/ unit	105,731	8	845,848	3%
	Lubrication cost per year/ unit	7,082	8	56,656	3%
	Operation & Administrative cost/year	20,000	1	20,000	0%

Year	Capital Exp. x 1000Rp	Major Overhaul x 1000 Rp	Diesel & lube Exp. x 1000 Rp	Operation Exp. x 1000 Rp	Total Cost x 1000 Rp	Present Value at 8%	Present Value at 10%	Present Value at 12%	Present Value at 14%
0	1,928,920				1,928,920	1,928,920	1,928,920	1,928,920	1,928,920
1			902,504	20,000	922,504	854,170	838,640	823,664	808,214
2			929,579	20,000	949,579	814,111	784,776	758,999	730,670
3			957,466	20,000	977,466	776,944	734,385	695,741	659,782
4			986,190	20,000	1,006,190	733,580	687,242	639,452	595,748
5		440,000	1,015,776	20,000	1,475,776	1,004,388	916,341	837,395	766,472
6			1,046,249	20,000	1,066,249	671,918	601,870	540,195	485,769
7			1,077,637	20,000	1,097,637	640,461	563,261	496,515	438,657
8			1,109,966	20,000	1,129,966	610,488	527,138	458,374	396,120
9		475,200	1,143,265	20,000	1,638,465	819,640	694,869	590,847	503,841
10			1,177,563	20,000	1,197,563	554,703	461,712	385,583	323,035
11			1,212,890	20,000	1,232,890	528,765	432,120	354,426	291,723
12			1,249,277	20,000	1,269,277	504,047	404,431	325,792	263,450
13		513,218	1,286,755	20,000	1,819,971	669,200	527,161	417,090	331,361
14			1,325,358	20,000	1,345,358	458,042	354,276	276,287	214,867
15			1,365,118	20,000	1,385,118	436,847	331,588	253,058	194,050
16			1,406,072	20,000	1,426,072	416,267	310,355	232,623	175,252
17		554,273	1,448,254	20,000	2,022,527	546,626	400,146	294,670	218,028
18			1,491,702	20,000	1,511,702	378,302	271,893	196,581	142,948
19			1,536,453	20,000	1,556,453	360,649	254,492	180,715	129,105
20			1,582,546	20,000	1,602,546	343,823	238,208	166,131	116,604
21		598,615	1,630,023	20,000	2,248,638	446,705	303,880	208,133	143,522
22			1,678,923	20,000	1,698,923	312,501	208,708	140,403	95,119
23			1,729,291	20,000	1,749,291	297,931	195,358	129,077	85,911
24			1,781,170	20,000	1,801,170	284,043	182,865	118,665	77,596
25			1,834,605	20,000	1,854,605	270,808	171,173	109,094	70,066
Total cost discounted over the life of the diesel generators:						12,071,485	9,773,468	8,043,746	6,719,024

Observed Cost per kilowatt hour:

Total Cost incurred over the life of the of the project:	37,914,856
Total Kilowatt hours produced over the 25 years:	197,100,000
Total Cost per kilowatt hour (Rp):	**192.36**

REII APPRAISL - MINI HYDRO PROJECTS Oct-93

PROJECT	1994 LC	1994 FC	1995 LC	1995 FC	1996 LC	1996 FC	1997 LC	1997 FC	TOTAL
Ulung Peliang		20	463	185	308	741			1,717
Bambalo		20	998	515	665	1,830			4,028
Kolondom			296	332	886	907	296	13	2,856
Lokomboro		20	479	232	319	738			1,788
Werba			324	268	974	913	324	22	3,032
TOTAL constcost x1000$US (Converstion rte 2100)	**0**	**60**	**2560**	**1,532**	**3,152**	**5,129**	**620**	**36**	**13,421**
PPN Tax					1,467		538		2,006
Contingency					727	497	264	22	1,717
TOTAL for contingency and tax					**2,194**	**497**	**802**	**22**	**3,722**
TOTAL all cots (Less FC tax / PN shown in Oct 26 simmary)									17,143

SYSTEM EQUIPMENT STANDARDIZATION

PROCUREMENT - JANUARY 1994

Ulung Peliang H = 64 M Q = 2.1 M/sec P = 1597 HP RPM = 1000	FB 1 unit standardized turbine generator LB 1 unit standardized switchgear / panels
Bambalo H = 64 M Q = 3.4 M/sec P = 1830 HP RPM = 1000	FB 2 units standardized turbine generator LB 2 units standardized switchgear / panels

PROCUREMENT - AUGUST 1994

Kolondom H = 70 M Q = 2.5 M/sec P = 2100 HP RPM = 1000	FB 1 unit standardized turbine generator LB 1 unit standardized switchgear / panels
Werba H = 70 M Q = 2.5 P = 2100 HP RPM = 1000	FB 1 unit standardized turbine generator LB 1 unit standardized switchgear / panels

Total of 5 standardized turbine / generators and 5 standardized switchgear / panel sets.

Powerhouse design can also be standardized at the 4 locations which have single unit installation of turbine/generator set.

Prior to PLN procurement, the option of standardization needs to be studied and a set of specifications supplied for the procurement process. Some minor changes in penstock diameter specification may also be required. A single supplier source of the 5 pre-packaged units will reduce costs, lower spare parts inventory and simplify continued support and operation.

Foreign bid - 5 pre-packaged turbine/generator units.
Local bid - 5 panel and switchgear sets.

For non-standardized Lokomboro system :
Foreign bid - 1 pre-packaged turbine/generator unit.
Local bid - 1 panel and switchgear set.

GEOTHERMAL PROSPECTS IN INDONESIA : ESTIMATED RESOURCES AND ITS RESEVOIR CHARACTERISTICS

1992/YS

PROSPECT	POTENTIAL (MW)				PROVED BY : DeepWell (DW) SlimHole (SH) GradHole (GH) SurfaceExp(SE)	RESERVOIR CHARACTERISTICS				
	INSTALLED	PROVEN	PROBABLE	RESOURCES		DEPTH TO RESERVOIR (m)	T oC or G oC/10 m	P bar	SYSTEM & DRYNESS (%)	GAS CONTENT (% Weight)
SUMATERA										
1. SIBAYAK	-	-	140	240	DW(in prog),GH	>1600	290, >2	-	Hot Water (HW), -	-
2. SARULA	-	-	280	380	SE	<2000	280, -	-	HW, -	-
3. SIBUAL-BUALI	-	-	300	375	SE	<1500	>240, -	-	2Phase, -	-
4. Gn KUNYIT	-	-	75	115	DW	>1500	260, -	50	HW, -	Low
5. LUMUT BALAI	-	-	330	760	SE	<1500	280, -	-	HW, -	-
6. MARGABAYUR	-	-	240	540	SE	<2000	260, -	-	HW, -	-
7. SUOH-SEKINCAU	-	-	1250	2900	SE	<1500	>280, -	-	HW, -	-
8. ULUBELU	-	-	420	950	DH	>1000	>260,>1.6	-	HW, -	Low
9. RAJABASA	-	-	75	165	DH	-	<250,>1.6	-	HW, -	-
10. OTHERS	-	-	1500	2000	SE	-	-	-	-	-
SUB TOTAL POTENTIAL			4610	8425						

JAVA DAN BALI										
1. WANGUN-BANTEN	-	-	100	170	SH	~1000	260, >1.8	-	HV, -	-
2. KAMOJANG	140.25	210	300	460	DV	>1000	240, -	32-40	Vapour (V), 100	~0.5
3. DARAJAT	-	120	250	420	DV	>1200	240, -	32-40	V, 100	~0.5
4. SALAK	-	280	370	600	DV	>1750	>260, -	>50	HV, 30	<1
5. WAYANG-WINDU-MALABAR	-	-	260	420	DV	<1500	280, >2	65	HV, 70	<2
6. PATUHA	-	-	400	685	GH	>1000->1700	>280, >2	-	HV, -	-
7. KARAHA	-	-	200	250	GH	<1500	>240,>1.8	-	2Phase, -	Lov
8. TELAGABODAS	-	-	200	300	GH	<1500	270,2.1	-	HV, -	-
9. DIENG	2	285	575	1430	DV	1500-2000	300, >2.5	>85	HV, 50-70	<2
10. TELOMOYO	-	-	100	170	GH	>1000	230, >2.5	-	HV?, -	-
11. NGEBEL-WILIS	-	-	100	170	SH	>1000	220, >2	-	HV, -	-
12. BALI	-	-	215	325	GV	>2000	>240, 2.5	-	2Phase?,-	-
13. OTHERS	-	-	1850	2700	SE	-	-	-	-	-
SUB TOTAL POTENTIAL	142.25	895	4920	8100						

SULAWESI										
1. LAHENDONG	-	65	175	300	DV	>1500	>300, -	85	HV, 55	<1
2. TOMPASO	-	-	230	400	SE	>1500	>280, -	-	HV, -	-
3. KOTAMOBAGU	-	-	280	300	SE	>1300	>230, -	-	HV, -	-
4. OTHERS	-	-	350	500	SE	-	-	-	-	-
SUB TOTAL POTENTIAL		65	955	1500						
OTHER ISLAND										
1. ULUMBU-FLORES	-	-	200	350	SE	>1200	>250, -	-	HV, -	-
2. OTHERS	-	-	850	1200	SE	-	-	-	-	-
SUB TOTAL POTENTIAL			1050	1550						
TOTAL POTENTIAL	142.25	960	11535	19575						

GEOTHERMAL ENERGY IN INDONESIA

1. Hystorical Background

Survey of geothermal energy in Indonesia has been initiated since 1918, and 5(five) exploratory drillings were conducted at Kamojang (West Java) by Netherlands East Indies Vulcanological Survey during 1926-1928. There was no further activity until 1964 when UNESCO-Vulcanological Survey gave a technical assistance for geothermal study in Java and Bali.

Under New Zealand Government Aid to Indonesia(1975), Kamojang Geothermal Power Plant was intensively studied, and finally first unit of 30 MW was operated in 1983; and then following 2 units of 55 MW were successfully operated in 1988.

2. Potential Resource

The potential resource of geothermal energy in Indonesia is reported 16,035 MW (other source qouted 56,617 MW) with its distribution as follows :

Sumatra	4,885 MW
Java-Bali	8,100 MW
Sulawesi	1,500 MW
Others	1,800 MW

3. Installed Capacity

The total installed capacity is 144.75 MW which consist of the following generating plants :

1978 Kamojang Monoblock, 250 KW (West Java)

1979 Dieng Monoblock, 2 MW (Central Java)

1983 Kamojang * 1, 30 MW (West Java)

1988 Kamojang * 2-3, 2 X 55 MW (West Java)

1992 Lahendong binary cycle, 2.5 MW (for research and development purposes, North Sulawesi)

4. Committed Project

PLN :

Under construction	:	Drajat 1, 1 X 55 MW, West Java (commercial operation 1994/95)
		SALAK 1 - 2 2 X 55 MW, West Java (commercial operation 1993/94-1994/95)
Detail Design	:	Lahendong 1 X 20 Mwe, North Sulawesi
Private :		(pass through concept)
Drilling	:	2 X 55 MW, North Sumatera

5. Geothermal Power Plant up to 2003/2004 (PELITA VII)

With respect to the Government guideline on the energy policy for diversification of energy resources, the development of geothermal energy utilization in Indonesia plays an important role in the meeting of the energy demand.
The target of geothermal energy utilization in Indonesia is above 2,500 MW of installed capacity by the year 2003/2004.

GEOTHERMAL POWER PLANT PROJECT UP TO 2003/4

(PELITA VII)

NO.	PROSPECT	PROVINCE	PLN REGION/ DIST.	CAPACITY (MW)										
				1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
A.	CONSTRUCT BY PLN													
I.	BIG SCALE													
1.	Kamojang #4-5	West Java	Dist. Jabar				110	110	110	110	110	110	110	110
2.	Salak # 1-2	West Java	Dist. Jabar	55	110	110	110	110	110	110	110	110	110	110
3.	Darajat #1-2	West Java	Dist. Jabar		55	55	55	110	110	110	110	110	110	110
4.	Lahendong # 1-3	North Sulawesi	VII				20	75	130	130	130	130	130	130
5.	Tompaso #1-3	North Sulawesi	VII					55	110	165	165	165	165	165
6.	Sulili #1-4	South Sulawesi	VIII					55	110	165	220	220	220	220
II.	SMALL SCALE													
1.	Kerinci # 1-5	Jambi	III			0.4	0.4	5.4	10.4	15.4	20.4	20.4	20.4	20.4
2.	Ambon # 1-4	Ambon	IX				5	5	5	10	15	20	20	20
3.	Unsimi # 1-2	Irian Jaya	X						3	3	6	6	6	6
4.	Sorong # 1-4	Irian Jaya	X				5	10	15	15	15	15	20	20
5.	Sembalun # 1-4	West Nusa Tenggara	XI				5	10	15	15	15	15	15	20
6.	Ulumbu # 1-3	East Nusa Tenggara	XI			3	3	6	6	8	9	9	9	9
7.	Hu'u # 1-4	West Nusa Tenggara	XI						5	7.5	10	10	10	10
	TOTAL OF PLANNING (PLN)			55	165	168.4	313.4	551.4	739.4	864.9	936.4	940.4	945.4	950.4
B.	PRIVATE													
1.	Sarulla #1-4	North Sumatera	II						55	110	165	220	275	330
2.	Sibayak #1-2	North Sumatera	II						20	20	75	75	75	75
3.	Ulubelu # 1-8	Lampung	IV						20	40	60	60	100	120
4.	Rajabasa # 1-8	Lampung	IV						20	40	60	60	100	120
5.	Lumutbalai # 1-8	Lampung	IV						20	40	60	60	100	120
6.	Patuha # 1-3	West Java	Dist. Jabar					20	40	95	95	95	95	95
7.	Wayang-Windu # 1-3	West Java	Dist. Jabar					20	40	85	95	95	95	95
8.	Karaha	West Java	Dist. Jabar						55	55	55	55	55	55
9.	Salak #3-8	West Java	Dist. Jabar				110	200	200	200	200	200	200	[illegible]
10.	Dieng # 1-6	Central Java	Dist. Jateng		50	50	140	140	140	140	140	140	140	[illegible]
11.	Bali #1-4	Bali	XI					55	110	165	220	220	220	
	TOTAL OF PLANNING (PRIVATE)				50	50	250	439	720	1000	1225	1340	1455	
C.	EXISTING													
1.	Kamojang # 1-3	West Java	Dist. Jabar	140	140	140	140	140	140	140	140	140	140	[illegible]
2.	Dieng	Central Java	Dist. Jateng	2	2	2	2	2	2	2	2	2	2	2
3.	Lahendong	North Sulawesi	VII	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	TOTAL EXISTING			144.5	144.5	144.5	144.5	144.5	144.5	144.5	144.5	144.5	144.5	144.5
	GRAND TOTAL			199.5	359.5	362.9	707.9	1130.9	1603.9	2009.4	2304.9	2424.9	2544.9	2684.9

"GEOTHERMAL POWER PLANT"

(IN MILLION)

NO.	PROJECT LOCATION	CAPACITY	STATUS	ENGINEERING CONSULTANT	PROJECT COST	SCHEDULE OF CONSTRUCTION		REMARKS
						COMMENCEMENT OF WORK	COMPLETION OF WORK	
1.	KAMOJANG, UNIT 1 BANDUNG	1 X 30 MW	Under Operation	GENZL (New Zealand)	Foreign Curr NZ$. 12,50 Local Curr. Rp. 8.000,00	April, 1978	December, 1982	Excluded E/S NZ$. 12,50 Rp. 8.000,00
2.	KAMOJANG, UNIT 2 & 3. BANDUNG	2 X 55 MW	Under Operation	GENZL (New Zealand)	Foreign Curr US$ 47,95 Local Curr. Rp. 9.893,93	August, 1984	October, 1987	Excluded E/S US$. 47,95 Rp. 9.893,93
3.	GUNUNG SALAK, UNIT 1 & 2 SUKABUMI	2 X 55 MW	Under Construction	-	Foreign Curr US$ 70,63 Local Curr. Rp. 35.922,13	April, 1991	Unit 1 : Nov'93 Unit 2 : Feb'94	Excluded E/S US$. 70,63 US$. 35.922,13
4.	DIENG, UNIT 1 SEMARANG	1 X 55 MW	Engineering Design Stage	WES JECT (Jepang)	Cost Estimate : Foreign Curr US$. 61,37 Local Curr. US$. 23,88	September,1992	July 1995	Engineering Design Yen. 153,73 Rp. 248,3
5.	DARAJAT, UNIT 1 BANDUNG	1 X 55 MW	Engineering Design Stage	GENZL (New Zealand)	Cost Estimate : Foreign Curr US$. 45,75 Local Curr. Rp. 52.442	Juni 1992	Agustus 1994	Engineering Design NZ$. 3,47 Rp. 1.897,61
6.	LAHENDONG, UNIT 1 MANADO	1 X 20 MW	Feasibility Study	CFG (France)	Cost Estimate : Foreign Curr FFR. 99,00 Local Curr. FFR. 26,00	Maret 1994	Agustus 1995	Feasibility Study FFR. 3,00 Rp. 155,63
7.	KAMOJANG, UNIT 4 BANDUNG	1 X 55 MW	Feasibility Study	GENZL (New Zealand)	Cost Estimate : Foreign Curr US$. 43.480 Local Curr. US$. 20.220	Maret 1994	Juni 1996	Feasibility Study US$. 0,772 Rp. 548,06

WORLD BANK
RE- II MINI-HYDRO PROJECT
PRE-INVESTMENT STUDY

Prepared By:
OAK RIDGE NATIONAL LABORATORY
Michael Johnson

18-Aug-93

Final report

TABLE OF CONTENTS

WORLD BANK RE-II MINI-HYDRO PRE-INVESTMENT STUDY

-EXECUTIVE SUMMARY-

Aug. 18, 1993

A. PURPOSE:

The purpose of this pre-investment study is to review several mini-hydro projects which have already been inventoried for development by PLN PISFP, in order to make a recommendation for funding the implementation of up to 10 megawatts of total installed capacity in Indonesia's Eastern provinces.

The report presents the results of the study in terms of technical, economic and environmental updated reviews of existing data for projects which have already been studied to detailed design phase. For projects which have not yet reached a completed detailed design stage, the report provides sufficient information upon which decisions can be made to include these projects in the overall funding plan.

B. STRUCTURE OF THE REPORT:

Each project evaluated is presented as a separate report covering the following areas of information:

I. Demand Center location, background and statistics
   - A. Population
   - B. Population rate of growth
   - C. Electrification ratio / customer breakdown
   - D. Average annual peak load / projected peak loads
   - E. Annual energy production / projected energy production
   - F. Current and projected production costs, diesel

II. Technical Evaluation
   - A. Screening checklist
   - B. Discussion of overall project layout
   - C. Discussion of project hydrology
   - D. Flow duration curve
   - E. Model analysis of system performance
   - F. Flow duration / estimate of energy produced

III. Environmental Evaluation
   - A. Discussion of mini-hydro environmental impacts
   - B. Construction activities, related impacts
   - C. Reduced in-stream flow values during operation
   - D. Positive aspects
   - E. Suggested strategies, monitoring and mitigation

IV. Financial Evaluation
   - A. Mini-hydro project Cost summary
   - B. Cost analysis of comparable diesel and mini-hydro
   - C. Benefit/Cost ratio at 4 discount rates

C. BACKGROUND:

1. SELECTION CRITERIA-

In recommending the mini-hydro projects which are to be included in the World Bank RE II planning, the following basic guidelines and criteria were applied in order of priority:

A. That the projects will be located in Eastern Indonesia in line with GOI development priorities and objectives.

B. Rank the overall technical feasibility of the project as evaluated in terms of geo-technical, hydrology and environmental aspects.

C. Determine that the projects selected, demonstrate the least cost electrification alternative for the demand centers serviced, and that the mini-hydro projects will replace current diesel usage.

2. SELECTION PROCESS -

The initial selection process involved discussions with PLN PISFP (investigations and planning), and acquiring the most recent reports and information on those run of river projects which have been studied to detailed design, and which are located in Eastern Indonesia. After further study of the project documentation, site visits were undertaken at which time an effort was made to involve the regional PLN Planning structure in the prioritization of projects within their own region. At the same time, individual site visitation was done to confirm existing report data, and determine what changes needed to be made in order to bring the report data up to date.

Many of the original studies were done by Tecsult and other engineering firms as early as 1986. Accordingly, an updating of

data was needed to include areas such as confirming hydrology, and reexamination of the site layout to determine if any geological anomalies had developed, or if there were alternative development options to improve the design or lower the cost of the project. A separate, and complete examination of the demand center loads, current diesel generation costs and PLN grid planning was also completed during the site visitations during June and July 1993.

The RE II Project administrators are interested in demonstrating that small renewable energy projects can be quickly and inexpensively designed and implemented in the remote areas of Indonesia where diesel generators are currently the only source of electricity. The mini-hydro projects recommended were evaluated with this concept in mind. An effort was made to consider not only the financial and technical viability of the projects, but to consider the degree of difficulty in implementation as well. Requirements such as local harbor facilities with sufficient capacity cranes to off load heavy equipment were investigated. Condition of roads from port to site, and availability of local materials (concrete aggregate and forming lumber) were verified.

The prospects identified in the evaluation process were:

PLN REGION	MPH SCHEME	DEMAND CENTER	CAPACITY (KW)	DESIGN DETAIL
VII	ULUNG PELIANG	Tahuna/Tamako	1000 KW	Tecsult 1986
VII	BAMBALO	Poso	2400 KW	Tecsult 1986
VII	KOLONDOM	Toli Toli	1500 KW	Karya
X	WERBA	Fak Fak	1450 KW	Teknindo
XI	LOKOMBORO	Waikabubak	860 KW	Tecsult 1986

PLN REGIONS: VII - North Sulawesi
VIII - South Sulawesi
X - Irian Jaya
XI - NTT

3. IRRIGATION BASED SCHEMES -

In the interest of achieving the REII objective of bringing up to 10 megawatts of mini-hydro power on line prior to 1997, those projects which clearly demonstrate characteristics lending towards rapid and successful site development were prioritized. Despite the availability of other development options such as irrigation canal potentials, there are serious questions as to the potentially time consuming institutional procedures involved with PLN and DPU in jointly developing mini-hydro schemes on existing canal drops. Although potentially less costly in some cases because of shared civil works structures, canal dewatering and repairing operations could also reduce mini-hydro plant factors significantly. Further, there are currently no irrigation canal based projects which have been studied to detailed design stage in Eastern Indonesia. To identify and bring irrigation based hydro schemes to a detailed design stage would require a minimum of 2 years. Initial investigation concluded that although irrigation canal based projects offer certain advantages in terms of cost and development, further study should be undertaken prior to inclusion into the current RE II mini-hydro plans.

The evaluation process included some run of river projects which fulfilled the criteria of having been studied to detailed design and located in Eastern Indonesia, yet were ranked lower in priority on the basis of high installed cost for low output, low plant factor due to hydrology, or environmental / competitive water use issues. These remain viable projects for future development and should be inventoried accordingly.

4. MINI-HYDRO PROJECT CAPITAL COSTS -

Current capital cost estimates for the mini-hydro projects were determined based upon original estimates, factored inflation, and current actual costs involving the equipment, material and labor components. These costs will need to be examined and adjusted during preparation of the tender documents. In some cases, changes were anticipated in material specifications and quantities. Low pressure conduit being replaced with open or covered masonry canal, elimination of surge tanks, or ELC governing in favor of expensive hydraulic/mechanical governing for the smaller output schemes. All project costs were reviewed jointly by PLN PISFP, World Bank and the ORNL consultant in August meetings.

5. STANDARDIZATION -

Several of the projects will have similar hydraulic characteristics which will result in a standardization of equipment and materials including electro/mechanical, governing equipment, switchgear, penstock and water control devices. In order to take advantage of this potentially cost reducing situation, some standardization of the design flow rates will be required. An increase of design flow may dictate that the penstock be enlarged to accommodate the increased flow at an acceptable velocity. The cost of the larger penstock therefore, needs to be weighed against the cost savings realized by standardizing the electro-mechanical equipment. When flow rates are increased, plant factors will be lowered somewhat, as well as bottom end, low flow efficiencies, particularly for single unit installations. The total energy output however, will increase as more of the available flow is utilized.

The chart below lists the characteristics of several system components.

PROJECT	*TURBINE*	*GENERATOR*	*SWITCHGEAR*	*PENSTOCK*
ULUNG PELIANG	1 unit Q = 2.1 M/sec H = 64 M RPM = 1000 P = 1597 HP	1 unit 1.2 MW 6 KV RPM = 1000	1 unit 1.2 MW 6 KV	L= 875 M D= 1.15 M
BAMBALO	2 units Q = 2.4 M/sec H = 64 M RPM = 1000 P = 1830 HP	2 units 1.25 MW 6 KV RPM = 1000	2 units 1.25 MW 6 KV	L= 430 M D= 1.70 M
KOLONDOM	2 units Q = 1.29 M/sec H = 70 M RPM = 1000 P = 1074 HP (optional) 1 unit Q = 2.57 H = 70 M RPM = 1000 P = 2147 HP	2 units .750 MW 6 KV RPM =1000 1 unit 1.5 MW 6 KV RPM = 1000	2 units .750 MW 6KV 1 unit 1.5 MW 6 KV	L= 575 M D= 1.15 M
LOKOMBORO	1 unit Q = 2.6 M/sec H = 40 M RPM = 600 P = 1075 HP	1 unit .9 MW 6 KV RPM = 600	1 unit .9 MW 6KV	L= 230 M D= 1.30 M
WERBA	1 unit Q = 2.57 M/sec H = 70 M RPM = 1000 P = 2147 HP	1 unit 1.5 MW 6 KV RPM = 1000	1 unit 1.5 MW 6 KV	

TURBINES / GENERATORS / SWITCHGEAR - Ulung Peliang and Poso units could be considered for possible standardization of 3 turbines. This decision would require that the Ulung Peliang turbine be up sized to a 2.4 M3/sec design flow and that the generator be up sized to 1.25 MW. The penstock diameter would be increased to keep velocity within limits. There would be a corresponding increase in energy output for the Ulung Peliang system. The plant factor would be decreased. This could be a worthwhile option if the standardization of the three units lowers the overall cost. This proposal should be studied further.

An additional single unit of the same type, running at a higher head might be utilized at Kolondom (H = 70M, Q = 2.57 M/sec). with a slight overall reduction in output. The speed of this unit would cause it to operate on the back side of the power curve, yet not significantly. During periods of low stream flow, part flow turbine efficiencies would be reduced utilizing this single unit approach over a two unit system. Werba could also utilize the same single unit system. Feasibility of this option should be studied.

Lokomboro will operate at a 40 M head with a flow of 2.6 M/3 sec. and will utilize a site specific turbine / generator unit.

<u>There exists a potential therefore, to standardize the equipment selection to include 5 similar turbine generator units at 4 sites</u>.

PENSTOCK -

Both Ulung Peliang and Kolondom projects utilize 1.15 M diameter steel penstock of various wall thicknesses according to the pressure requirement.

6. FINANCIAL EVALUATION / LEAST COST ANALYSIS -

Capital costs and 25 year operational costs were determined for both mini-hydro schemes and equivalent capacity diesel generation. Costs were discounted at four different rates.

BENEFIT / COST RATIO -

PROJECT	DEMAND CENTER	B / C RATIO			
		8%	10%	12%	14%
Ulung Peliang	Tahuna	2.64	2.22	1.90	1.64
Bambalo	Poso / Tentena	3.76	3.15	2.68	2.31
Kolondom	Toli Toli	2.53	2.12	1.81	1.55
Lokomboro	Waikabubak	2.75	2.32	1.99	1.72
Werba	Fak Fak	2.78	2.34	2.00	1.78

Equivalent capacity diesel generation was determined on the basis of multiple 250 KW units with a .67 multiplier. This approach takes into consideration the typical PLN installation serving a demand center of up to 2 MW where peak load growth has dictated the installation of a series of incremental capacity units. The multiplier factor of 1.67 determines the actual number of units needed to meet the required capacity considering that at any given time a number of the units will be out of service for repairs or overhaul.

7. Projects lacking detailed design.

Two of the projects, Kolondom and Werba have been included in the mini-hydro projects selected for RE II funding, yet at present do not have a detailed engineering design completed. Of these two projects, Werba was included because of the strategic location near an isolated, growing demand center in Irian Jaya. Kolondom was

selected due to the overall project viability in comparison with other inventoried projects. PLN PISFP, with internal funding, has agreed to produce detailed designs and tender documents on both projects prior to the Oct. 1994 tendering process. This agreement should be within reason considering the normal 10 month time period required to produce a detailed design and tender documents. PLN has requested a memorandum of understanding from World Bank concerning this agreement prior to initiating work on the detailed designs and tender documents.

8. Design changes suggested to PLN PISFP

Ulung Peliang - Penstock position to be changed from East to West side of the river. Results in shorter penstock without the need of two river crossings with the penstock.

Kolondom - Use of open channel rather than concrete conduit pipe. Results in considerable savings.

Lokomboro - Use of tunnel for 30 meters beginning from the headrace intake. Will eliminate the need of placing the penstock on a difficult cliff face.

Werba - Open canal and penstock position to be changed from West side of the river to the East side, increase the total available head to 70 meters. A topo survey team will be on site in late August to verify this change of design.

9. PRIVATE SECTOR PROJECTS -

It should be pointed out that any private sector development of mini-hydro schemes at the present, remains contingent upon receiving a tariff agreement from PLN which will establish avoided costs and investor project economic viability for private sector developers. It is correct to assume that once there has been a favorable tariff agreement offered by PLN, a good deal of private MHP development will be in the works in all parts of Indonesia. Efforts to include private sector projects in the World Bank RE II funding plan must be accompanied by an effort to convince PLN to quickly reach a tariff agreement for viable mini-hydro scale projects. Presently, there are negotiations involving large scale private sector generation schemes in Java, which obviously are more complex and involved than mini-hydro projects. A simple approach, excluding capacity agreements, would involve the mini-hydro purchase tariff being based upon a percentage, (75 to 80%) of the KWH production cost in the particular region as an avoided cost. This purchase tariff would be adjusted yearly in accordance with the PLN production cost rate.

<u>Private sector mini-hydro projects under active consideration in Irian Jaya are:</u>

Project - Amai Demand Center - Depabrae / Sentani 1000 KW
Project - Maruni Demand Center - Manokwari 1500 KW
Project - Hubai Demand Center - Jayapura 500 KW

These projects are in feasibility study stage by WRC Mini-hydro Program.

PROJECT - ULUNG PELIANG DEMAND CENTER - TAHUNA

I. DEMAND CENTER LOCATION AND BACKGROUND

Demand center 1993 data:

Population	110,188
Pop. rate of growth	2.44%
Electrification ratio	34%
Average annual peak load	1751 KW
Current capacity	1760 KW
Annual energy production	6.1 GWH
Current production cost per/KWH	154 rupiah

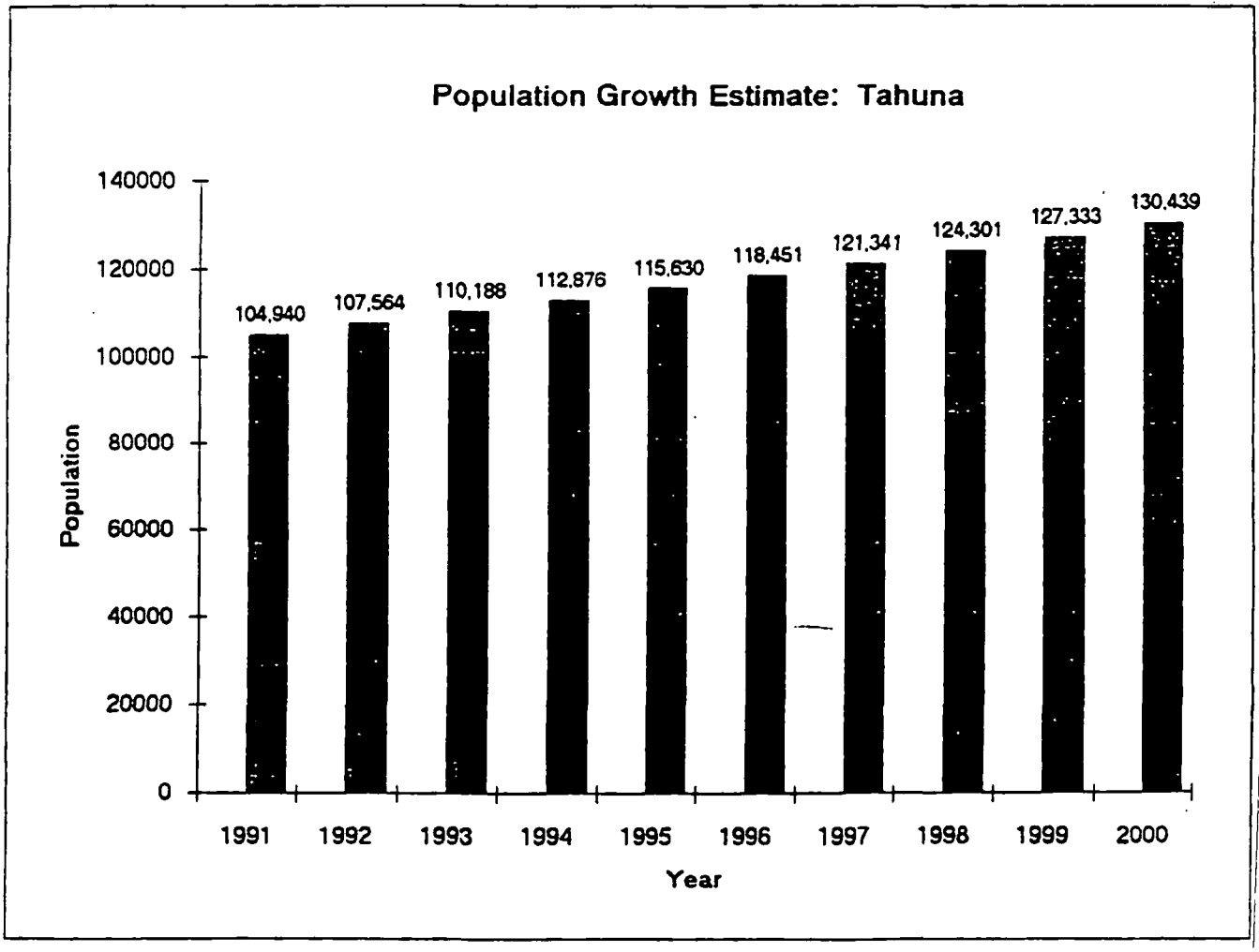
This project and demand center was previously studied by Tecsult in 1985 to detailed design stage and is currently inventoried for funding by PLN. The proposed project is located on the island of Sangihe, 200 Km north of Manado, Sulawesi, and will serve the load center of Tahuna. At the time of the 1985 Tecsult survey, Tahuna and Tamako were separate load centers. Recently, Tahuna and Tamako, the two major load centers, have become one integrated system. The island at this time is nearly circled by a 20 KV transmission line. There remains two short sections of 6 KV line which will be upgraded to 20 KV in the future.

The primary generation point is Tahuna where 7 diesel generators of various capacities and makes have an installed nameplate capacity of 2000 KW. The actual output however, is 1500 KW due to the condition of the equipment. The secondary generation point is Petia where a single diesel generator of 260 KW nameplate capacity produces 210 KW. The total actual capacity of the Tahuna system is currently 1760 KW. The average peak load is 1708 KW as of 6/93. The rate of growth for peak load is 5.8% per year and will be over 2500 KW by year 2000.

POPULATION GROWTH PROJECTION
PROJECT: ULUNG PELIANG
LOAD CENTER: TAHUNA

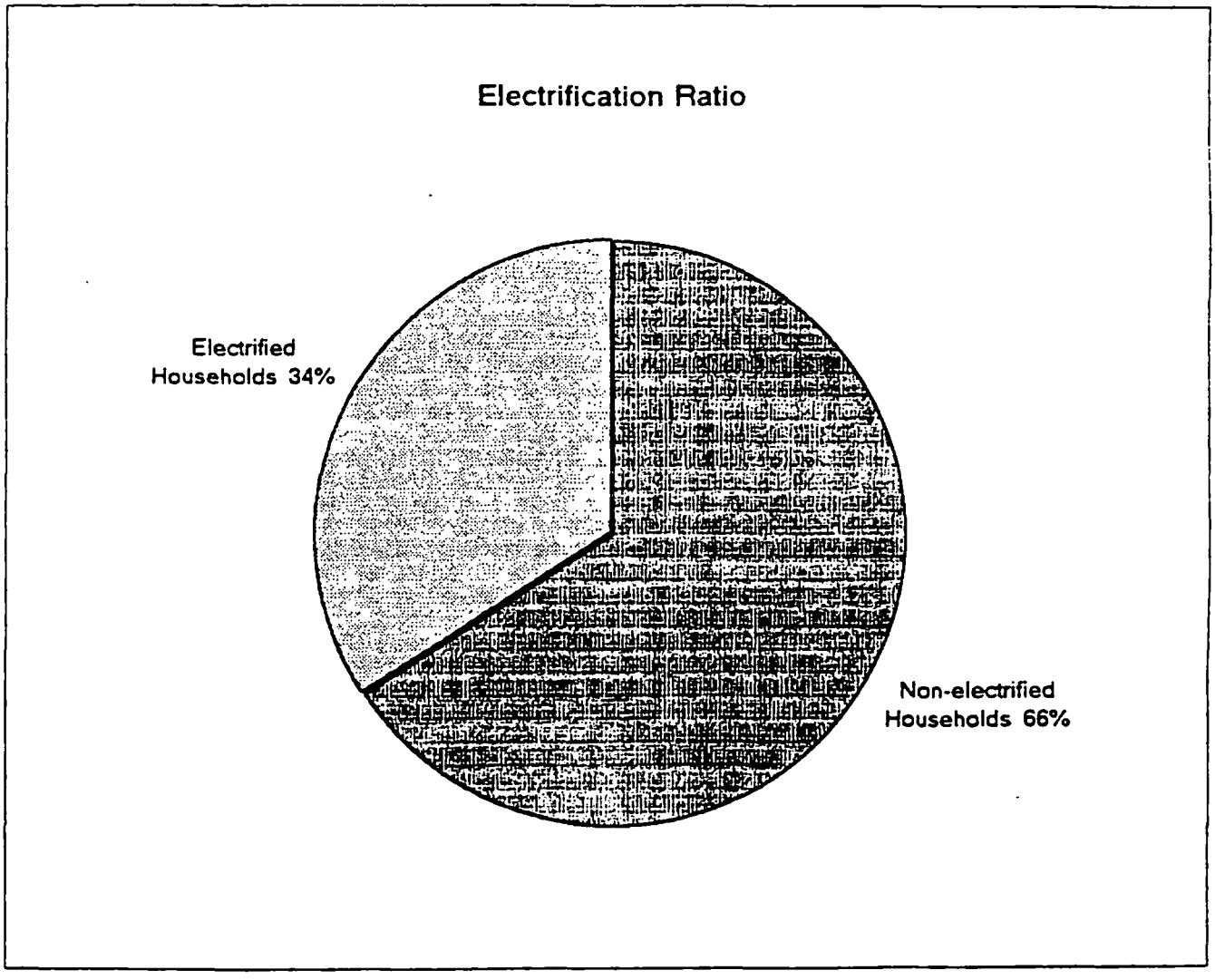
Year	Population
1991	104,940
1992	107,564
1993	110,188
1994	112,876
1995	115,630
1996	118,451
1997	121,341
1998	124,301
1999	127,333
2000	130,439

*Assume population growth rate of 2.44%



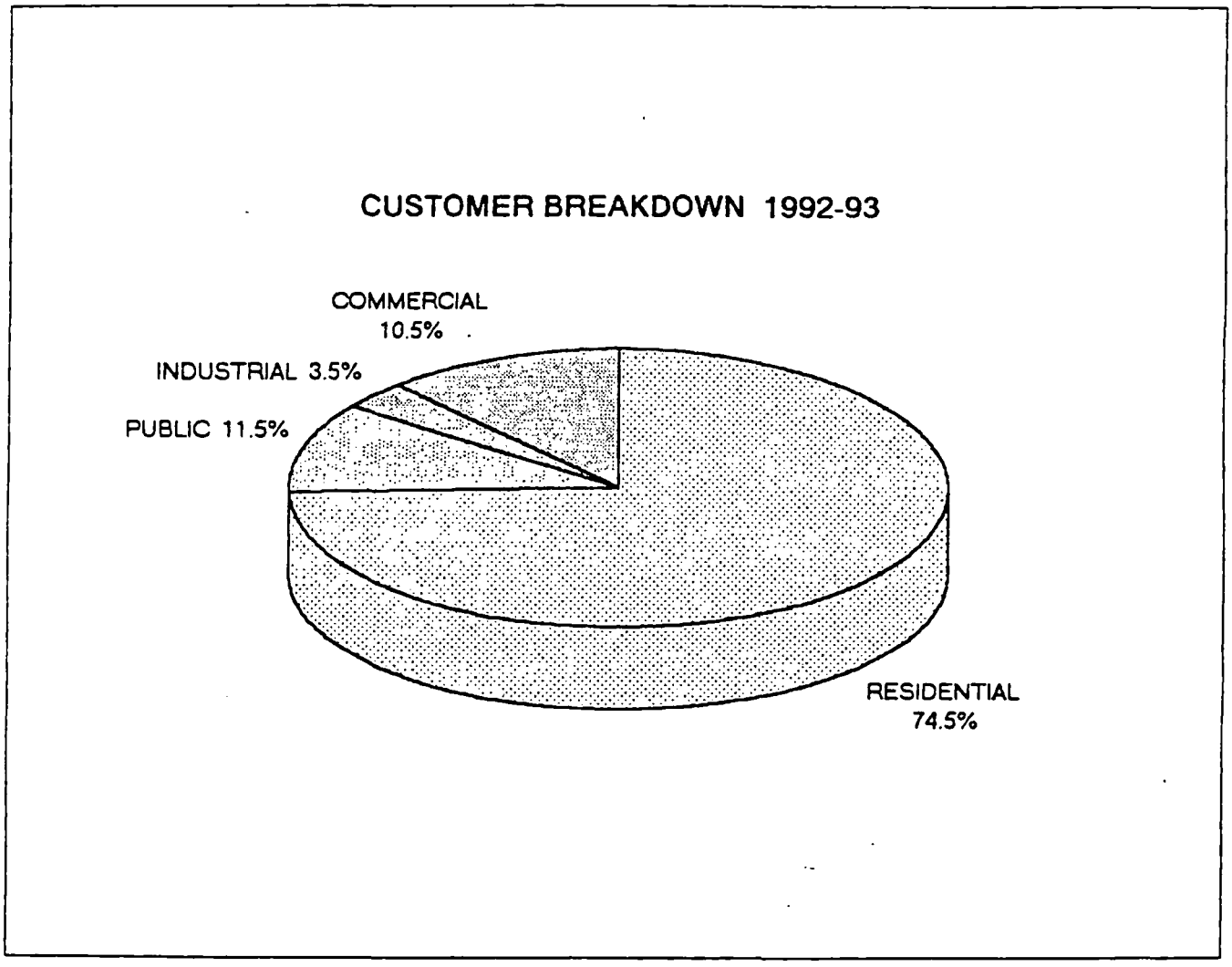
ELECTRIFICATION RATIO 1992-93
PROJECT: ULUNG PELIANG
LOAD CENTER: TAHUNA

	Total	Percent
Electrified Households	7,560	66
Non-electrified Households	14,521	34
Total Households	22,081	100



CUSTOMER BREAKDOWN 1992-93
PROJECT: ULUNG PELIANG
LOAD CENTER: TAHUNA

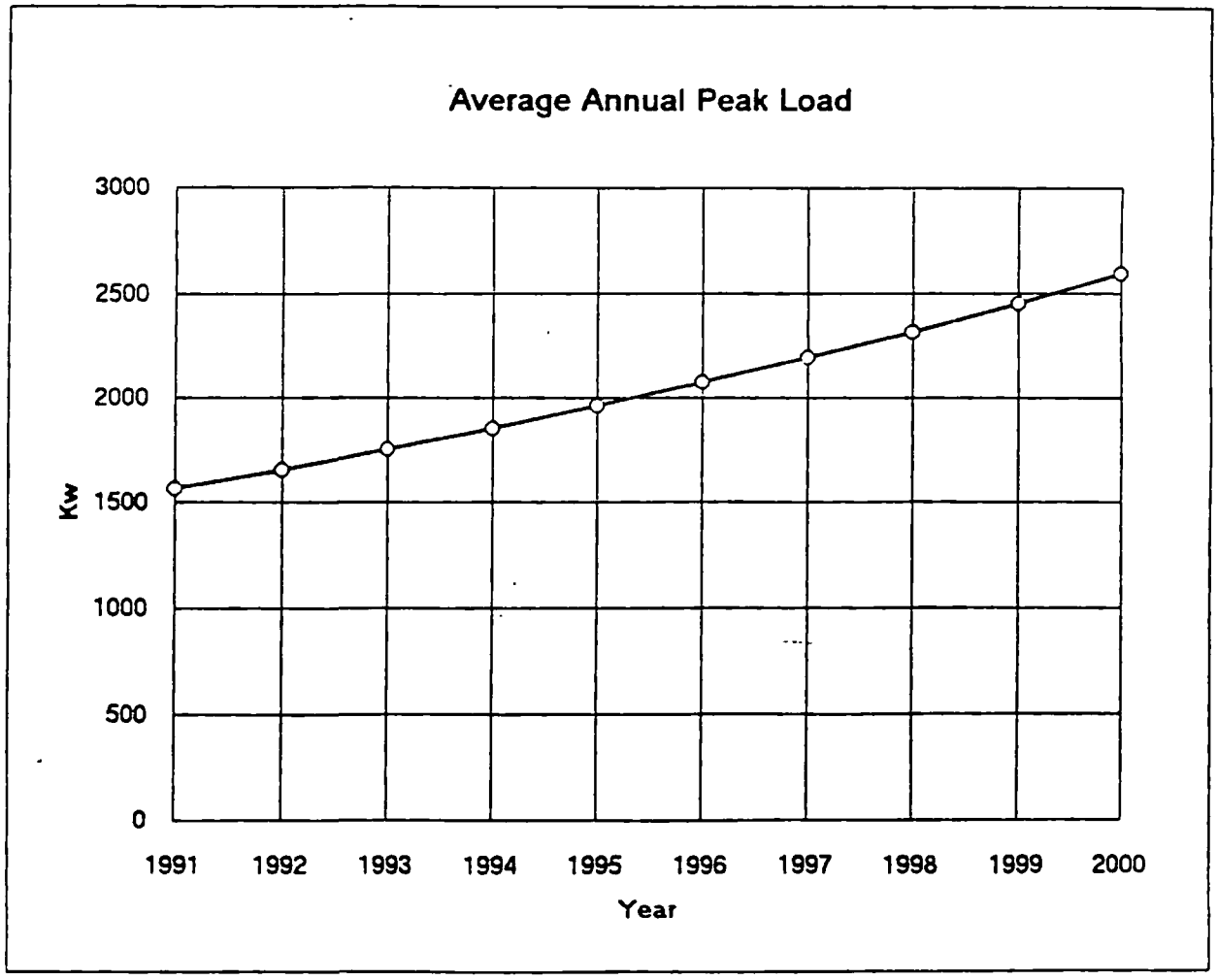
Type	Percent
Residential	74.5
Commercial	10.5
Industrial	3.5
Public	11.5

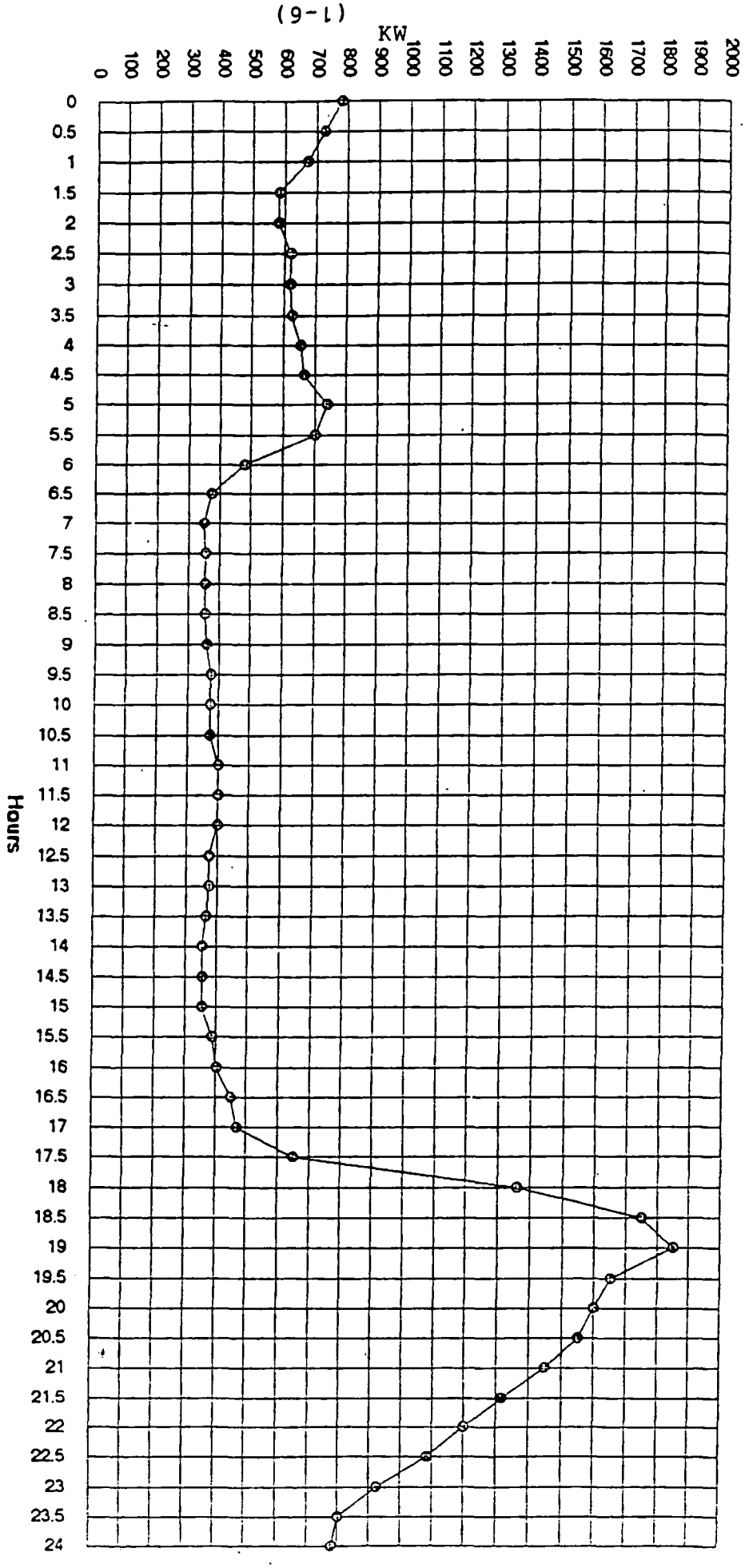


AVERAGE ANNUAL PEAK LOAD: KW
PROJECT: ULUNG PELIANG
LOAD CENTER: TAHUNA

Year	Kw
1991	1,565
1992	1,655
1993	1,751
1994	1,852
1995	1,959
1996	2,072
1997	2,192
1998	2,314
1999	2,453
2000	2,595

*Assume annual peak load growth rate of 5.8%





DAILY LOAD CURVE: TAHUNA

Planning calls for the installation of a single 1000 KW diesel unit in 1993 at Tahuna to supplement the current system which is at full capacity during peak load times. After the installation of the 1000 KW diesel unit, several of the smaller, older units will be decommissioned or moved to other locations. There will therefore, be little actual increase in capacity with the installation of the new unit. Reliability will however, be increased.

II. TECHNICAL EVALUATION

Project data:

Mean flow	2.1 cumecs
Design flow	2.1 cumecs
Net head	64 meters
Power	1090 KW
Length of open channel	100 meters
Length of penstock	875 meters
Diameter of penstock	1.15 meters
Turbine -	single horizontal francis
Length of MV line	1.3 KM

The Ulung Pelinag Mini Hydro Project was extensively studied to detailed design phase by Tecsult under contract with PLN in 1986. A review of the proposed original design confirmed the site location and salient features. There essentially have been no significant geological changes which would adversely affect the project if implemented at this time. In some respects, the project viability has been enhanced by the completion of additional transmission line which now brings the interconnection point to within 1.3 KM of the project powerhouse location. The access road has also been upgraded and runs directly to the project powerhouse and beyond. There has been no significant development of gardens, houses or other land uses in the immediate project area.

Equipment and materials may be unloaded 8 Km from the project site at a landing area in Tamako. There is not a dock, however, landing barge ships have placed equipment on the beach in the past. The road from Tahuna would be acceptable for transport of the project materials, there are however, steep areas and sharp curves along the 40 Km route. Concrete aggregate and sand is available near the project location. Concrete forming lumber can be ordered locally.

The project should be implemented as planned with one exception in the routing of the penstock. The original design routes the penstock across the river in two locations with bridges and places most of the penstock on the east side of the river. This involves one river crossing above a waterfall and another below an existing road bridge. Both crossings will be costly and expose the penstock to possible flood damage. There will also have to be access by bridge or ford to the construction area on the east side of the river which lies between the Ulung Peliang and another river.
It was found that the west side of the river provides an adequate route for the penstock and shortens the route to 872 meters in length vs the 1120 meter proposal using the east side of the river. The route appears to be stable and workable in every respect. There are presently three homes along the west route which the penstock would pass nearby. It is possible that Tecsult did not consider the west route because at the time of the original survey, it was overgrown with brush and there was not yet a road on the west side of the river. The road, while non vehicle, is adequate and now begins from the powerhouse location and runs to the intake point. Possibly the only drawback would be the fact that there are rocky, yet workable, areas on the west route. It would be anticipated that a medium sized (20,000 kg) trackhoe would be on site to do excavation for the headworks, penstock route and later pipeline placement. Undoubtedly, a significant cost reduction in the penstock will be realized with this change. A redesign will be required, however this alone should not be costly.

SCREENING EVALUATION:
PROJECT: ULUNG PELIANG
DEMAND CENTER: TAHUNA

	CONSTRUCTION ACTIVITIES												OPERATION & MAINTENANCE ACTIVITIES						
ACTIVITY IDENTIFICATION	Construction Mobilization	Local Labor Availability	Site Access	Dewatering Procedures	Soil Conditions	General Excavation	Rock Removal	Adverse Seasonal Conditions	Equip. & Material Transportation	Concrete Aggregate Availability	Formwork & Materials		Flooding	Erosion	Siltation	Falling Trees	Soil Instability	Undergrowth Removal	TOTAL SCORE
Land Clearing	1	1	1	1	1	1	1	1	1	0	0		1	1	1	1	1	1	15
Diversion Wier	1	1	2	2	1	2	1	1	1	1	1		1	1	1	1	1	1	20
Intake / Headworks	1	1	2	1	1	1	1	1	1	1	1		1	1	1	1	1	1	18
Headrace	1	1	2	1	1	1	1	1	1	1	1		1	1	1	1	1	1	18
Sand Trap	1	1	2	1	1	1	1	1	1	1	1		1	1	1	1	1	1	18
Open Channel	1	1	2	1	1	1	1	1	1	1	1		1	1	1	1	1	1	18
Penstock	1	1	2	1	1	2	2	1	1	1	1		1	1	1	1	1	1	20
Surge Tank																			
Powerhouse	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	17
Tailrace	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	17
Switchyard	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	17
Operator House	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	17
Access Road	1	1	1	1	1	1	1	1	1	1	0		1	1	1	1	1	1	16
Transmission Lines	1	1	1	0	1	1	1	1	1	1	0		1	1	1	1	1	1	15
Fence	1	1	1	0	1	1	1	1	1	1	0		1	1	1	1	1	1	15
Bridge																			

LEGEND:
Acceptable Conditions (1)
Special Techniques or Equipment Required (2)
Substantial Difficulties Anticipated (3)
Unacceptable Conditions (4)

The topography has already been completed by Teclsult including the west side of the river. There would be an estimated 30 man days of engineering involved to produce a design for the routing of the penstock on the west side of the river.

Grid interconnection - The interconnection with the existing distribution line will consist of an additional 1.3 KM of 6 KV line. The generator and switchgear will be 6 KV. A transformer will not be required until such time as the 6 KV line is upgraded to 20 KV. The present 70 mm2 cable size is adequate for the 1000 KW capacity of the mini hydro system. Standard switchgear with protective devices and synchronizing equipment will be utilized with the system.

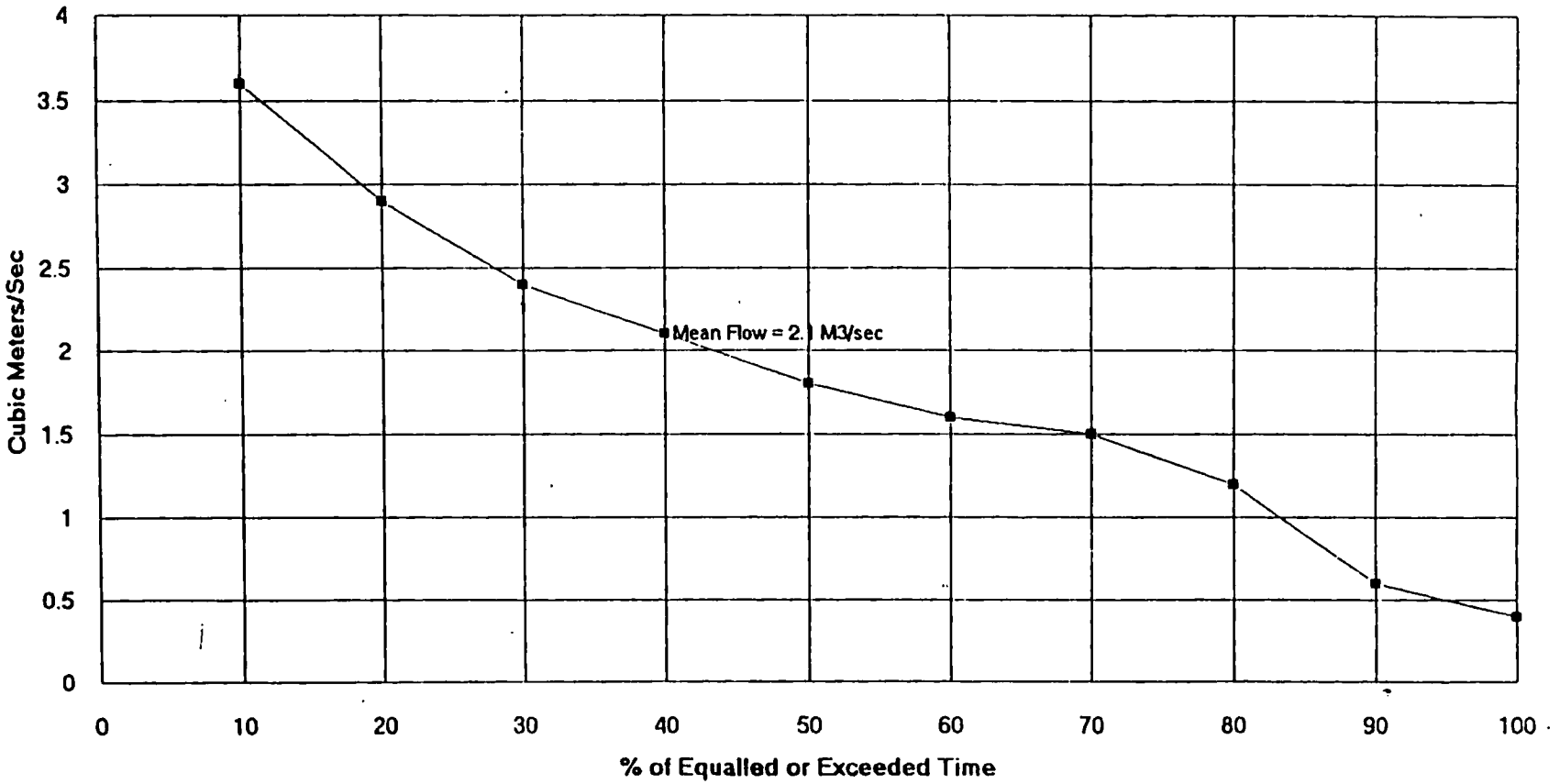
III. HYDROLOGY

The hydrological and meteorological data is the basic information necessary for determining flow characteristics for the investigation of mini-hydro power schemes. The contents of the hydrological study are composed mainly of the mean annual flow, low and high flows and the flow duration curve which determines the time variation of the stream discharges.

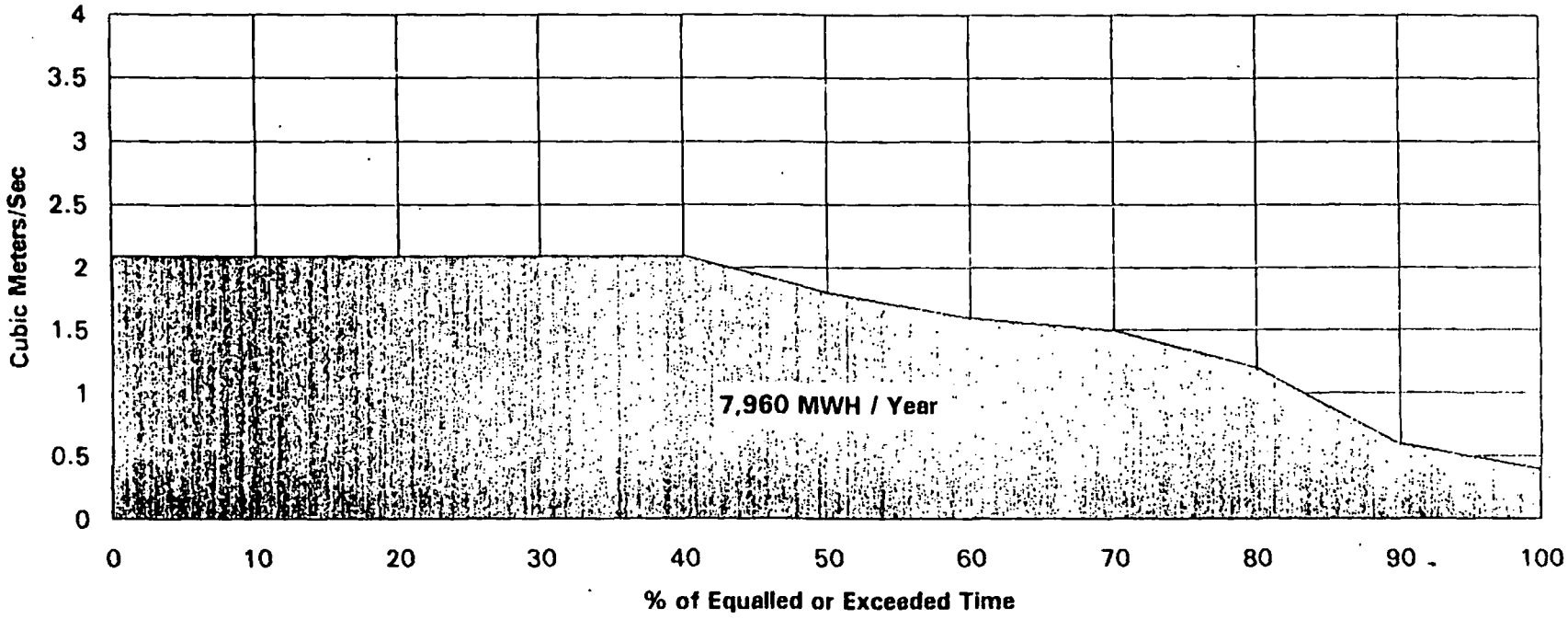
The Tahuna project hydrology was extensively studied by Tecsult in 1986 during preparation of the feasibility study report. The project hydrology was found to be consistent with the original estimates. This evaluation however, is only based upon observation during the site visit and estimates of the stream flow. Estimated stream flow observed 8 June, 1993 was 2M3/sec. Since the time of the original Tecsult survey, there has been no monitoring of the streamflow on a regular basis by PLN.

The project will utilize a design flow which is equal to the estimated mean flow of 2.1 cubic meters per sec. Approximately 40% of the time the single francis turbine will run at full capacity producing 1000 KW.

FLOW DURATION CURVE Project - Ulung Peliang Demand Center - Tahuna



ESTIMATED ANNUAL ENERGY PRODUCTiON Project: Ulung Peliang \ Demand Center: Tahuna



SMALL HYDROELECTRIC SYSTEM PARAMETERS from file ULUPEL.SHD 06-24-1993

SLOPE IN DEGREES FROM THE HORIZONTAL	0.00
SLOPE AS PERCENTAGE (PERCENT RISE PER UNIT OF RUN)	0.00
SLOPE DISTANCE AS MEASURED ALONG THE SURFACE	0.00
HORIZONTAL OR MAP DISTANCE	0.00
VERTICAL DISTANCE (CHANGE IN HEIGHT)	0.00
ACCUMULATED SLOPE DISTANCE OF PREVIOUS ENTRIES	0.00
ACCUMULATED HORIZONTAL DISTANCE OF PREVIOUS ENTRIES	0.00
ACCUMULATED VERTICAL DISTANCE OF PREVIOUS ENTRIES	0.00
STATIC OR GROSS HEAD OF WATER IN FEET	216.54
STATIC OR GROSS HEAD OF WATER IN METERS	66.00
STATIC OR GROSS HEAD OF WATER IN POUNDS PER SQUARE INCH	93.76
STATIC OR GROSS HEAD OF WATER IN KILOPASCALS	646.94
FLOW OF WATER IN AMERICAN GALLONS PER MINUTE	33371.62
FLOW OF WATER IN CUBIC FEET PER MINUTE	4461.45
FLOW OF WATER IN CUBIC FEET PER SECOND	74.36
FLOW OF WATER IN CUBIC METERS PER SECOND	2.10
HEAD LOSS DUE TO FRICTION, IN FEET	5.86
HEAD LOSS DUE TO FRICTION, IN METERS	1.79
HEAD LOSS DUE TO FRICTION, IN POUNDS PER SQUARE INCH	2.54
HEAD LOSS DUE TO FRICTION, IN KILOPASCALS	17.51
HEAD LOSS DUE TO FRICTION, AS PERCENTAGE OF STATIC OR GROSS HEAD	2.71
INSIDE DIAMETER OF PENSTOCK IN INCHES	45.28
INSIDE DIAMETER OF PENSTOCK IN CENTIMETRES	115.00
HAZEN - WILLIAMS COEFFICIENT OF FRICTION FOR PIPE BEING CONSIDERED	150.00
DYNAMIC OR WORKING HEAD OF WATER IN FEET	210.67
DYNAMIC OR WORKING HEAD OF WATER IN METERS	64.21
DYNAMIC OR WORKING HEAD OF WATER IN POUNDS PER SQUARE INCH	91.22
DYNAMIC OR WORKING HEAD OF WATER IN KILOPASCALS	629.43
TOTAL LENGTH OF PENSTOCK IN FEET	2870.73
TOTAL LENGTH OF PENSTOCK IN METERS	875.00
VELOCITY OF WATER IN PENSTOCK, FEET PER SECOND	6.70
VELOCITY OF WATER IN PENSTOCK, METERS PER SECOND	2.04
PERCENT EFFICIENCY OF PENSTOCK	97.29
PERCENT EFFICIENCY OF TURBINE	90.00
PERCENT EFFICIENCY OF GENERATOR	92.00
OVERALL EFFICIENCY OF WHOLE SYSTEM, AS A PERCENTAGE	80.56
MECHANICAL POWER OUTPUT OF TURBINE IN HORSEPOWER	1597.78
ELECTRICAL POWER OUTPUT OF SYSTEM IN KILOWATTS	1096.59
AMOUNT OF ELECTRICAL ENERGY PRODUCED IN ONE DAY, IN KILOWATT HOURS	26318.06

SMALL HYDROELECTRIC SYSTEM PARAMETERS from file ULUPEL75.SHD 06-24-1993

SLOPE IN DEGREES FROM THE HORIZONTAL	0.00
SLOPE AS PERCENTAGE (PERCENT RISE PER UNIT OF RUN)	0.00
SLOPE DISTANCE AS MEASURED ALONG THE SURFACE	0.00
HORIZONTAL OR MAP DISTANCE	0.00
VERTICAL DISTANCE (CHANGE IN HEIGHT)	0.00
ACCUMULATED SLOPE DISTANCE OF PREVIOUS ENTRIES	0.00
ACCUMULATED HORIZONTAL DISTANCE OF PREVIOUS ENTRIES	0.00
ACCUMULATED VERTICAL DISTANCE OF PREVIOUS ENTRIES	0.00
STATIC OR GROSS HEAD OF WATER IN FEET	216.54
STATIC OR GROSS HEAD OF WATER IN METERS	66.00
STATIC OR GROSS HEAD OF WATER IN POUNDS PER SQUARE INCH	93.76
STATIC OR GROSS HEAD OF WATER IN KILOPASCALS	646.94
FLOW OF WATER IN AMERICAN GALLONS PER MINUTE	24406.11
FLOW OF WATER IN CUBIC FEET PER MINUTE	3262.85
FLOW OF WATER IN CUBIC FEET PER SECOND	54.38
FLOW OF WATER IN CUBIC METERS PER SECOND	1.54
HEAD LOSS DUE TO FRICTION, IN FEET	2.92
HEAD LOSS DUE TO FRICTION, IN METERS	0.89
HEAD LOSS DUE TO FRICTION, IN POUNDS PER SQUARE INCH	1.26
HEAD LOSS DUE TO FRICTION, IN KILOPASCALS	8.71
HEAD LOSS DUE TO FRICTION, AS PERCENTAGE OF STATIC OR GROSS HEAD	1.35
INSIDE DIAMETER OF PENSTOCK IN INCHES	45.28
INSIDE DIAMETER OF PENSTOCK IN CENTIMETRES	115.00
HAZEN - WILLIAMS COEFFICIENT OF FRICTION FOR PIPE BEING CONSIDERED	160.00
DYNAMIC OR WORKING HEAD OF WATER IN FEET	213.62
DYNAMIC OR WORKING HEAD OF WATER IN METERS	65.11
DYNAMIC OR WORKING HEAD OF WATER IN POUNDS PER SQUARE INCH	92.50
DYNAMIC OR WORKING HEAD OF WATER IN KILOPASCALS	638.23
TOTAL LENGTH OF PENSTOCK IN FEET	2870.73
TOTAL LENGTH OF PENSTOCK IN METERS	875.00
VELOCITY OF WATER IN PENSTOCK, FEET PER SECOND	4.90
VELOCITY OF WATER IN PENSTOCK, METERS PER SECOND	1.49
PERCENT EFFICIENCY OF PENSTOCK	98.65
PERCENT EFFICIENCY OF TURBINE	88.00
PERCENT EFFICIENCY OF GENERATOR	90.00
OVERALL EFFICIENCY OF WHOLE SYSTEM, AS A PERCENTAGE	78.13
MECHANICAL POWER OUTPUT OF TURBINE IN HORSEPOWER	1158.53
ELECTRICAL POWER OUTPUT OF SYSTEM IN KILOWATTS	777.84
AMOUNT OF ELECTRICAL ENERGY PRODUCED IN ONE DAY, IN KILOWATT HOURS	18668.10

SMALL HYDROELECTRIC SYSTEM PARAMETERS from file ULUPEL50.SHD 06-24-1993

SLOPE IN DEGREES FROM THE HORIZONTAL	0.00
SLOPE AS PERCENTAGE (PERCENT RISE PER UNIT OF RUN)	0.00
SLOPE DISTANCE AS MEASURED ALONG THE SURFACE	0.00
HORIZONTAL OR MAP DISTANCE	0.00
VERTICAL DISTANCE (CHANGE IN HEIGHT)	0.00
ACCUMULATED SLOPE DISTANCE OF PREVIOUS ENTRIES	0.00
ACCUMULATED HORIZONTAL DISTANCE OF PREVIOUS ENTRIES	0.00
ACCUMULATED VERTICAL DISTANCE OF PREVIOUS ENTRIES	0.00
STATIC OR GROSS HEAD OF WATER IN FEET	216.54
STATIC OR GROSS HEAD OF WATER IN METERS	66.00
STATIC OR GROSS HEAD OF WATER IN POUNDS PER SQUARE INCH	93.76
STATIC OR GROSS HEAD OF WATER IN KILOPASCALS	646.94
FLOW OF WATER IN AMERICAN GALLONS PER MINUTE	16934.85
FLOW OF WATER IN CUBIC FEET PER MINUTE	2264.02
FLOW OF WATER IN CUBIC FEET PER SECOND	37.73
FLOW OF WATER IN CUBIC METERS PER SECOND	1.07
HEAD LOSS DUE TO FRICTION, IN FEET	1.48
HEAD LOSS DUE TO FRICTION, IN METERS	0.45
HEAD LOSS DUE TO FRICTION, IN POUNDS PER SQUARE INCH	0.64
HEAD LOSS DUE TO FRICTION, IN KILOPASCALS	4.43
HEAD LOSS DUE TO FRICTION, AS PERCENTAGE OF STATIC OR GROSS HEAD	0.68
INSIDE DIAMETER OF PENSTOCK IN INCHES	45.28
INSIDE DIAMETER OF PENSTOCK IN CENTIMETRES	115.00
HAZEN - WILLIAMS COEFFICIENT OF FRICTION FOR PIPE BEING CONSIDERED	160.00
DYNAMIC OR WORKING HEAD OF WATER IN FEET	215.05
DYNAMIC OR WORKING HEAD OF WATER IN METERS	65.55
DYNAMIC OR WORKING HEAD OF WATER IN POUNDS PER SQUARE INCH	93.12
DYNAMIC OR WORKING HEAD OF WATER IN KILOPASCALS	642.51
TOTAL LENGTH OF PENSTOCK IN FEET	2870.73
TOTAL LENGTH OF PENSTOCK IN METERS	875.00
VELOCITY OF WATER IN PENSTOCK, FEET PER SECOND	3.40
VELOCITY OF WATER IN PENSTOCK, METERS PER SECOND	1.04
PERCENT EFFICIENCY OF PENSTOCK	99.32
PERCENT EFFICIENCY OF TURBINE	86.00
PERCENT EFFICIENCY OF GENERATOR	88.00
OVERALL EFFICIENCY OF WHOLE SYSTEM, AS A PERCENTAGE	75.16
MECHANICAL POWER OUTPUT OF TURBINE IN HORSEPOWER	790.88
ELECTRICAL POWER OUTPUT OF SYSTEM IN KILOWATTS	519.20
AMOUNT OF ELECTRICAL ENERGY PRODUCED IN ONE DAY, IN KILOWATT HOURS	12460.70

SMALL HYDROELECTRIC SYSTEM PARAMETERS from file ULUPEL25.SHD 06-24-1993

SLOPE IN DEGREES FROM THE HORIZONTAL	0.00
SLOPE AS PERCENTAGE (PERCENT RISE PER UNIT OF RUN)	0.00
SLOPE DISTANCE AS MEASURED ALONG THE SURFACE	0.00
HORIZONTAL OR MAP DISTANCE	0.00
VERTICAL DISTANCE (CHANGE IN HEIGHT)	0.00
ACCUMULATED SLOPE DISTANCE OF PREVIOUS ENTRIES	0.00
ACCUMULATED HORIZONTAL DISTANCE OF PREVIOUS ENTRIES	0.00
ACCUMULATED VERTICAL DISTANCE OF PREVIOUS ENTRIES	0.00
STATIC OR GROSS HEAD OF WATER IN FEET	216.54
STATIC OR GROSS HEAD OF WATER IN METERS	66.00
STATIC OR GROSS HEAD OF WATER IN POUNDS PER SQUARE INCH	93.76
STATIC OR GROSS HEAD OF WATER IN KILOPASCALS	646.94
FLOW OF WATER IN AMERICAN GALLONS PER MINUTE	8467.42
FLOW OF WATER IN CUBIC FEET PER MINUTE	1132.01
FLOW OF WATER IN CUBIC FEET PER SECOND	18.87
FLOW OF WATER IN CUBIC METERS PER SECOND	0.53
HEAD LOSS DUE TO FRICTION, IN FEET	0.41
HEAD LOSS DUE TO FRICTION, IN METERS	0.13
HEAD LOSS DUE TO FRICTION, IN POUNDS PER SQUARE INCH	0.18
HEAD LOSS DUE TO FRICTION, IN KILOPASCALS	1.23
HEAD LOSS DUE TO FRICTION, AS PERCENTAGE OF STATIC OR GROSS HEAD	0.19
INSIDE DIAMETER OF PENSTOCK IN INCHES	45.28
INSIDE DIAMETER OF PENSTOCK IN CENTIMETRES	115.00
HAZEN - WILLIAMS COEFFICIENT OF FRICTION FOR PIPE BEING CONSIDERED	160.00
DYNAMIC OR WORKING HEAD OF WATER IN FEET	216.12
DYNAMIC OR WORKING HEAD OF WATER IN METERS	65.87
DYNAMIC OR WORKING HEAD OF WATER IN POUNDS PER SQUARE INCH	93.58
DYNAMIC OR WORKING HEAD OF WATER IN KILOPASCALS	645.71
TOTAL LENGTH OF PENSTOCK IN FEET	2870.73
TOTAL LENGTH OF PENSTOCK IN METERS	875.00
VELOCITY OF WATER IN PENSTOCK, FEET PER SECOND	1.70
VELOCITY OF WATER IN PENSTOCK, METERS PER SECOND	0.52
PERCENT EFFICIENCY OF PENSTOCK	99.81
PERCENT EFFICIENCY OF TURBINE	84.00
PERCENT EFFICIENCY OF GENERATOR	86.00
OVERALL EFFICIENCY OF WHOLE SYSTEM, AS A PERCENTAGE	72.10
MECHANICAL POWER OUTPUT OF TURBINE IN HORSEPOWER	388.17
ELECTRICAL POWER OUTPUT OF SYSTEM IN KILOWATTS	249.03
AMOUNT OF ELECTRICAL ENERGY PRODUCED IN ONE DAY, IN KILOWATT HOURS	5976.79

The sizing of the design flow appears to be correct in that there should be a reasonable usage of higher stream flow values and an efficient utilization of low stream flow values considering the single francis turbine installation. No changes are anticipated in the area of hydrology or design flow.

V. ENVIRONMENTAL - It is understood that typical, small scale, run of river mini hydro projects are environmentally benign in that there is little water impoundment, radical fluctuation of water levels, or other similar adverse effects. This evaluation applies to the Ulung Peliang project also. In an effort to identify possible adverse environmental impacts, two areas were considered:

A. Construction activity - While temporary in nature, short term impacts can be significant, such as erosion caused by excavation and construction activities carried out directly in the stream itself. Results in turbid water, reduced water quality, downstream siltation. Some of the effects can be mitigated by careful planning of construction activities near the stream banks. There will however be unavoidable impacts during the construction phase. Rather than attempt to plan solutions in advance to counteract the unknown potential adverse effects, a program of monitoring during the construction phase could hold adverse impacts to a minimum. Timely replanting of disturbed slopes for erosion control and coordinating construction activities during the dry season would be areas in which project monitoring could help significantly to reduce short term impacts.

It should be noted that due to frequent heavy rainfall, water quality in the Ulung Peling often deteriorates because of upstream erosion and siltation. While at times the stream does indeed look pristine, normal rainfall patterns can cause the stream to become swollen with water borne debris. The point being, of course, that temporary construction activities may influence the stream quality no worse than occasional normal flooding.

7. Reduced stream flow values - Significant reduction of in-stream flow values between the intake and the point of discharge during periods of low stream flow. Results in water stagnation, reduced streamflow environment for streamlife and other use patterns such as bathing, washing clothes etc.

Assuming a design discharge of 2.1 cubic meters per second, There will be a significant reduction of streamflow approximately 60% of the total time during an average year. Some water will be bypassed and there are several springs which bring water into the Ulung Peliang below the diversion point. The actual instream flow value cannot be determined until the system is in operation. Flow values in the stream can easily be adjusted by simply reducing the flow through the turbine and bypassing additional water if necessary. This will however cause a reduction of energy output.

It should be noted that 100 meters above the powerhouse on the Ulung Peliang, there is a confluence with another river of equal flow. There currently is a limited number of people living above the powerhouse location on the Ulung Peling. During periods of low stream flow there will be a reduction in the water available for washing and bathing.

It is doubtful if low flow values will be an issue with the local villagers since there are no significant fisheries in the Ulung Peliang. The fishing consists mainly of young boys catching small indigenous river fish. Tamako is situated on the ocean, where fishing is one of the primary economies.

C. Positive aspects of mini hydro project - In contrast to diesel generating plants, mini hydro projects produce no air or thermal pollution. Likewise, hydropower impacts are fairly well understood and, therefore, predictable to a degree of accuracy. Hydropower is an economic use of a renewable resource, which is in direct contrast to diesel generation which consumes large amounts of

fossil fuel as diesel fuel and lube oil. The mini hydro project will provide a needed, and appropriate, new source of energy for an isolated, growing, electrical demand center which is already at capacity.

D. Suggested environmental strategies -

1. Implementation of a monitoring plan during project construction.
2. Consultation with affected communities prior to project startup.
3. Follow up monitoring to determine longer term impacts during project operation.

VI. FINANCIAL EVALUATION

The Tahuna Demand center is experiencing a typical population growth of 2.44% per year. The electrification ratio, at 34% will continue to increase primarily in the area of residential installations. The average annual peak load, growing at a rate of 5.8%, will reach will over 2500 KW by year 2000. The mini-hydro scheme, with an output of just over 1000 KW, will be able to supply 100% of the off-peak load capacity for the next 2 to 3 years, at which time additional generation will be needed. The mini-hydro scheme can currently supply approximately 50% of the peak load capacity. The potential yearly output, which could be utilized 100% by 1996, would be nearly 5,600,000 KWH/yr. at a capacity factor of 70%. The MHP project could therefore, displace up to 5,600 MWH per year in diesel fuel generation.

The Total investment cost is divided into local and foreign currency components. The original estimates of cost were updated based on inflation of materials and services. July 1993 estimate of cost is $2,014,790 The estimated cost per installed kilowatt is USD $1,848.

A cost analysis of equal capacity mini-hydro and diesel generation was produced using 4 different discount rates to determine net present values over 25 year lifetimes. The total overall costs incurred were determined, as well as total cost per kilowatt hour.

COST ESTIMATE SUMMARY

MINI HYDRO DEVELOPMENT PROJECT
PROJECT: ULUNG PELIANG
DEMAND CENTER: TAHUNA
CAPACITY: 1 x 1,090 kW
Date: Aug 2, 1993

CODE	DESCRIPTION	LOCAL CURRENCY TOTAL x1000 Rp	FOREIGN CURRENCY UNIT PRICE $ U.S.	FOREIGN CURRENCY TOTAL x1000	EQUIVALENT IN RUPIAHS EXCHANGE RATE	EQUIVALENT IN RUPIAHS TOTAL x1000Rp	TOTAL x 1000 Rp
0.0	**LAND AND LAND RIGHTS**	**25,000**		**0**		**0**	**25,000**
	PROJECT DIRECT COST						
	CIVIL WORK						
1.0	General	155,000		0		0	155,000
2.0	Land Clearing and Fencing	22,000		0		0	22,000
3.0	Access Road	10,000		0		0	10,000
4.0	Bridges	0		0		0	0
5.0	Headwork Water Control	180,000		0		0	180,000
6.0	Open canal 100 Meters	220,000		0		0	220,000
7.0	Headrace Penstock 870 meters	506,000		0		0	506,000
8.0	Powerhouse and Civil	62,000		0		0	62,000
9.0	Tail Race	8000		0		0	8,000
10.0	Switchyard Civil	5,000		0		0	5,000
11.0	Operator House and Yard	25,000		0		0	25,000
	SUB TOTAL CIVIL WORK	1,193,000		0		0	1,193,000
	GENERATING AND SWITCH YARD EQUIPMENT						
M-1	Mechanical Equipment	24,500		$490	2,100	1,029,000	1,053,500
E-1	Electrical Generating Equip.	24,500		$163	2,100	342,300	366,800
E-2	Switchyard Equipment	120,000		0		0	120,000
	SUBTOTAL GENERATING AND SWITCHYARD EQUIPMENT	169,000		653		1,371,300	1,540,300
	SUBTOTAL PROJECT DIRECT COST	1,362,000		653		1,371,300	2,733,300
	PROJECT INDIRECT COST						
I-1	Project Management Services	125,000		60	2,100	126,000	251,000
I-2	Start Up and Commissioning	5,000		20	2,100	42,000	47,000
I-3	Engineering	134,000		65	2,100	136,500	270,500
	SUBTOTAL PROJECT INDIRECT COST	264,000		145		304,500	568,500
	TOTAL DIRECT AND INDIRECT COST	**1,626,000**		**798**		**1,675,800**	**3,301,800**
	Risk 10% PPN tax 10%	325,200		80	2,100	167,580	492,780
	CONTINGENCY	243,900		80	2,100	167,580	411,480
	TOTAL CONSTRUCTION COST	**2,195,100**		**958**		**2,010,960**	**4,206,060**
	TOTAL INVESTMENT COST	**2,220,100**		**958**		**2,010,960**	**4,231,060**
						$1,848 /KW	$2,014,790

COST ANALYSIS OF COMPARABLE DIESEL
AND HYDRO GENERATED POWER SCHEMES
PROJECT: ULUNG PELIANG
DEMAND CENTER: TAHUNA
CAPACITY: 1090 kW
2-Aug-93

HYDRO GENERATED POWER SCHEME

		Cost
***All costs are expressed in current Rupiahs**		x 1000 Rp
Capitalization Costs:	Initial capital expenditure	4,231,060
Annualized Costs:	Operation & Adm. Expense per year	20,000
	Maintenance Expense per year	10,000

Year	Capital Exp. x 1000Rp	Operation. Exp. x 1000 Rp	Main. Exp. x 1000 Rp	Total Cost x 1000 Rp	Present Value at 8%	Present Value at 10%	Present Value at 12%	Present Value at 14%
0	0	0	0	0				
1	1,692,424	0	0	1,692,424	1,567,059	1,538,567	1,511,093	1,484,582
2	2,538,636	0	0	2,538,636	2,176,471	2,098,046	2,023,785	1,953,398
3		20,000	10,000	30,000	23,815	22,539	21,353	20,249
4		20,000	10,000	30,000	22,051	20,490	19,066	17,762
5		20,000	10,000	30,000	20,417	18,628	17,023	15,581
6		20,000	10,000	30,000	18,905	16,934	15,199	13,668
7		20,000	10,000	30,000	17,505	15,395	13,570	11,989
8		20,000	10,000	30,000	16,208	13,995	12,116	10,517
9		20,000	10,000	30,000	15,007	12,723	10,818	9,225
10		20,000	10,000	30,000	13,896	11,566	9,659	8,092
11		20,000	10,000	30,000	12,866	10,515	8,624	7,099
12		20,000	10,000	30,000	11,913	9,559	7,700	6,227
13		20,000	10,000	30,000	11,031	8,690	6,875	5,462
14		20,000	10,000	30,000	10,214	7,900	6,139	4,791
15		20,000	10,000	30,000	9,457	7,182	5,481	4,203
16		20,000	10,000	30,000	8,757	6,529	4,894	3,687
17		20,000	10,000	30,000	8,108	5,935	4,369	3,234
18		20,000	10,000	30,000	7,507	5,396	3,901	2,837
19		20,000	10,000	30,000	6,951	4,905	3,483	2,488
20		20,000	10,000	30,000	6,436	4,459	3,110	2,183
21		20,000	10,000	30,000	5,960	4,054	2,777	1,915
22		20,000	10,000	30,000	5,518	3,685	2,479	1,680
23		20,000	10,000	30,000	5,109	3,350	2,214	1,473
24		20,000	10,000	30,000	4,731	3,046	1,976	1,292
25		20,000	10,000	30,000	4,381	2,769	1,765	1,134
Total costs discounted over the life of the hydro:					4,010,276	3,856,859	3,719,471	3,594,768

Observed Cost per kilowatt hour:			
Capasity Factor:	**70%**	**60%**	**50%**
Total Cost incurred over the life of the of the project:	4,921,060	4,921,060	4,921,060
Total Kilowatt hours produced over the 25 years:	139,300,000	119,400,000	99,500,000
Total Cost per kilowatt hour:	**35.33**	**41.21**	**49.46**

COST ANALYSIS OF COMPARABLE DIESEL
AND HYDRO GENERATED POWER SCHEMES
PROJECT: ULUNG PELIANG

DEMAND CENTER: TAHUNA
CAPACITY: 1090 kW

COMPARABLE DIESEL GENERATED POWER SCHEME

Number of Generators to produce a comparable output capacity of 1090 kW:

Multiplier	**1.67**
Number of 250 kW diesel units to meet a constant 1090kW capacity:	**7**

***All costs are expressed in current Rupiahs**		Cost/ unit x 1000 Rp	# of units	Total Cost x 1000	Annual Real Cost Escalation
Capitalization Costs:	Initial capital expenditure per unit	241,115	7	1,687,805	-
	Major overhaul cost per unit	50,000	7	350,000	2%
Annualized Costs:	Diesel fuel costs per year/ unit	105,731	7	740,117	3%
	Lubrication cost per year/ unit	7,082	7	49,574	3%
	Operation & Administrative cost/year	20,000	1	20,000	0%

Year	*Capital Exp.* x 1000Rp	*Major Overhaul* x 1000 Rp	*Diesel & lube Exp.* x 1000 Rp	*Operation Exp.* x 1000 Rp	*Total Cost* x 1000 Rp	*Present Value* at 8%	*Present Value* at 10%	*Present Value* at 12%	*Present Value* at 14%
0	1,687,805				1,687,805	1,687,805	1,687,805	1,687,805	1,687,805
1			789,691	20,000	809,691	749,714	736,083	722,938	710,255
2			813,382	20,000	833,382	714,491	688,745	664,367	641,260
3			837,783	20,000	857,783	680,936	644,465	610,553	578,979
4			862,917	20,000	882,917	648,970	603,044	561,110	522,758
5		385,000	888,804	20,000	1,293,804	880,541	803,351	734,139	671,961
6			915,468	20,000	935,468	589,504	528,047	473,937	426,187
7			942,932	20,000	962,932	561,862	494,137	435,582	384,824
8			971,220	20,000	991,220	535,525	462,412	400,337	347,481
9		415,800	1,000,357	20,000	1,436,157	718,436	609,071	517,893	441,630
10			1,030,368	20,000	1,050,368	486,523	404,962	338,190	283,330
11			1,061,279	20,000	1,081,279	463,742	378,982	310,842	255,849
12			1,093,117	20,000	1,113,117	442,034	354,673	285,709	231,038
13		449,064	1,125,911	20,000	1,594,975	586,469	482,007	365,527	290,396
14			1,159,688	20,000	1,179,688	401,638	310,649	241,388	188,408
15			1,194,478	20,000	1,214,478	382,854	290,736	221,881	170,144
16			1,230,313	20,000	1,250,313	364,954	272,105	203,953	153,653
17		484,989	1,267,222	20,000	1,772,211	478,974	350,623	258,113	191,044
18			1,305,239	20,000	1,325,239	331,640	238,356	172,334	125,316
19			1,344,396	20,000	1,364,396	316,147	223,090	158,416	113,174
20			1,384,728	20,000	1,404,728	301,382	208,804	145,624	102,210
21		523,788	1,426,270	20,000	1,970,058	391,363	266,215	182,348	125,741
22			1,469,058	20,000	1,489,058	273,898	182,925	123,059	83,369
23			1,513,130	20,000	1,533,130	261,115	171,217	113,127	75,295
24			1,558,524	20,000	1,578,524	248,932	160,261	103,996	68,004
25			1,605,279	20,000	1,625,279	237,320	150,007	95,604	61,420
Total cost discounted over the life of the diesel generators:						10,584,760	8,570,136	7,053,660	5,892,211

Observed Cost per kilowatt hour:

Total Cost incurred over the life of the of the project:	33,237,999
Total Kilowatt hours produced over the 25 years:	199,000,000
Total Cost per kilowatt hour (Rp):	**167.03**

Department of Energy
Washington, DC 20585

July 14, 1994

Dr. Phillip M. Wright
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, UT 84108-1295

Dear Mike:

I have visited with Dr. Anil Cabraal in the Asia Alternative Energy Unit at the World Bank. I suggested that he incorporate "Micro-Geothermal" (300kW to 1MW) in his next Rural Electrification Program with PLN in Indonesia. Binary geothermal plants of this size could be installed at prices competitive with mini-hydro and much lower than diesel generators, shallow wells could be drilled with locally available water-well rigs, and the geothermal units could be remote controlled with only minor need for servicing. My suggestion met with a warm response and I received copies of material on rural electrification and geothermal resources in Indonesia. I thought these reports would be of interest to you.

I also visited with Ross Pumfrey at AID for talks of the Hemispheric Summit in December. While there, I picked up this literature you may have an interest in reading.

I will keep you informed of any progress.

Sincerely,

Marshall

Marshall Reed, Program Manager
International Geothermal Program
Geothermal Division, EE-122