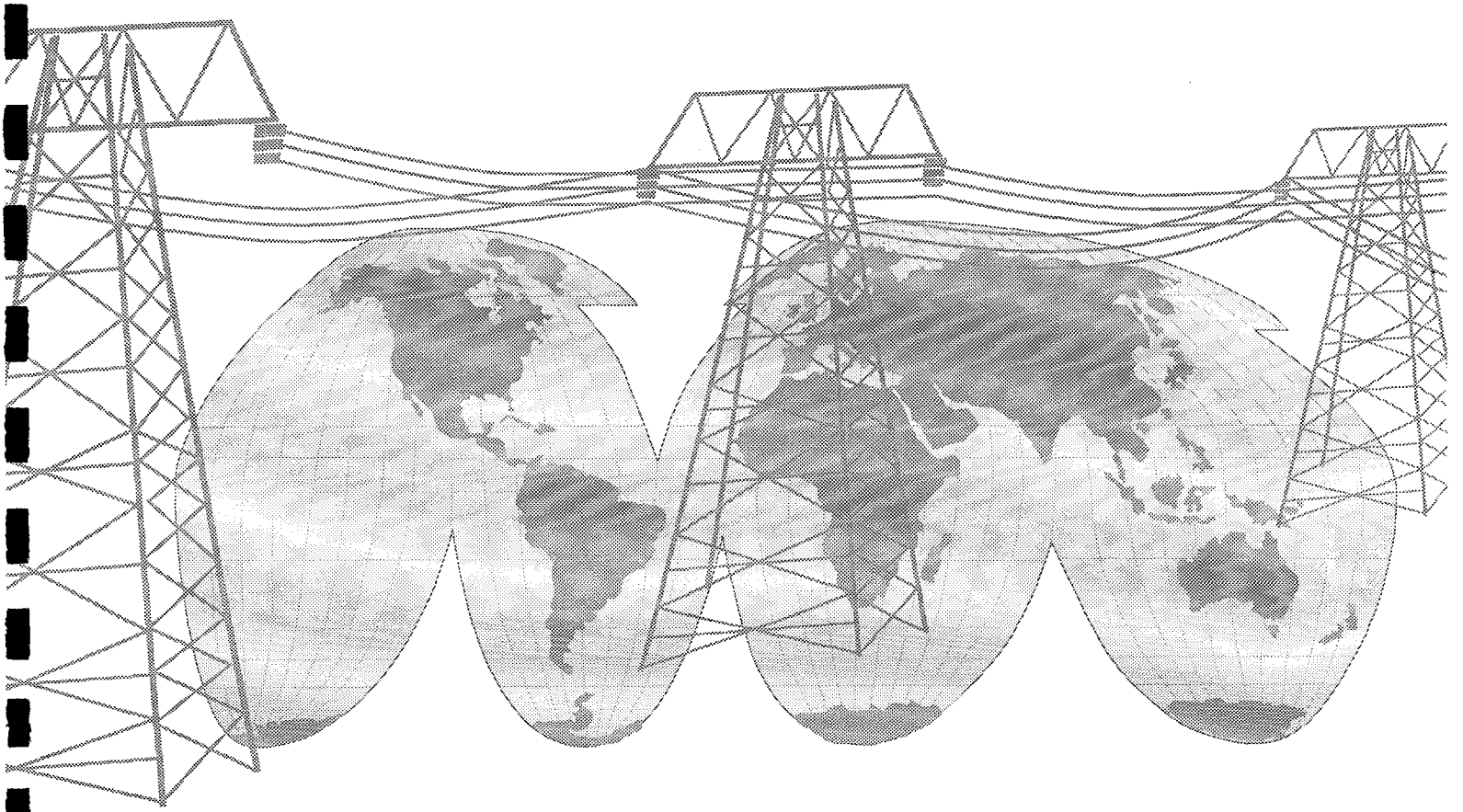
PD-ABN-847

Center for Environment
Office of Energy, Environment, and Technology

ENERGY PROJECT DEVELOPMENT FUND

End of Project Report

March 24, 1995



U.S. Agency for International Development
Bureau for Global Programs, Field Support, and Research
Center for Environment
Office of Energy, Environment, and Technology
Washington, D.C. 20523-1810

Administered by:
Price Waterhouse LLP

Contract No. DHR-5738-C-00-0097-00

Table of Contents

Table of Contents

Acronyms

CFB	Circulating Fluidized Bed
DOE	U.S. Department of Energy
EPC	Engineering and Procurement Contractor
FSA	Fuel Supply Agreement
IA	Interconnection Agreement
IPP	Independent Power Producer
MW	Mega Watt
O&M	Overhead and Management
PPA	Power Purchase Agreement
PSI	Pounds per Square Inch
RFP	Request for Proposal

I. ENERGY PROJECT DEVELOPMENT FUND BACKGROUND

Background

The Energy Project Development Fund (EPDF), administered by Price Waterhouse LLP (PWLLP), was established by USAID's Office of Energy, Environment, and Technology to promote the development and application of environmentally-sound energy technologies in projects aimed at alleviating the energy problems currently faced by developing countries. EPDF provided assistance in the form of financial support to conduct feasibility and pre-feasibility studies aimed at evaluating the technical, economic, financial, and legal viability of the proposed project in the energy sector. The primary objectives of EPDF were the following:

- To provide financial assistance for pre-feasibility and feasibility studies that evaluate public and private energy projects in developing countries, with priority given to those that involve proven, environmentally acceptable, and clean technologies; and

- To assist private companies from the United States and public sector entities from developing countries to identify and develop projects that support sustainable and environmentally acceptable economic development and promote U.S. trade and investment.

Criteria for Participation

The applicant pool was limited to U.S. owned private power developers, utilities and subsidiaries, energy and equipment suppliers, and engineering firms. In addition, developing country public utilities and other public sector entities working with U.S. companies were eligible. To receive funding the applicants had to demonstrate the following:

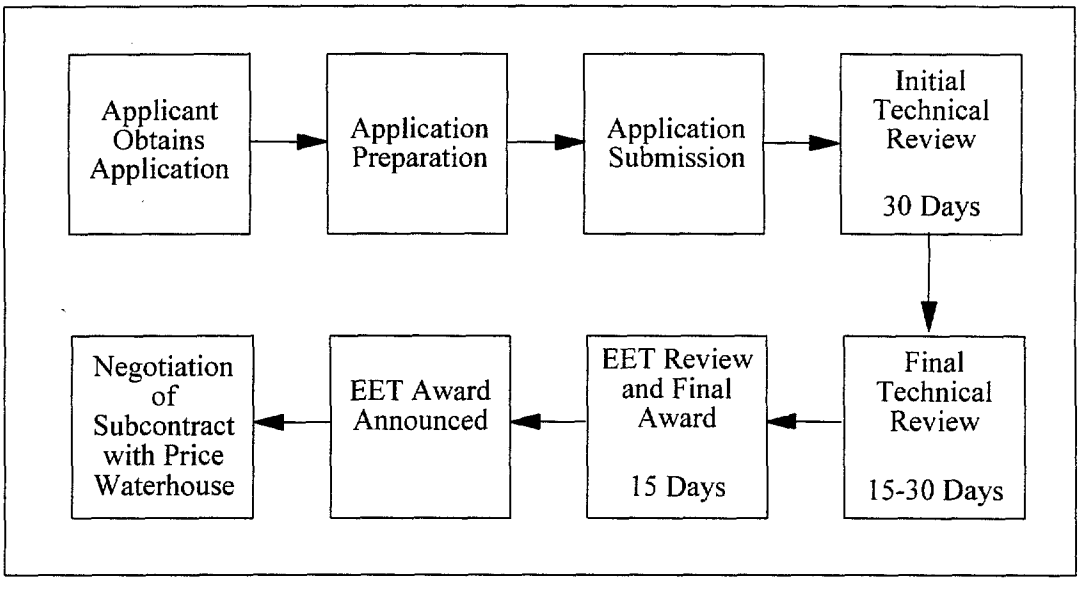
- U.S. Ownership or A.I.D.-assisted country in collaboration with U.S. firm;
- Project's ability to meet World Bank Environmental Standards;
- Commercial viability of proposed technology;
- Identified project site;
- Applicants ability to cover 50 percent of the cost; and
- Repayment of conditional loans upon completion of project financing.

Assistance provided by EPDF was based on a cost sharing arrangement. Eligible applicants received up to 50 percent of the cost of the feasibility studies and other related project development activities from EPDF in the form of grants (for publicly-owned projects) or loans (for privately-owned projects). Threshold criteria was established to ensure that accepted projects were likely to achieve commercial success and the projects were consistent with the development goals of EPDF.

Project Evaluation Process

The procedure for applying to EPDF was initiated by the interested party submitting an application to PWLLP, the fund administrator. Each application was reviewed by a Technical Review Panel, composed of engineers from the U. S. Department of Energy, and financial specialists from PWLLP. In addition, each application was approved by USAID's Office of Energy, Environment, and Technology. Figure 1 on the following page shows a diagram of the application process.

Energy Project Development Fund
Application Process Flowchart



EET - USAID's Office of Energy, Environment, and Technology

Figure 1

There were two phases to the review process. The initial review took 30 days and a second review took 15-30 days. Factors considered in evaluating the proposed projects were as follows:

- Use of commercially proven and environmentally-sound technology.
- Project supports sustainable economic development and promotes U.S. trade and investments.
- Prior international experience in proposed venture.
- Technical and financial soundness of the proposed project.
- Technical and financial merits of the proposed study.

Upon completion of the technical review, a final review was performed by USAID's Office of Energy, Environment, and Technology. The award decision was announced within 15 days. After being awarded approval, the applicant entered into an Assistance Agreement (Subcontract) with PWLLP. PWLLP, as administrator of EPDF, was responsible for disbursing funds and monitoring the progress of the proposed activities. A copy of EPDF's Information and Application Packet is attached in Appendix A.

Administration

When EPDF began in 1990, it was administered jointly by K & M Engineering and Bechtel with PWLLP as subcontractor. PWLLP was later contracted in June 1993 by USAID to become the sole administrator of EPDF.

As administrator, PWLLP was responsible for the day-to-day operation of the fund, and served as liaison between interested parties and USAID. In its role as liaison, PWLLP was responsible for coordinating all activities related to the evaluation of the proposed study and management of all successful awards, as described earlier.

In addition to serving as liaison, PWLLP was actively involved in promoting EPDF and marketing it to both the private and public sector. As is evident from the project summaries, EPDF has been involved in various unique and interesting ventures worldwide with firms of international repute. Appendix B shows one of EPDF's brochures used to market the fund to private U.S. companies. In addition, Appendix C shows the required Mission Clearance form used to inform the local USAID Mission of the project's proposed activities.

Repayment of Feasibility Study Loans

The funding provided to private companies (Subcontractor) under EPDF was primarily designed to serve as a loan from the U.S. Agency for International Development. The funding supports U.S. companies who have conducted energy project feasibility studies until the project becomes more secure financially and reaches financial closure. Upon financial closure, the Subcontractors are obliged to repay the loan as long as financial closure is reached within three years of signing the Promissory Note. The Promissory Note was signed at the same time as the Subcontract with Price Waterhouse LLP.

There are several situations where the funded Subcontractor is not obliged to repay the loan. First, a few projects were conducted by private companies for public entities such as the Government of the Ukraine. In this case, the funding received from EPDF was originally meant to be a grant. Second, a Subcontractor may not reach financial closure perhaps because the project was discontinued or financial backing was not secured. Third, a Subcontractor may reach financial closure more than three years after signing the Promissory Note. In these instances, the loan becomes a grant and the Subcontractors are not obliged to repay the funding received.

If a Subcontractor has reached financial closure within three years of the Promissory Note, they are obliged to repay the full amount of funding received. The total amount received is listed in the project summaries in this report and is stated in the Release and Certification form that was returned to EPDF following receipt of the final payment. The Project Summary Table located in Section II shows the funded projects and indicates the amount and date of repayment.

The Subcontractor must repay the loan directly to USAID. There is not a specific bank or account number, but the correspondence must reference the EPDF Project contract number DHR-5738-C-00-0097-00. The following is the address where the payment should be sent:

United States Agency for International Development
515 22nd Street, NW
Room 700, SA-2
FM / CMP / DCB
Washington, D.C. 20523-0209
ATTN: Kristy Dent

In addition, the payment should be accompanied by a Certification of Acknowledgement of Receipt of Payment. This certification is meant to serve as a receipt from USAID to the Subcontractor. Appendix D shows a sample certification.

II. PROJECT SUMMARY TABLE

PROJECT SUMMARY TABLE

Energy Project Development Fund - March 1995

ALPHABETICAL LISTING OF FUNDED PROJECTS

Company	Country	MW	Fuel	Contract Date	Contract Value	Total Funding Received	Date of Next Status Report	Date of Expected Repayment
Altresco/ Harris Group	Philippines	400	Oil/Gas	1/19/93	$200,000	$200,000	6/30/95	1/19/96
Babcock & Wilcox	Ukraine	55	Coal	3/22/94	$176,000	$125,408	6/30/95	Public Project*
Caribbean Electric	Jamaica	65	Coal	7/30/91	$100,000	$100,000	6/30/95	No Financial Closure**
Cogentrix	India	1000	Coal	12/7/92	$200,000	$200,000	6/30/95	12/7/95
Energia Global	Costa Rica	22	Hydro	12/11/92	$127,000	$121,000	6/30/95	12/11/95
Heard Energy	Indonesia	220	Coal	3/14/94	$200,000	$200,000	6/30/95	3/14/97
Hidro Atlantica	Costa Rica	12	Hydro	6/18/92	$40,000	$40,000	Not Applicable	Project Discontinued
Hidro Electrica	Costa Rica	13	Hydro	10/1/91	$114,500	$114,500	Not Applicable	Remitted 3/31/95
Joseph Technologies	Russia	340	Gas	5/7/93	$140,000	$140,000	6/30/95	Public Project*
National Power Company	Philippines	273	Cogen	5/27/94	$237,000	$183,927	6/30/95	1/20/98
Public Power of India	India	500	Coal	12/9/92	$200,000	$200,000	6/30/95	12/9/95
Synergics	Dominican Republic	22	Oil	3/22/91	$130,000	$130,000	6/30/95	No Financial Closure**
Tazcogen	Mexico	56	Cogen	3/17/94	$250,000	$250,000	6/30/95	3/17/97

* The funding provided to public projects was a grant, thus does not require repayment.

** The funding provided to Caribbean Electric and Synergics has become a grant since they did not reach financial closure within 3 years of their contract date.

Figure 2

III. SUMMARY REPORTS

17

A. PROJECTS GRANTED APPROVAL

13

ALTRESCO / HARRIS GROUP INC. (Luzon)

Project Name: Luzon Power Project

Type of Power/Output: 300 MW Diesel Engine Based Electric Power Generating Plant

Location: Batangas Bay, Batangas Province, Luzon, Republic of the Philippines

Project Summary:

The Luzon Power Project began as a 400 MW, residual oil-fired combined cycle power plant to be installed on a site near Batangas Bay in the Philippines. This project was needed to address the shortages of electric power which cause rotating brown outs and have severely stalled the development of new industry in the Philippines.

The Luzon Power Project is a joint development of Altresco Philippines, Inc., a United States-based developer; Meralco Industrial Engineering Services Corporation, a subsidiary of Manila Electric Company; and CMS Generation, an unregulated subsidiary of a major U.S. Utility Company. These companies have formed a Philippine partnership known as Luzon Power Associates (LPA). LPA signed a Power Supply Agreement with the Manila Electric Company in October 1992. Due to the shortage of power, this project is needed on-line as soon as possible and is projected to be fully operational in 1995.

Around the time of the final deliverable in November of 1993, the project was downsized to a 300 MW facility. The reasons cited for the downsizing were the availability of long-term debt financing in the Philippines and a desire to keep the total project cost under $500 million. In addition to changing the net output of the proposed plant, the type of power and plant configuration were altered. The plant was changed from a Net No. 6 Heavy Fuel Oil-Fired Combined Cycle plant to a Diesel Engine-based facility.

Current Status:

At the time of this report, the most recent status report received was in the form of a phone conversation on March 16, 1995. During this phone call, Mr. William R. Williams of Altresco stated that the project is still moving towards its goals. However, some governmental and regulatory issues had arisen recently, the effect of which could not be determined at this time. An official written status report outlining these issues and the details of the project's current status is due to be submitted by Mr. Williams at the end of March

1995. Since the EPDF office will be closing on March 24, 1995, Mr. Williams has been instructed to submit this report to Dr. Samuel Schweitzer at USAID.

Dates:

Application: August 1992
Approval: January 15, 1993
Contract Signature: January 19, 1993
Promissory Note Signed: January 19, 1993
Deliverables Received: Phase I: March 1993
Phase II: April 23, 1993
Phase III (Final): November 1993
Expected Financial Closure: Can not be determined at this time
Date To Repay If Financial Closure: January 19, 1996 (3 Years From Contract Date)
Release and Certification: May 17, 1994 ($200,000.00)

Payment Summary:

Phase I:	Payment Approval Form Dated April 27, 1993	$ 75,000.00
Phase II:	PW Check Dated December 15, 1993	$ 75,000.00
Phase III:	PW Check Request Dated April 25, 1994	$ 50,000.00
Total:		$200,000.00

Client Contact:

Name:	William R. Williams
Position/Title:	President, Altresco
Address:	600 South Cherry Street, Suite 1200
	Denver, Colorado 80222
Phone:	(303) 320-8306
Fax:	(303) 321-6133

BABCOCK & WILCOX

Project Name: Kharkovenergo GRES-2 Station

Type of Project: Repowering a Ukrainian 50 MW Coal-Fired Boiler with Circulating Fluidized-Bed (CFB) Technology

Location: Kharkov, Ukraine

Project Summary:

Prior to the dissolution of the Soviet Union, Ukraine generated nearly 50% of its electricity through gas and oil-fired thermal power stations. Nuclear power represented approximately 25% of total production and coal-fired plants only 22%. Since the Chernobyl nuclear disaster, Ukraine has been decreasing its production of nuclear power. Ukraine's reserves of natural gas and oil have been depleted, thus these fuels must be imported from Russia and other former Soviet Union countries at world price levels. Ukraine possesses vast reserves of coal which represent an economically attractive alternative to imported fuels. Unfortunately, much of the coal being used for power production is a high ash, very low-volatility waste anthracite (culm) fuel. This fuel is extremely difficult to burn and requires high amounts of costly imported supplemental natural gas and oil fuels. In addition, coal-fired plants throughout Ukraine present the following problems:

- Aging and worn coal-fired boiler equipment in need of replacement, and
- High levels of SOx and NOx emissions.

To address the problems with the existing coal-fired plants the Government of Ukraine requested that Babcock & Wilcox examine an alternative energy generation source using fluidized-bed technology. Fluidized-bed technology is an attractive choice for replacement of aging coal-fired boilers throughout Ukraine because it provides effective combustion of low grade fuels while achieving low levels of NOx and SOx emissions.

The estimated cost of the project, with maximum amounts of local materials and 100% local construction labor, is $16,800,000 ($US equivalent). Approximately 55% of this amount represents hard currency requirements of the project. The project is scheduled to start commercial operations by March 1997.

Current Status:

The Ukraine Ministry of Energy Innovation Fund, created under the program for development of Ukrainian Boiler Manufacturing, is the intended source of financing for the project. The overall project plan/proposal is scheduled to be presented to the Technical Committee of Minenergo by the end of March 1995. The prime contractor for the execution of the project will be Kotloprominvest (KPI). KPI is a Ukrainian/Russian joint venture company which has recently licensed CFB boiler technology from B&W. The Minister of Energy's approval is expected during the month of April 1995. Completion of the project is expected in April 1997.

Dates:

Contract Signature: March 22, 1994
Deliverables Received: Phase I: July 29, 1994
Phase II: November 17, 1994
Expected Financial Closure: April 1997
Date to Repay if Financial Closure: Not Applicable -Public Project which does not require repayment.

Payment Summary:

First invoice: February 20	$ 51,378.88
Second invoice: March 15	$ 74,028.78
Total:	$125,407.66

Client Contact:

Name:	Chris Jones
Position/Title:	Project Manager
Address:	205 Van Buren Avenue
	P.O. Box 351
	Barbeton, OH 44203
Phone:	(216) 860-2713
Fax:	(216) 860-1721

CARIBBEAN ELECTRIC POWER L.P.

Project Name: Caribbean Cement Electric Power Project

Type of Project: 60 MW Coal-Fired Generating Plant

Location: Kingston, Jamaica

Project Summary:

In 1989 a report commissioned by the Jamaican Public Service (JPS) company found that energy sales grew at an average of 9% in the late 80's and were expected to continue experiencing high growth rates into the 90's. However, the report found that capacity during the 80's did not keep pace with energy demands and consequently, additional capacity was required immediately to meet system demands.

The Caribbean Electric Power, L.P. (CEP), a partnership of HYDRA-CO Enterprise, Inc., the International Energy Finance, Ltd., and the U.S. Energy Corporation, examined the feasibility of constructing a 60 MW Build-Own-Operate-Transfer coal-fired power plant. The location of the project site is next to the Caribbean Cement Company in Kingston Harbor, Kingston, Jamaica. The estimated total project cost is $13,280,000 financed with a capital structure of 70% debt and 30% equity.

This project will add almost 15% new capacity to the country, reduce the need for the government to incur additional public sector debt in the power sector, and reduce the need for Jamaica to increase its foreign exchange spending on imported oil. This would also be the first coal-fired plant in Jamaica allowing its government to diversify its energy reliance on oil.

Current Status:

CEP is currently working with the owner of the project site to secure the rights to develop the plan. The plant continues to be high on the priority of the JPS because of the benefits to the country in fuel diversification. Important milestones continue to be met in order for this project to reach financial closure. CEP seeks to achieve financial closing within the earliest possible timeframe.

Dates:

Contract Signature: July 30, 1991
Deliverables Received: Phase I: January 31, 1992
Phase II: October 15,1992
Final Report: June 30, 1993
Expected Financial Closure: Can not be determined at this time
Date to Repay if Financial Closure: July 30, 1994

Payment Summary:

First Invoice: March 4, 1992	$ 30,000
Second Invoice: January 7, 1993	$ 40,000
Third and Final Invoice: October 8, 1993	$ 30,000
Total:	$100,000

Client Contact:

Name:	Richard Germain
Position/Title:	Vice President International Energy Finance Ltd.
Address:	4800 Hampden Lane, Suite 910 Bethesda, MD 20814
Phone:	(301) 215-7800
Fax:	(301) 215-7804

COGENTRIX

Project Name: Mangalore Power Project

Type of Project: 4 pulverized coal-fired units of 250 MW

Location: Nandikur (Mangalore), State of Karnataka, India

Project Summary:

The existing generating capacity in Karnataka is entirely hydro-based, with the exception of the 2X210 MW thermal power station at Raichur. The rapid rate of growth of electricity demand cannot be served by the expansion of the hydropower resources and therefore thermal power stations are necessary on a rapid development basis. This growth in electricity demand coupled with the Government of India's commitment to independent power created an exceptional opportunity to develop coal-fired generating units in Mangalore.

Cogentrix and the General Electric Company established the Mangalore Power Company (MPC), to manage the construction of the Mangalore Power Project. They also provided the equipment and facility, and provided financing and investments for more than 50% of the non-Indian equity required for the project. Cogentrix changed the configuration of the power plant on two occasions. The initial plant design was 2X250 MW units. The second configuration was 6X167 MW units, and the final configuration established was 4X250 MW units.

Total project cost is estimated to be $1,723 million. The project will be financed using limited recourse finance with a debt ratio of 70%. The first, second, third, and fourth 250 MW units are scheduled to start commercial operations 36, 42, 48, and 54 months respectively after financial closure is achieved.

Current Status:

MPC continues to work on several fronts in order to achieve its goal of financial closure by the first quarter of 1996. MPC has issued a request for proposal to interested fuel suppliers and bids were received on March 3, 1995. The MPC bid package has been released and bids are due on May 1, 1995. The first rough draft of the financial solicitation book has been completed. However, a number of issues remain to be resolved such as finalizing the Power Purchase Agreement, land acquisition plan, and obtaining final environmental clearance.

Dates:

Contract Signature: December 7, 1992
Deliverables Received: Phase I: August 8, 1994
Final Report: August 8, 1994
Expected Financial Closure: 1st quarter 1996
Date to Repay if Financial Closure: December 7, 1995

Payment Summary:

First and only invoice: November 30, 1994	$200,000

Client Contact:

Name:	Jerry Bernstein
Position/Title:	
Address:	9405 Arrowpoint Blvd Charlotte, N.C. 28273
Phone:	(704) 525-3800
Fax:	(704) 529-5313

21

ENERGIA GLOBAL

Project Name: P.H. Don Pedro, S.A. and P.H. Rio Volcan, S.A.

Type of Project: Two Hydroelectric Projects; Combined Capacity 26 MW

Location: Sarapaqui Valley, Costa Rica

Project Summary:

Costa Rica currently faces a serious shortfall in its energy generation capacity due to the rapid growth in electricity demand during the past decade (6-10% per year) and increasingly tighter financial constraints placed on the country. The national utility, Instituto Costarricense de Electricidad (ICE), has put forth a development plan that calls for almost tripling its generation capacity by the year 2005, from 660 MW to 1800 MW, requiring anywhere from $300 to $600 million in investments. Already debt servicing claims are over 40% of the ICE's total available funds.

Due to the serious financial and power constraints, the Government of Costa Rica along with the ICE has developed new policies and a law to encourage the production and sale of electricity from private producers, up to 15% of installed capacity, based on the use of indigenous energy resources.

Energia Global's project will be part of a nation-wide effort to reduce Costa Rican dependency on imported fuel oil. It is expected to help improve the balance of payments, improve power availability and reliability, reduce the environmental impact of power production, and provide employment opportunities through construction and operation of the facility.

Energia Global's project encompasses two hydroelectric plants with a combined capacity of 26 MW. The San Pedro plant will provide a capacity of 14 MW and the Rio Volcan plant a capacity of 12 MW. The San Pedro plant will use the water of the San Fernando River. The estimated cost of the San Pedro plant is $17,613,808 to be financed with a capital structure of 80% debt and 20% equity.

The Rio Volcan plant will be located in part in the province of Heredia and in part in the province of Alajuela. It will use the water of the Volcan River. The estimated total cost of the Rio Volcan plant is $16,900,673 to be financed with a capital structure of 80% debt and 20% equity.

22

Current Status:

P.H. Don Pedro is at an advanced stage having completed the project feasibility study, signed a 15 year Power Purchase Agreement with ICE, negotiated all the required water rights and environmental permits, and secured equity commitments for project financing. Energia Global is presently in discussions with two potential lenders of senior and sub debt for the full costs of the project. They have also signed an agreement with Jose Cartellone of Argentina to be the full EPC contractor for the project.

P.H. Rio Volcan is at mature stage but not as fully developed as Don Pedro. Energia Global has completed the feasibility study, signed a Power Purchase Agreement with ICE, negotiated water rights and required environmental permits. Energia Global has to complete further geotechnical and hydrological analysis as well as finalizing the EPC contract.

Dates:

Contract Signature: December 11, 1992
Deliverables Received: Don Pedro Phase I: March 16, 1993
Don Pedro Final Report: June 18, 1993
Rio Volcan Phase I: July 28, 1993
Rio Volcan Final Report: October 2, 1993
Expected Financial Closure: Don Pedro, July 1995
Rio Volcan, January 1996
Date to Repay if Financial Closure: December 11, 1995

Payment Summary:

Fine Don Pedro Phase I: July 16, 1993	$ 32,179.48
Fine Don Pedro Final: October 7, 1993	$ 30,002.05
Fine Rio Volcan Phase I: December 2, 1993	$ 42,000.00
Rio Volcan Final Invoice: May 16, 1994	$ 16,294.04
Total:	$ 120,475.57

Client Contact:

Name: Peter B. Clark
Position/Title: Vice President, Power Systems Division
Address: c/o Energia Global, Inc.
101 Edgewater Drive
Wakefield, MA 02154
Phone: (617) 224-1125
Fax: (617) 224-3375

HEARD ENERGY CORPORATION (Sibolga Bay)

Project Name: Sibolga Bay Power Project

Type of Power/Output: 2X100 MW Coal Fired Power Plant

Location: Near Sibolga, North Sumatra, Indonesia

Project Summary:

The proposed plant will be a 200 MW net pulverized coal-fired power plant, developed and constructed near Sibolga Bay, North Sumatra, Indonesia.

Particulars of the plant include:

- The plant will consist of two independent power generating units, each capable of producing a 100 MW net output.
- Each power generating unit will consist of a pulverized coal non-reheat boiler, a steam turbine generator, condenser, feedwater heaters, and required auxiliary systems for a complete power plant.
- Pulverized coal will be the primary fuel and will be delivered by an ocean-going vessel to the power plant unloading dock, where it will then be conveyed to a common stock pile.
- Electrical power will be exported to the PLN grid through a double-circuit 150 kV steel tower transmission line to be constructed as part of the project.
- The plant site area will be of sufficient size for two additional 100 MW net power generating units to allow for future expansion of the plant.
- The plant will be designed to operate continuously at maximum rate load, with the ability to operate safely at a reduced capacity and achieve an 83% capacity factor during the project life of 30 years.

As of the final deliverable, Heard Energy Corporation had not yet specified a final equipment suppler or O&M contract services provider.

Current Status:

At the time of this report, the most recent status report received was dated March 13, 1995. At present, the project sponsors expect financial closure for the project to occur in the first quarter of 1996 and commercial operations to begin in the fourth quarter of 1998. The final selection of coal mines to supply the project still has not been completed. The proposed O&M contractor, Entergy Power Development Corporation, and its coal consultant have identified several suppliers capable of supplying coal to the project. Final selection will depend on coal supply negotiations with these several candidates.

The land site for the project has been identified and geotechnical evaluations have been carried out. The land on the proposed site has been reserved for the project by regional governmental officials.

The O&M contractor is expected to be a subsidiary of Entergy Corporation, a major US electric utility. Entergy also expects to be a major owner of the project.

To date, no additional discussions have been held with IFC. Heard Energy states that negotiations with financing sources will be meaningful only after the terms of the EPC turnkey construction contract are concluded. At present, the project sponsors are relying on the experience of the project's financial advisor and on publicly available information for estimates of financing to be obtained for the project.

Dates:

Application: August 4, 1993
Approval: February 3, 1994
Contract Signature: March 14, 1994
Promissory Note Signed: March 14, 1994
Deliverables Received: Phase I: July 31, 1994
Final: November 21, 1994
Expected Financial Closure: First quarter of 1996
Date To Repay If Financial Closure: March 14, 1997 (3 Years from Contract Date)
Release and Certification: Not Yet Received

Payment Summary:

Invoice #1: PW Check Dated November 14, 1994	$127,512.56
Invoice #2: PW Check Dated March 10, 1995	$ 60,745.34
Total:	$188,257.90

25

Client Contact:

Name:	Alex Budzinsky
Position/Title:	Chief Financial Officer
Address:	14643 Dallas Parkway, Suite 500, Dallas, TX 75240
Phone:	(214) 239-3331
Fax:	(214) 239-8929

HIDROATLANTICA S.A.

Project Name: Lomas Hydroelectric Project

Type of Project: 12 MW Hydropower Generation

Location: Siquirres, Costa Rica

Project Summary:

Costa Rica is currently facing a serious shortfall in its energy generation capacity due to the rapid growth in electricity demand during the past decade (6-10% per year) and increasingly tighter financial constraints placed on the country. The current financial and power constraints have forced the Government of Costa Rica along with the Instituto Costarricense de Electricidad (ICE) to develop new policies and laws to encourage the production and sale of electricity from private producers.

HidroAtlantica's project will be part of a nation-wide effort to reduce Costa Rican dependency on imported fuel oil. It is expected to help improve the balance of payments, improve the availability and reliability of electricity supply, reduce the environmental impact of power production, and provide employment opportunities through construction and operation of the facility.

The proposed 12 MW Lomas Hydroelectric Power Project will be developed under a build-own-operate model by HidroAtlantica S.A., a 100% Costa Rican owned corporation comprised of a small group of business developers in Costa Rica. HidroAtlantica S.A. will be responsible for overall project management, project quality control, and construction management of the proposed project. The estimated total project costs will be $12,707,000 and will be financed with a capital structure of 80% debt and 20% equity.

Current Status:

On September 29, 1994 the ICE informed HidroAtlantica that their application for the Lomas Hydroelectric Project would not being extended. The reason given by the ICE was that the Dos Noviellos Hydroelectric Project applied to the ICE for the sale of power before HidroAtlantica applied for their project's extension. ICE granted the permission to the Dos Noviellos Project and denied HidroAtlantica's extension. This resolution meant the complete stop of all activities for the Lomas Hydroelectric Project.

Dates:

Contract Signature: June 18, 1992
Deliverables Received: Phase I Report: September 14, 1992
Final Report: May 24, 1993
Expected Financial Closure: HidroAtlantica will not reach financial closure, thus are not obliged to repay the loan.
Date to Repay if Financial Closure: Not Applicable

Payment Summary:

First Invoice: December 18, 1992	$ 20,000
Final Invoice: October 7, 1993	$ 20,000
Total:	$ 40,000

Client Contact

Name:	Roberto Esquivel
Position/Title:	President
Address:	P.O. Box 275 Pavas 1200, Costa Rica Barrio Rohrmoser-De casa Oscar Arias 100 m. Oeste, 100 m. Sur, 50 m. Oeste
Phone:	(506) (2) 31-44-56
Fax:	(506) (2) 31-44-56

HIDROELECTRICA AGUAS ZARCAS, S.A.

Project Name: Aguas Zarcas Hydropower Project

Type of Project: 11 MW Hydropower Facility

Location: San Carlos, Province of Alajuela, Costa Rica

Project Summary:

Costa Rica is currently facing a serious shortfall in its energy generation capacity, due to the rapid growth in electricity demand during the past decade (6-10% per year) and increasingly tighter financial constraints placed on the country. The current financial and power constraints have forced the Government of Costa Rica along with the Instituto Costarricense de Electricidad to develop new policies and laws to encourage the production and sale of electricity from private producers.

Hidroelectrica's project will be part of a nation-wide effort to reduce Costa Rican dependency on imported fuel oil. It is expected to help improve the balance of payments, improve power availability and reliability, reduce the environmental impact of power production, and provide employment opportunities through construction and operation of the facility.

The 11 MW hydropower plant will be located in the province of Alajuela, in the central portion of Costa Rica. The project would use the water of the Aguas Zarcas River and two other streams of water. The catchment area is situated on the Atlantic side of the central mountain chain, where there is a long rainy season. The total cost of the project is estimated to be $15 million, and it is assumed that the project will be capitalized as 75% debt and 25% equity.

Current Status:

Hidroelectrica Aguas Zarcas is the first feasibility study to reach financial closure and to repay their loan from USAID. A Private Power Agreement between Hydrozarcas and Instituto Costa Ricas de Electricidad was signed in early 1994 to purchase 100% of the plants energy capacity. Late in 1994, Hidroelectrica formalized loans with the International Finance Corporation, FMO (a holding bank), and Banco Banex International of Costa Rica. The total project cost is $16 million of which $13 million has been financed while Hidroelectrica will fund the remaining $3 million. Construction began in May 1994 and the plant is expected to be completed in December 1995. Hidroelectrica repaid they loan in March 1995.

Dates:

Contract Signature: October 1, 1991
Deliverables Received: Phase I: November 1991
Phase II (final): December 1991
Financial Closure: March 31, 1995
Date to Repay because of Financial Closure: March 31, 1995

Payment Summary:

First Invoice: February 18, 1992	$ 64,400
Final Invoice: June 2, 1992	$ 50,100
Total:	$114,500

Client Contact:

Name:	Marcos Fernandez
Position/Title:	Project Manager
Address:	P.O. Box 4009-1000 San Jose
	San Jose, Costa Rica
Phone:	(506) 257-6664
Fax:	(506) 257-2962

JOSEPH TECHNOLOGY CORPORATION, INC.

Project Name: VIZ Repowering Alternatives Project

Type of Power/Output: Variable Depending on Alternative Selected

Location: Ekaterinburg, Russia

Project Summary:

The purpose of this project is to investigate repowering alternatives for Verch-Elsetsky Metallurgical Plant (VIZ), a large steel manufacturing facility located in Ekaterinburg, Russia. The VIZ facility not only manufactures steel products, but also is a major supplier of heat and electricity to the region. The facility owns a cogeneration plant and generates electricity and heat for its own needs and supplies heating to adjacent districts. The plant currently has three generating units, each with a capacity of 35 MW.

Since VIZ is a steel manufacturing facility, it has a significant electric demand. VIZ currently purchases more than 50% of its electricity from the local electric utility, Sverdlovskenergo. The repowering alternatives will help VIZ increase its electric and heat output, thus decreasing VIZ's dependence on Sverlovskenergo. In addition, it is anticipated that this project will permit the sale of U.S. manufactured gas turbines to VIZ and improve the facility's competitiveness. This improved competitiveness will help expand VIZ's steel products' market in the region and U.S.

Three repowering arrangements with combustion turbines can be integrated with the existing power plant units: Cold Windbox, Feedwater Heating, and Hot Windbox. The Cold Windbox repowering alternative provides the largest capacity and efficiency improvement over the conventional plant. The maximum electrical output achievable for VIZ with this configuration is 178,502 kWe. The Feedwater Heating repowering option provides a maximum repowered capacity of 174,889 kWe, while the Hot Windbox method also provides sizable improvements with a maximum achievable electric output of 166,618 kWe.

The total project cost of the investigated alternatives is ranked as follows: the least expensive option is Feedwater Heating repowering, next is the Hot Windbox, and the most expensive is Cold Windbox. Furthermore, the Cold Windbox alternative will require significant modification of the existing boiler and controls, while the Feedwater Heating alternative requires only minor modifications to the existing piping and controls.

However, different options offer different power output increases which is the crucial factor. Therefore, a comparison of the project cost per additional kWe was developed. In this comparison the Hot Windbox and Feedwater Heating alternatives are very similar, and the Feedwater Heating alternative provided a slightly less expensive option. The Cold Windbox option, while it offers the greatest power output increase, is clearly the most expensive option in terms of capital investments.

Finally, the project's economic viability has been evaluated using financial internal rate of return (FIRR). All options showed a positive rate of return, thus the investments will outpace inflation. Feedwater Heating repowering appears to be the most attractive option, yielding an FIRR of 24.9%, the highest FIRR for all units after five years of operation. The Cold Windbox repowering option requires the highest capital investment and yields the lowest FIRR at 17.8% by 2004. The Hot Windbox repowering option falls between the two other alternatives with an FIRR of 19.3%.

It should be noted that this particular project did not include a promissory note nor a contractual obligation to repay USAID. Joseph Technology Corporation, Inc. (JTC) is a consulting firm hired by VIZ to explore repowering options for them. This plant is currently owned and operated by the Government of Russia and as such any option chosen would fall under the public sector. As a result, the funds provided to JTC for this feasibility study were provided as a grant, rather than a loan, and JTC is under no obligation to repay.

Current Status:

At the time of this report, the most recent status report received was dated March 8, 1995. The final repowering option will be chosen by the VIZ during the engineering phase of the project. At the present time, due to financial difficulties and a substantial reduction in production capacity, the power plant repowering is not the main objective of VIZ. Because of its financial difficulties, VIZ is focussing on opportunities to develop new products in order to increase their steel sales. For these reasons, the expected date of financial closure can not be determined at this time.

Dates:

Application: February 11, 1993
Approval: May 3, 1993
Contract Signature: May 7, 1993
Promissory Note Signed: Not Applicable.
Deliverables Received: Phase I - November 1, 1993
Phase II - January 18, 1994
Phase III (Final) - March 31, 1994

Expected Financial Closure: Can Not Be Determined at the Present Time.
Date To Repay If Financial Closure: Not Applicable - Public Project.
Release and Certification: August 3, 1994 ($140,000.00)

Payment Summary:

Phase I:	PW Check Request Dated April 25, 1994	$ 25,000.00
Phase II:	PW Check Request Dated April 25, 1994	$ 42,000.00
Phase III:	Final Payment FedEx Date July 25, 1994	$ 73,000.00
Total:		$140,000.00

Client Contact:

Name:	Dr. Ishai Oliker, P.E.
Position/Title:	Principal
Address:	188 Broadway, Woodcliff Lake, NJ 07675
Phone:	(201) 573-0529
Fax:	(201) 573-9060

NATIONAL POWER COMPANY

Project Name: Nonoc Cogeneration Power Station

Type of Power/Output: 241 MW Coke-Fired Cogeneration Power Station (Using fluidized bed boiler technology)

Location: Mindanao, Philippines

Project Summary:

Nonoc Island has become the focal point for development of three major industrial projects in the Philippines. These include a Nickel Complex, an Oil Refinery and the Nonoc Cogeneration Power Station. The Power Station will service the steam and power requirements of the Nickel Complex (totalling 70 MW of cogeneration capacity) and the Oil Refinery, and will export up to 200 MW of electric power to Mindanao, a nearby Philippine island. National Power Corp. and the New Saga Power Corporation, with the assistance of Duke/Fluor Daniel Corp., performed a feasibility study for the Nonoc Cogeneration Power Station.

The Power Station will be configured as a 241 MW power station. It will be designed to provide 41 MW of electricity and 859,000 pounds per hour, low-pressure steam production to the Nickel Complex. The remaining 200 MW will be sold to the regional power company, National Power Corporation (NAPOCOR). The Power Station should be able to provide steam and/or electricity at economical rates to the Nickel Complex and to NAPOCOR (estimated at approximately 20% below the lowest bid received by NAPOCOR in response to its solicitation for 200 MW of coal-fired power on Mindanao).

Steam generators will be sourced from Combustion Power Company, a world leader in the development of fluidized bed boiler technology. The Combustion Power Company's fluidized bed boilers are the same technology used in commercial operations for petroleum coke in California, and meeting California's strict emissions standards. These boilers will meet all emission standards established by the World Bank and the Philippine government.

The combined capital investment of the 3 projects is approximately $750 million. While each project alone would be a valuable investment in the industrial development of the Philippines, developing them as an integrated project generates a synergy that makes each of them more valuable economically. A reliable source of low-cost energy, such as the Nonoc Cogeneration Power Station, will be the key for this development. The Nickel Complex and Oil Refinery need steam and electricity at a price below what they would incur if they were

to self-generate these utilities. This requirement can be filled by the Power Station. In addition, the Power Station can receive a substantial portion of its fuel requirement from the Oil Refinery in the form of petroleum coke, thus eliminating the need to import this fuel from the United States, and consequently lowering the cost of both electricity and steam. Finally, the Nickel Complex's need for steam and exhaust gases allows the Power Station to operate as a cogeneration power station, and thus achieve a higher operating efficiency.

Current Status:

At the time of this report, the most recent status report received was dated March 15, 1995. Discussions with the Nickel Mine and Refinery operators are continuing, with two major nickel suppliers currently studying teaming to re-open and operate the facilities. Several site visits have taken place to complete audit and corporate reports. With world nickel prices at a decade high, it is expected that the prospective operators and equity stakeholders will provide definitive offers within the next few weeks. The Department of Energy has been requested to extend the power station accreditation in order to maintain power sale negotiation with the National Power Corp. Securing the steam and power host operation is critical toward maintaining the accreditation as co-generation. High thermal efficiency is an objective of the Philippine Government and provides financial improvement of the operation by providing low cost steam. In addition, two prospective engineering and procurement contractors have been given the opportunity to provide new power station bids in order to lower capital costs and reduce the cost of power and steam.

Dates:

Application: February 11, 1994
Approval: May 23, 1994
Contract Signature: May 28, 1994
Promissory Note Signed: May 28, 1994
Deliverables Received: Phase I - July 29, 1994
Phase II - September 7, 1994
Expected Financial Closure: July 1996
Date To Repay If Financial Closure: January 20, 1998 (3 Years From Payment Date)
Release and Certification: February 3, 1995 ($183,927.24)

Payment Summary:

Phase 1: PW Check Request Dated November 7, 1994	$ 90,509.17
Phase 2: PW Check Dated January 20, 1995	$ 93,418.07
Total:	$183,927.24

Client Contact:

Name:	Frank H. Walton
Position/Title:	Vice President
Address:	2101 Webster Street, Suite 1700, Oakland, CA 94612-3049
Phone:	(510) 839-4996
Fax:	(510) 839-4953

PUBLIC POWER of INDIA, LIMITED PARTNERSHIP

Project Name: Duburi Power Project

Type of Power/Output: 2X250 MW Coal Fired Thermal Power Generating System

Location: Duburi, Orissa, India

Project Summary:

Public Power of India Limited Partnership (PPI), a sister company of Northeast Energy Services, Inc., is developing a 500 MW coal-fired steam turbine power plant in Duburi, India. The project will be privately built, owned and operated by PPI.

The project is an important part of the economic development of Orissa. The Orissa State Electricity Board (OSEB) plans to build an additional 1,500 MW of coal-fired power plants to meet its electricity needs in 1995-96. Currently, businesses may be subject to severe curtailment of electricity due to a lack of adequate supply. It is expected that the electricity provided by the project will result in $1 billion of additional annual sales for Orissa businesses. In recognition of these benefits, OSEB has executed a letter of intent to purchase the project's power and contribute land to the project. In addition, the Government of India has demonstrated its support for the project by issuing a critical environmental permit for forest clearance and by actively working with PPI to obtain approval from the Central Electricity Authority. In addition, the Government of India's Ministry of Environment has granted an "umbrella" clearance for the project, approving the project with regard to all environmental matters.

As of the last deliverable/status report, PPI's conclusion was that the project is feasible in all respects, citing the following supporting reasons:

- PPI has moved beyond the feasibility stage in several respects by obtaining the land for the project, obtaining all permits able to be acquired prior to selection of an EPC contractor, including environmental permits, executing a power contract with the OSEB, and composing a short list of three internationally recognized and qualified contractors for the EPC.
- PPI has composed a high quality development team consisting of Stone & Webster, Ernst & Young, Lehman Brothers, and Scadden, Arps, among others.
- PPI has secured $10 million of development funding.

- The latest technical information has been reviewed by Stone & Webster and was determined to be technically feasible and affordable within the project budget.
- Coal supplies that have been secured are substantial enough to fuel the project for over 50 years.
- The Ministry of Railways has approved transportation for the coal from the mine to the site (contract to be signed shortly).
- Lehman Brothers has completed the financing plan.
- There are no known barriers to the remaining development and other tasks to complete.
- PPI is currently negotiating with GOI regarding tariffs, Interconnection Agreement (IA), Power Purchase Agreement (PPA), and Fuel Supply Agreement (FSA).

Current Status:

At the time of this report, the most recent status report received was dated March 17, 1995. There have been no major developments since the final deliverable was submitted. George Sakellaris of PPI visited the Chief Minister of Orissa and the Indian Minister of Power in February of 1995, and negotiations are proceeding at a good pace. The resolution of logistical issues regarding the mining of the coal, transportation of the coal and the construction of the project is expected in the next few months

Dates:

Application: July 16, 1992
Approval: November 5, 1992
Contract Signature: December 9, 1992
Promissory Note Signed: December 9, 1992
Deliverables Received: Phase I: January 14, 1994
Phases II & III: November 1, 1994
Supplement to Phases II & III: January 5, 1995
Expected Financial Closure: December 1995
Date To Repay If Financial Closure: December 9, 1995 (3 Years After Contract Date)
Release and Certification: March 15, 1995 ($200,000.00)

Payment Summary:

Phase I: December 14, 1994	$ 75,000.00
Phases II & III: March 10, 1995	$125,000.00
Total:	$200,000.00

Client Contact:

Name:	George P. Sakellaris
Position/Title:	President, PPI
Address:	P.O. Box 2053, Framingham, MA 01701
Phone:	(508) 875-1147
Fax:	(508) 875-9921

SYNERGICS, INC.

Project Name: CTGE - Santiago Power Plant Project

Type of Power/Output: 21.5 MW Diesel Generating Facility

Location: Santiago de los Caballeros, Dominican Republic

Project Summary:

Synergics, Inc. is a U.S.-owned company headquartered in Annapolis, Maryland, specializing in hydropower, cogeneration and engineering. Synergics will develop this project through a joint venture with CTGE, S.A., a Dominican Republic-based consortium organized for independent power production. CTGE already operates one small IPP plant in the Dominican Republic, and will operate this facility once it is on-line.

It is expected that Wartsila-Diesel, Inc., a U.S. subsidiary of Wartsila-Diesel International, will hold an equity interest in the project, as well as provide the diesel generators for the project. This company has already supplied equipment for two power plants in the Dominican Republic, and maintains a permanent office in Santo Domingo.

The CTGE-Santiago project is located in the Santiago Free Zone close to the city of Santiago in the Dominican Republic. Over 60 export-oriented light industry businesses employing approximately 30,000 individuals are located in the industrial park. The project has been designed primarily to supply the projected energy requirements of the Industrial Free Zone of Santiago for the next 15 years with any excess power being sold to the grid serving Santiago and the region of Cibao. In addition, the modular design and layout of the plant allows for the possibility of future expansion of generation capacity.

This $14.3 million project entails the installation of a 21.5 MW electrical generating facility comprised of four new, medium-speed diesel generating sets supplied by Wartsila Diesel. These generating sets are to operate on No. 6 fuel oil and are designed for continuous base load operation. In addition to the generating sets, a new 25 MW substation, including transformers, will be installed.

At current demand levels, half of the power generated by the 21.5 MW facility would be consumed within the Free Zone with the rest available to be sold to the regional power grid at discounted rates. If this project is successful, the developers envision siting additional

generation facilities in some or all of the other Industrial Free Zones in the Dominican Republic, using the CTGE-Santiago project structure as the prototype.

Current Status:

At the time of this report, the most recent status report received was dated March 17, 1995. This project is currently on hold due to financing difficulties in the Dominican Republic. No further project status information was offered.

Dates:

Application: August 1990
Contract Signature: March 22, 1991
Promissory Note Signed: March 22, 1991
Deliverables Received: Final: October 30, 1991 (Various other drafts in workpapers)
Expected Financial Closure: Unknown at this time
Date To Repay If Financial Closure: March 22, 1994 (3 Years From Contract Date)
Release and Certification: February 25, 1992 ($130,000.00)

Payment Summary:

Payment 1:PW Invoice Dated September 4, 1991	$ 50,012.47
Payment 2:PSED Feasibility Fund Invoice Dated November 27, 1991	$ 79,987.53
Total:	$130,000.00

Client Contact:

Name:	Wayne L. Rogers	or	Keith M. Arndt
Position/Title:	President		Chief Operating Officer
Address:	191 Main Street Annapolis, Maryland 21401		
Phone:	(410) 268-8820		
Fax:	(410) 269-1530		

TAZCOGEN DEVELOPMENT, INC.

Project Name: CRISOBA Cogeneration Project

Type of Power/Output: 50 MW Combined Cycle Cogeneration Project

Location: Crisoba Mill, Ecatepec, Mexico (Approximately 20 km Northeast of Mexico City)

Project Summary:

The Crisoba Paper Mill (CPM), owned and operated by Grupo Crisoba, produces tissue and paper towel products using mainly purchased wood pulp. The mill operates continuously, 24 hours a day, 7 days a week and currently generates steam from old, inefficient gas-fired boilers which are owned and operated by the mill. These boilers provide 250 psi steam to satisfy the daily demand which varies from 80,000 to 100,000 lbs/hour.

Electrical energy is purchased from the Comision Federal de Electricidad (CFE) through the local utility that services the District of Mexico City. Projected power purchases will range from 30 to 32 MW after the modernization work is completed in 1995. Seeking to reduce their energy costs, Grupo Crisoba decided to turn over their energy needs to a third party experienced in the development of cogeneration projects. In September 1993, Crisoba selected Tazcogen Development, Inc., a California corporation, to develop, build, finance and operate a new cogeneration plant for the Ecatepec Paper Mill. The new cogeneration plant, to be located on the same property as the mill, will provide the total energy requirement for the mill and will sell as much as 20 MW of surplus energy to CFE.

The cogeneration plant will use natural gas that will be purchased from Pemex, the company which currently sells gas to the Ecatepec Mill. Other than for the condensate return and the make-up water, the new cogeneration plant will be an autonomous operation, and independent of any services from the paper mill. All utility connections (water, gas, sewer, etc.) are the responsibility of the cogeneration project and are known to be convenient to the project site.

Tazcogen will be responsible for obtaining all contracts and permits required to build and operate the plant. The plant design will be based on proven equipment as supplied by qualified suppliers and contractors. Whenever possible, suppliers with support service facilities already available in Mexico will be given preferential consideration in the selection evaluation process.

42

The plant design will ensure maximum attainable performance results in terms of power output and heat rate and high operational availability of not less than 95%. This design, based on a 30 year useful life, will be a base loaded, simple cycle design configuration comprised of one Industrial Type Combustion Turbine Generator, one Heat Recovery System Generator and one Steam Turbine Generator. The Balance of Plant equipment will provide the operational flexibility required to produce the total thermal and electrical energy consumed by the paper mill.

Current Status:

At the time of this report, the most recent status report received was dated March 22, 1995. Tazcogen is currently waiting for permit approval from the Secretary of Energy, Mines and Substate Industries (SEMIP). Upon receipt of the permit Tazcogen will be allowed to negotiate the power purchase agreement with the local utility, Luz y Fuerza del Centro (LyF) and a gas supply contract with Pemex.

The delay in the issuance of the permit has delayed the execution of the Project Development Agreement between CPM and Tazcomex, but instead a letter of intent has been signed. The letter states that CPM is committed to acquire all electrical and steam energy from Tazcomex, without any time limitations on the project development.

Additionally, the CFE released a pricing methodology on November 8, 1994 for sale of surplus electricity of up to 20 MW from congenerators. The pricing methodology requires the cogenerator to offer both a capacity and energy sale price, and further stipulates that the utility to which this bid is submitted accept the offer if it is less than the short run marginal cost (SRMC) of operation. Currently, the SRMC for LyF, the utility to purchase the excess capacity, is $.045/Kwh, while Tazcogen's proposed offer price is $.040/Kwh.

Given the current situation, Tazcogen estimates that financial closure could be reached by late 1995 or early 1996 and hopes to complete the PPA, fuel supply contract, and negotiate the final sale price soon after SEMIP's permit approval.

Dates:

Application: Dated September 15, 1993, Received December 1, 1993
Approval: February 28, 1994
Contract Signature: March 17, 1994
Promissory Note Signed: March 17, 1994
Deliverables Received: Phase I - May 1994
Phase II - August 1994

Expected Financial Closure: Late 1995 to Early 1996
Date To Repay If Financial Closure: March 17, 1997 (3 Years From Contract Date)
Release and Certification: January 4, 1995 ($250,000.00)

Payment Summary:

Phase I:	Check Request Dated 8/15/94	$109,880.84
	Check Request Dated 9/20/94	$ 9,025.75
Phase II:	Check Request Dated 11/10/94	$131,093.41
Total:		$250,000.00

Client Contact:

Name:	Robert F. Tamaro
Position/Title:	President
Address:	P.O. Box 496, Moraga, CA 94556
Phone:	(510) 376-4012
Fax:	(510) 376-0535

B. PROJECTS DENIED APPROVAL OR INCOMPLETE

AES TRANSPOWER (Hungary)

Project Name: Preliminary Review of the AES Transpower Project in Hungary

Type: 171 MW Thermal Plant Retrofit

Location: Borsod, Hungary

Proposed Task

The proposed project was to refurbish and operate the Borsod Power Facility under a long-term agreement with the Hungarian Electricity Board. AES planned to sell electricity to the Hungarian Electricity Board, and steam and hot water to the Chemical Works of Borsod and the town of Kazincbarcika. The Borsod Power Facility was operated by the HEB at the time of the proposal (with an installed capacity of 177 MW) and in dire need mechanical retrofits.

Reasons for Denial

Since there already exists an energy development fund dedicated to private projects in Eastern Europe, EPDF was not able to accept this application.

Date of Application: October 24, 1990

Client Contact:

Name:	Mr. Craig A. Nalen
Position/Title:	Chairman
Address:	1001 North 19th Street Arlington, VA 22209
Phone:	(703) 528-1315
Fax:	(703) 528-4510

AES TRANSPOWER (India)

Project Name: Ib Valley Thermal Power Project

Type: 4X210 MW thermal power plant

Location: Sambalpur District, State of Orissa, India

Proposed Task

AES Transpower, an independent power producer, intended to develop, own and operate Units 3 & 4 of the Ib Valley thermal power station. The total capacity of the power station would consist of 4X210 MW units. The sale of power would be to the Orissa State Electricity Board, with which AES had a signed PPA. The purpose of the study was to gather information about the Ib Valley Project and the regulatory environment for private power to:

- Negotiate agreements for sale of electricity, fuel supply and other inputs;
- Investigate possible methods of financing;
- Investigate possible suppliers of equipment;
- Conduct related studies; and
- Explore other possible operational structures, such as joint operation with OSEB.

Reasons for Denial

The study application was not approved upon review by the U.S. Department of Energy and the USAID Office of Energy, Environment, and Technology. The decision was taken based on the fact that the feasibility study had already been completed, prior to application submission to the EPDF approval, and financial closure was expected in the near future.

Date of Application: August 30, 1993
Date of Denial: December 10, 1993

Client Contact:

Name:	Mr. Bob Hemphill
Position/Title:	President & CEO
Address:	1001 North 19th Street Arlington, VA 22209
Phone:	(703) 522-1315
Fax:	(703) 528-4510

47

AHLSTROM PYROPOWER, INC.

Project Name: Proposal to Study the Feasibility of Using Fluidized Bed Combustion Technology for New Power Plants and for Repowering of Existing Power Plants

Type: Circulating Fuildized Bed Power Plants

Location: Russian Federation

Proposed Task

Ahlstrom Pyropower proposed to study three separate projects in Russia for the installation of their circulating fluidized bed (CFB) technology. The proposed sites for the projects were Cherepet power station with an installed capacity of 400 MW, Rostov power plant with an installed capacity of 1200 MW and Artem Power plant with an installed capacity of 800 MW. For each of the above listed project sites, Ahlstrom proposed to increase capacity by installing 200 MW CFB boilers. The respective additional capacities were: Cherepet 2X200 MW, Rostov 6X200 MW, and Artem 4X200 MW.

Reasons for Denial

The following are the reasons why EPDF denied this project:

- Ahlstrom Pryopower's failure to meet the EPDF's "U.S. Ownership" criterion;
- The technical risks associated with scale-up of the proposed technology, especially given Ahlstrom Pyropower's lack of experience in manufacturing and utilizing boilers at capacities in the 200 MW range;
- Ambiguous and uncertain ownership structure of the proposed projects, including the adequacy and stability of sources of equity and debt financing;
- Ahlstrom Pyropower's non-participation in the projects as an equity holder;
- The lack of disclosure of estimated plant-specific cash flows to demonstrate the economic viability of the proposed projects;
- Unreasonably high proposed level of effort for Teploeclectroproject; especially, considering the entity's previous experience in this field.

Date of Application: September 24, 1992 (Original)
August 18, 1993 (Modified)

Date of Denial: November 30, 1993

49

Client Contact:

Name:	Mr. John E. Barnes
Position/Title:	Project Manager
Address:	P.O. Box 85480 San Diego, CA 92138
Phone:	(619) 458-3050
Fax:	(619) 558-8724

ALTERN, INC.

Project Name: Sizing and Feasibility Study: Nine Low Head Hydro-Electric Projects on Indus Plains, Pakistan

Type: 9-12 MW Hydroelectric

Location: Punjab Province, Pakistan

Proposed Task

The project was to establish a wholly-owned Pakistani Corporation to oversee the development of a hydroelectric project in Punjab, Pakistan. The project would have a capacity of 6 MW expandable to 9-12 MW, using submersible turbine generators.

Reasons for Denial

Due to the high cost of establishing a hydro electric project, this project was not considered large enough to make the investment economical.

Date of Application: March 14, 1990

Client Contact:

Name:	Mr. Aldine J. Coffman, Jr.
Position/Title:	President
Address:	Six Cherry Lane Drive Englewood, Colorado 80110
Phone:	(303) 758-3939
Fax:	(303) 721-0848

ALTRESCO / HARRIS GROUP INC. (Manila)

Project Name: Metro Manila Municipal Solid Waste to Energy Generation Plant

Type: 7.5 MW mass-burn rotary kiln

Location: Metro Manila, Philippines

Proposed Task:

7.5 MW mass-burn (solid waste) rotary kiln incineration technology, coupled with a steam turbine to generate electricity.

Reasons for Denial

After careful evaluation of this proposal by Price Waterhouse, the U.S. Department of Energy, and the USAID Office of Energy and Infrastructure, it was determined that EPDF was unable to approve funding for the Metro Manila Municipal Solid Waste (MSW) Energy Project. The following reasons were cited in a letter dated January 6, 1994 as the basis for the decision:

- No commitment or indication of support was provided by the Government of the Philippines to turn the site over to the Harris Group, free of charge or otherwise;
- The commercial viability of the project was not clear;
- The export potential for the U.S. appeared to be minimal because the proposed kilns were an Italian brand;
- The DOE evaluation determined that the proposed technology was about 50% as efficient as other MSW technologies;
- The cost and reliability of the fuel source to operate the plant was not covered sufficiently;
- The heat value of the waste was assumed to be similar to that of Skagit County, Washington State, when in fact the heat value of Manila waste may prove to be lower than assumed due to the moisture content and the fact that waste in developing countries generally has a lower heat value because of the higher percentage of organic materials; and
- The applicant did not intend to hold an equity position in the project.

Date of Application: September 9, 1993

Date of Denial: January 6, 1994

Client Contact:

Name:	Peter A Mathisen
Position/Title:	Treasurer, Harris Group Inc.
Address:	P.O. Box 3855, Seattle, WA 98124
Phone:	(206) 443-4600
Fax:	(206) 443-0700

THE BEN HOLT CO.

Project Name: Assistance for Geothermal Project in Indonesia

Type: 2X30 MW Geothermal

Location: Dieng Fields, Central Java, Indonesia

Proposed Task

The Ben Holt Co. planned to build a geothermal power plant in the Dieng gas field, located in Central Java. The proposed plant was to have an installed capacity of 2X30 MW and would provide electricity for sale to PLN, the Indonesian national utility. The development of the power plant would have been under a Build-Own-Operate scheme.

Reasons for Denial

The application for a feasibility study was denied based on the following factors:

- Of the 26 wells drilled by Pertamina at the site, 22 could possibly have been dangerous,
- The Dieng geothermal field is characterized as having higher than typical non-condensible gas content, further
- The Asian Development Bank had rejected an application submitted by GOI to develop the Dieng fields due to an inadequate supply of steam.

Date of Application: April 30, 1992

Date of Denial: November 15, 1993

Client Contact:

Name:	Mr. Ben Holt
Position/Title:	Chairman/CEO
Address:	201 South Lake Ave, Suite 308 Pasadena, CA 91101
Phone:	(213) 684-2541
Fax:	(213) 584-9210

BESICORP GROUP INC. (BETA DEVELOPMENT CO.)

Project Name: Krishnapatnam Thermal Power Project

Type: 1000 MW Power Plant

Location: Nellore District, Andhra Pradesh, India

Proposed Task

The proposed project was to use existing technology in the production of 1,000 MWs of electricity for sale to the Andhra Pradesh State Electricity Board. This proposed IPP project would be owned by subsidiaries of Besicorp Group, Inc. and Brooklyn Marine & Oil. The intention of the study was to clearly identify the total cost of the project and to further segregate them by country of origin. In addition to the IPP project, an upgrade of a nearby water port facility was also proposed in order to handle the fuel transportation requirements.

Reasons for Incomplete Project

Project never materialized

Date of Application: November 16, 1993

Client Contact:

Name:	Ms. Martha McFarland
Position/Title:	Financial Manager
Address:	1511 Flatbush Road Kingston, NY 12401
Phone:	(914) 336-7700
Fax:	(924) 336-7172

BIOENERGY SYSTEMS INTERNATIONAL INCORPORATED

Project Name: Energy Cogeneration from Regional Waste Management

Type: Waste-to-Energy Recycling

Location: San Jose, Costa Rica

Proposed Task

The proposed project was to build at least one and up to five waste-to-energy recycling plants in San Jose, Costa Rica. The project would have used plants capable of converting residues and waste materials to thermal and electrical energy. The plants were based on a patented technology that produces homogeneous briquettes, which are then used to cogenerate steam and electricity.

Reasons for Denial

The funding for this study was not approved, based on the committee's conclusion that the proposed technology mix had not been proven to be economically viable in a commercial setting. Additionally, the committee was concerned about the undefined and "fluid" structure of the proposed project.

Date of Application: September 1, 1992

Date of Denial: January 8, 1993

Client Contact:

Name:	Mr. Ted Johnson
Position/Title:	President
Address:	P.O. Box 90 Houghton, MI 49931
Phone:	(906) 482-7200/482-2050
Fax:	(906) 482-1981

CAITHNESS INTERNATIONAL POWER CORP.

Project Name: Dandeli 60 MW Hydropower Project

Type: 60 MW Hydroelectric

Location: Karnataka, India

Proposed Tasks

The proposed project was to build a 60 MW hydroelectric dam in the North Canara District of Karnataka.

Reasons for Denial

Due to the high cost of establishing a hydro electric project, this project was not considered large enough to make the investment economical.

Date of Application: October 14, 1992

Client Contact:

Name:	Mr. Hiram A. Bingham
Position/Title:	President
Address:	1114 Avenue of the Americas (35th floor) New York, NY 10036-7790
Phone:	(212) 921-9099
Fax:	(212) 921-9239

ENRON DEVELOPMENT CORPORATION

Project Name: Bangpakong Industrial Park 2 Power Project

Type of Project: 130 MW combined cycle power based on natural gas

Location: Bangpakong Industrial Park, Thailand

Proposed Tasks

Thailand's economic performance in the last 10 years has been very impressive, registering double-digit growth over much of the period. This high rate of economic growth has led to high levels of electricity demand, with forecasted growth in energy load of 10.5% a year. It is estimated that the strong growth in electricity demand will require an addition of 1,000 MW of generation capacity every year.

The Bangpakong Industrial Park 2 was founded on October 30, 1989. In 1994 the project park had 32 power users representing a total demand of 18-27 MW. Enron estimated that by the year 2000 there will be more than 65 power consumers, and electricity demand will reach 200 MW. Given this high rate of power demand, Enron explored the possibility of building a 130 MW natural gas facility. The plant, with an initial budget of $133 million, was expected to be in commercial operations by 1997 and would:

- Sell 60 MW to the national utility, The Electricity Generating Authority of Thailand (EGAT), under a power purchase agreement.

- Sell 70 MW to the industrial consumers within the Bangpakong Industrial Park 2, through a power distribution company.

Reasons of Incomplete Project

However, after an initial study, Enron decided that the project fundamentals were not favorable to allow for successful financing and operation of the plant, and opted for dropping the project. Enron cited the following reasons as hindrances in the economic viability of the project:

- The quantity of power which could be sold to the national utility was restricted;
- EGAT was not willing to purchase power at a competitive rate;
- Park customers were reluctant to sign long term contracts for the purchase of power and the price they were willing to pay was not cost effective; and

- The Petroleum Authority of Thailand would not supply natural gas at a competitive rate.

Enron's contract with EPDF entitled them to $200,000, as long as they satisfied the requirements stated in the scope of work. Enron dropped the project at an early phase, and did not complete the full scope of work. Nevertheless, Enron did spend some resources in the assessment of the viability of the project and was reimbursed $11,000 on March 31, 1995.

Date of Application: January 12, 1994

Deliverables Received: Phase I: October 31, 1994

Client Contact

Name:	Sanjay Bhatnagar
Position/Title:	General Manager
Address:	333 Clay St., Suite 1800, Houston, TX 77002
Phone:	(703) 646-6206
Fax:	(703) 646-6088

96

INTERCONTINENTAL ELECTRIC INCORPORATED

Project Name: Feasibility Study for 2X500 MW Combined Cycle Power Project

Type: 2X500 MW Combined Cycle

Location: Lumut, Perak, Malaysia

Project Description

Intercontinental Electric Incorporated proposed to build, own and operate a 2X500 MW combined cycle plant in Malaysia. The electricity produced was to be sold to Tenaga Nasional Behard for transmission and distribution to the national grid. The plans for the power station included the installation of six natural gas-fired combustion turbines, two condensing turbines and six heat recovery generators. The plant was to be arranged in two separate 500 MW facilities.

The feasibility study consisted of six distinct tasks:

- Prepare Detailed Proposal (Phase One Report -- submitted),
- Make Presentations to GOM (Phase Two Report -- submitted),
- Form Project Company,
- Negotiate with GOM,
- Engage Turnkey and O&M Contractors,
- Finance Project.

The study was approved and a subcontract signed for $200,000.

Reason for Incomplete Project

Upon completion of Phase I, the project was no longer appealing to the Government of Malaysia and the study was terminated in December of 1992. IEI did receive payment for Phase I of $75,000, disbursed on December 10, 1992.

Date of Application: April, 1992

Date of Application: December, 1992

Client Contact:

Name:	Mr. Pirooz M. Sharafi
Position/Name:	Vice President
Address:	350 Lincoln Place, Suite 900 Hingham, MA 02043
Phone:	(617) 749-9800
Fax:	(617) 740-2159

60

PARSONS MAIN

Project Name: Mount Labo Geothermal Project

Type: 120 MW Geothermal

Location: Luzon, Philippines

Proposed Project

Parsons Main, Inc. proposed to develop, build, operate and transfer a 120 MW geothermal generation facility at the Mt. Labo field in the Luzon Province. The electricity produced at this facility would have been sold to the National Power Corporation.

Reasons for Incomplete Project

Although a subcontract was issued by Price Waterhouse, Parsons Main never signed the contract. As a result the contract was voided on July 25, 1994.

Date of Application: August 19, 1993

Client Contact:

Name:	James T. Callahan
Position/Title:	President
Address:	Prudential Center Boston, MA 02199
Phone:	(617) 262-3200
Fax:	(617) 859-2575

PRAXAIR, INC.

Project Name: Map Ta Phut -- Clean Coal and Chemicals Project

Type: Integrated Gasification Combined Cycle Cogeneration Plant

Location: Map Ta Phut Industrial Estate in Muang District, Rayong Province, Thailand

Proposed Task

Praxair proposed to perform a pre-feasibility study for a $800 million private power and chemicals project in Thailand. The proposal was based on Coal Integrated Gasification Combined Cycle cogeneration technology. In addition to electricity, the proposed plant could produce cogeneration by-products such as ammonia, urea, sulfuric acid, oxygen, argon, and nitrogen.

Reasons for Denial

Upon financial review of Praxair's application, it was deemed that funding this particular project was not in the best interest of the government. The rejection statement was authored by Mr. Ronald Stanley of USAID, since there was a possible organizational conflict of interest with Price Waterhouse.

Date of Application: August 27,1993

Date of Denial: February 28, 1994

Client Contact:

Name:	Mr. Steven Ervin
Position/Title:	Managing Director, Praxair Asia, Inc.
Phone:	011-852-731-9665
Fax:	011-852-721-0662

RESOURCE MANAGEMENT ASSOCIATES

Project Name: Minsk Porcelain Factory Energy Efficiency Improvement Feasibility Study

Type: Waste Heat Recovery Systems

Location: Minsk, Belarus

Proposed Project

The proposed project was a private/public partnership to determine the feasibility of installing waste heat recovery systems and automated controls for the kilns. The study also planned to look at possible savings in electricity consumption by installing correctly sized motors and drives. The estimated reductions in energy consumption from these measures was approximately 30 to 50% of current levels.

Reasons for Denial:

Since there already exists an energy development fund dedicated to private projects in Eastern Europe, EPDF was not able to accept this application.

Date of Application: June 26, 1993

Client Contact:

Name: Dr. Mark Hanson
Position/Title: Director of Technical Studies
520 University Ave., Suite 300
Madison, Wisconsin 53703
Phone: (608) 283-2280
Fax: (608) 283-2881

SUPERSYSTEMS, INC.

Project Name: Belize Cogeneration

Type: 8-12 MW Cogeneration Plant

Location: Belize

Proposed Tasks

Supersystems, Inc. proposed to conduct a feasibility study for a 8-12 MW cogeneration facility in Belize. The electricity from the cogeneration project was to be sold to the Belize Public Electricity Utility. The cogeneration system proposed was a gas turbine system with fired or unfired waste heat boiler and absorption chillers. The site for the facility has potential uses for cogeneration by the airport for air conditioning and also milk processing plants, breweries, and lumber mills.

Reasons for Denial

The application for Supersystems, Inc. (SSI) was not approved for the following reasons.

- No agreement or memorandum of understanding for the site had been submitted.
- The profitability of the site would depend on the purchase of steam and chilled water, and no information was submitted to the EPDF regarding the purchase of these by prospective users.
- The applicant's equity participation in the project did not seem possible.
- A cash flow analysis was not submitted and EPDF could not determine financial viability.
- The firms financial statements were un-audited, and highlighted the firms in-ability to hold a significant equity stake in the project.
- SSI's experience is mainly in developing projects for hospitals and industrial units, not as an independent power producer (IPP).
- SSI indicated minimal experience in negotiating with foreign utilities and governments.
- The proposed Civil/Environmental Engineer and Cost Specialist lacked experience for the proposed position and salary.

Date of Application: March 11, 1993 (Original)
September 22, 1993 (Additional Detail)

Date of Denial: February 7, 1994

Contact Information

Name:	Mr. Sam Tadros
Position/Title:	President
Address:	17561 Teachers Ave, Bldg A Irvine, CA 92714
Phone:	(714) 786-7117
Fax:	(714) 733-3430

IV. ENERGY DEVELOPMENT TASK ORDERS

EPDF's Energy Development Task Orders Worldwide

The following is a summary of the energy development Task Orders that took place under the Energy Project Development Fund, administered by Price Waterhouse LLP (PWLLP). The majority of the deliverables are attached in the End of Project Appendix, otherwise the deliverables are stand-alone final reports.

BANGLADESH: INTERNATIONAL FORUM ON PRIVATE SECTOR PARTICIPATION IN THE BANGLADESH POWER SECTOR

Dates: May 8 to 12, 1994
Location: Dhaka, Bangladesh
Deliverable: Forum Agenda (Please see Appendix E)

In May 1994, PSED sponsored a five-day forum in Dhaka, Bangladesh to provide an opportunity for Bangladeshi officials and potential private power participants to understand key aspects of private power. The Bangladeshi officials included private power and government officials from India, Indonesia, Pakistan, Thailand, and the Philippines. PWLLP assisted with the logistical arrangements for these ten foreign participants. In addition, PWLLP provided seminar materials and acquired EuroMoney Project Financing Yearbook 1993/1994 for the forum participants.

THAILAND: INDEPENDENT POWER POLICY REVIEW, PHASE I

Dates: June 18 to 26, 1994
Location: Bangkok, Thailand
Deliverable: Trip Report (Please see Appendix F)

At the request of the Thai Government through USAID/Thailand, PW contracted with New England Electric Resources, Inc. to provide a policy review of the proposed Independent Power Producers policy to be issued by the National Energy Policy Office (NEPO). The team reviewed the existing regulations for the purchase of power from small power producers. In addition, the team examined three proposed policy documents: (i) the Model Power Purchasing Agreement (PPA) for coal and gas-fired electricity generating plants; (ii) a draft Independent Power Producers Request for Proposals (RFP); and (iii) the Preliminary Grid Code. The team found that the PPA required significant modifications and assisted in developing the evaluation criteria for the RFP. The results of the review enabled NEPO to move forward in the issuance of the RFP and plan an investors conference for mid-August. The government was extremely pleased by the timely provision of assistance and the quality of the consultants contribution.

THAILAND: CHIANG MAI SOLID WASTE DISPOSAL ANALYSIS

Dates: June to July, 1994
Location: Chiang Mai, Thailand
Deliverable: Final Report (Please see Appendix G)

In order to address a serious solid waste management problem in Chiang Mai, Thailand, PWLLP analyzed revenue streams for privatization of the disposal of municipal solid waste. Although Chiang Mai has recently privatized half of the city's waste collection services, the city is rapidly reaching capacity at existing waste sites and the city limits are expected to expand from 40 square kilometers to about 200 square kilometers in the next few years. The urgency to resolve this crisis is further heightened by the upcoming South East Asian Games to be hosted in Chiang Mai in December of 1995.

The objectives of the project were the following:

- Develop and introduce an appropriate fee structure based on current collection/disposal operating costs and cost savings options available for an integrated solid waste management program;
- Address options for improving revenue collection; and
- Identify potential long-term savings in capital costs when the transfer/composting station begins operation.

The PWLLP study provides one of many pieces of information that the city of Chiang Mai must consider while developing its own short and long-term waste management policy. Recently, the study initiated the construction of a waste handling facility by a U.S. company. By the spring of 1995, this facility is expected to have the capacity to accommodate close to 100% of the city's 200 to 240 tons of waste generated daily and will incorporate an integrated process that can manage a wide variety of organic and hazardous wastes.

THAILAND: BANGKOK MEDICAL WASTE, PHASE I

Dates: June to December, 1994
Location: Bangkok, Thailand
Deliverable: Final Report (Please see Appendix H)

PWLLP provided three consultants to evaluate Bangkok's medical waste collection and disposal system and assist the Bangkok Metropolitan Administration (BMA) to evaluate various options including privatization of the services. In 1988, BMA established a policy to collect infectious and hazardous waste from many hospitals in the Bangkok area separately

1.9

from municipal solid waste. This policy was established in order to prevent the spread of disease. Currently, BMA collects medical waste from 581 sites. A number of conditions are making it extremely difficult for BMA to collect and dispose of the waste, including the absence of a definition of medical waste and the unknown sources of all medical waste generated due to the numerous locations and variety of health care providers.

In order to address these serious issues and assist in improving medical waste disposal in Bangkok, this study focused on two objectives:

1. Assess the viability of privatizing medical waste collection in Bangkok; and
2. Examine the possibility of converting the heat generated during the incineration process into power.

The study analyzed three potential options for addressing the medical waste service situation:

1. BMA continues to perform the service
2. BMA issues an invitation for bid to private firms
3. BMA issues a request for proposal to private firms

Following PWLLP's recommendation, BMA decided to pursue option #3 which entails the solicitation of bids from private investors, including US companies.

THAILAND: INDEPENDENT POWER PRODUCERS CONFERENCE, PHASE II

Dates: August 15 to 23, 1994
Location: Bangkok, Thailand
Deliverable: Trip Reports and Detailed Memorandum of Comments (Please see Appendix I)

As follow-on to the Independent Power Policy Review, USAID/Thailand requested that PWLLP advise the National Energy Policy Office (NEPO) and the Electricity Generating Authority of Thailand (EGAT) with the Independent Power Producers (IPP) Conference in Bangkok. PWLLP provided consultants from New England Electric Resources, Inc., Hunton & Williams, and White & Case. The team reviewed the IPP document package (the three items detailed in Phase I above) that had been prepared by PWLLP for NEPO and EGAT. This package was intended for presentation at the IPP conference. The team focused on the treatment of major risk issues, financiability, and comparison of EGAT's document package to the terms in other IPP programs, particularly in Southeast Asia.

THAILAND: ASSISTANCE TO BANG SAPHAN STEEL INDUSTRIES

Dates: September 12 to October 21, 1994
Location: Bangkok and Bang Saphan, Thailand
Deliverable: Final Report and Trip Report (Please see Appendix J)

In cooperation with Bechtel's Energy Technology Innovation Project, PWLLP examined the Sahaviriya Steel Industries to complete a Strategy Paper on the Sahaviriya Steel Industry Environmental Management Program. The Strategy Paper provided an initial evaluation of environmental management issues associated with Sahaviriya's industrial development and identified an overall strategy for addressing environmental considerations related to the development. A team of two engineering consultants collected environmental data on the Bang Saphan site and reviewed Bang Saphan's expansion plans. The team identified and recommended solutions to: (i) potential environmental issues and ranked them in order of their significance, (ii) possible management approaches to fully mitigating future environmental impacts, and (iii) the merits of a near-term monitoring program implementation. Finally, the team developed a Terms of Reference for the implementation of either several environmental management approaches or a single specific "high-priority" environmental project.

MEXICO: PRIVATE POWER OPPORTUNITIES

Dates: May to December 1994
Location: Mexico City, Mexico
Deliverable: Final Report (Stand-alone report)

Mexico's private power program began in 1991 with the amendment of the electricity law permitting the Comision Federal de Electricidad (CFE), the state-owned power utility to purchase excess power from private suppliers. This process was further developed in 1992 when foreign investment was permitted in the sector. The country's market has a potential for some 26,000 MW by the year 2005 and it is estimated that 18,000 MW will be available for private investment. While there has been limited private investment, limitations exist in the current power expansion program that hinder steady growth. While the Government of Mexico (GOM) is willing to sell individual plants to private investors, it is unwilling to permit participation in the distribution and transmission of electric power which will remain the exclusive right of CFE. To address some of these issues, in late 1993 the Ministry of Energy held a series of meetings to review the situation and determine changes that could be made to encourage independent power production.

10

To further encourage private power investment in Mexico, USAID/Mexico requested PWLLP to develop a guide for investors interested in private power development in Mexico based on a review of the private power program currently in place. This report includes discussion and analysis of the regulatory and legal framework, market and sector structure, and business and investment environment that affects private sector participation in Mexico's power sector development. In addition, the report analyses proposed and on-going power projects that would affect the sector's structure.

INDONESIA: REVIEW OF INDONESIAN POWER SECTOR DEVELOPMENT & ISSUES

Dates: December, 1994 to March, 1995
Location: Jakarta, Indonesia
Deliverable: Final Report (Stand-alone report)

Indonesia's power sector is currently undergoing a process of substantial reorganization and evolution. Rapid increases in electricity demand have strained the resources of PLN, the state-owned electric utility, leading many users to construct their own power stations. At the same time, the Government of Indonesia (GOI) wants to reduce its financial support of PLN, limiting future contributions to those that subsidize explicitly social objectives. The GOI's responses to these developments have been to encourage increased efficiency within PLN and increased private sector participation in the sector.

After identifying these options, the Ministry of Finance (MOF) of Indonesia requested technical assistance to aid in analyzing them. USAID retained Price Waterhouse LLP (PWLLP) to provide such assistance, with a focus on the role the MOF should play in establishing sector policy. The specific objectives of this project were the following:

- To assist the MOF in encouraging the development of policies that promote greater efficiency within the power sector, with a particular emphasis on alternative approaches to privatization; and
- To advise the MOF on the role it should play in the proposed corporatization and selected privatization of PLN.

The PWLLP team was asked to review current and proposed policies relating to the following specific issues, within the context of the objectives described above: electricity tariffs and subsidies; design and status of the IPP program; an appropriate structure for the electricity sector; and the role of privatization in achieving sectoral goals.

GUATEMALA: INDEPENDENT POWER SEMINAR

Dates: January 17 to 20, 1995
Location: Guatemala City, Guatemala
Deliverable: Trip Report (Stand-alone report)

At the request of Instituto de Nacional Electrificacion (INDE) and USAID/Panama, PWLLP conducted an introductory seminar on the principles of soliciting and contracting independent power. The seminar was attended by 35 national power utility representatives from Guatemala, Panama, Nicaragua, and Costa Rica. The four day seminar covered legal and project development issues, solicitation of new power suppliers, and limited recourse financing structures. In addition to the lectures, several case studies were completed by small teams on the third day. The case studies focused on the development of a hydro project and a thermal project by independent developers. One team represented the developers and a second team represented the utility. The teams developed their negotiating strategies and conducted their negotiations before the remainder of the participants.

The participant's feedback indicated that the seminar provided valuable information and knowledge for their future use. The participants from Panama indicated that their country's energy sector would benefit greatly from a similar seminar, thus a customized seminar was prepared for Panama in March 1995.

THAILAND: BANGKOK MEDICAL WASTE RFP, PHASE II

Dates: March, 1995
Location: Bangkok, Thailand
Deliverable: Draft Request for Proposals (Stand-alone report)

Following Phase I, a team of three consultants proposed a Draft Request for Proposals (RFP) aimed at soliciting private sector involvement in the collection and disposal of medical waste in Bangkok. While many issues have been resolved, there are still a number of key decisions that must be taken by the Government of Thailand, the BMA, and essential Ministries. Such decisions include establishing (i) a definition of medical waste and (ii) appropriate regulations to govern the medical waste disposal and allow a private company to assume the disposal responsibilities. In addition to soliciting private sector involvement in collection and disposal, the BMA is soliciting concurrently a turnkey project for building additional incinerator capacity. As of this report's publication, the BMA had not reviewed the Draft RFP. Furthermore, the Draft RFP needs to be reviewed by a legal specialist to ensure it follows Bangkok's Privatization Law and other pertinent laws.

PANAMA: INDEPENDENT POWER SEMINAR

Dates: March 20-23, 1995
Location: Panama City, Panama
Deliverable: Trip Report (Stand-alone report)

Panama intends to expand its hydro-electric power supplies to meet an anticipated rapidly expanding need for power. It has therefore embarked on an ambitious program to expand its generating capacity through contracting with independent power suppliers. The Instituto de Recursos Hidraulicos y Electrificacion (IHRE), Panama's electric utility, has expressed an interest in reviewing current U.S. and Central American practice in soliciting and contracting with independent power projects. In particular, IHRE was interested in the benefits and impacts of future hydropower projects on Panama's electric utility system.

PWLLP provided an introductory seminar on the principles of soliciting and contracting from independent power projects for thermo-electric and hydro-electric power in Panama. The seminar was intended for officials from IHRE, local financial sector lenders, entrepreneurs, and prospective participants in the independent power (especially hydro-electric power) industry. The seminar provided an introduction to key issues and policies involved in solicitations for new power supplies and contracting principles which will successfully attract private investment to the Panamanian electric sector.

EGYPT: SUSTAINABILITY OF ENERGY-RELATED DEVELOPMENT PROJECTS IN THE MIDDLE EAST PEACE REGION

Dates: March, 1995
Location: Cairo, Egypt
Deliverable: Final Report (Please see Appendix K)

Chemonics, Inc., an environmental consulting firm, prepared a report on privatization issues related to energy and environment in the "Peace Region" (Egypt, Israel, Jordan, West Bank/Gaza). Chemonics completed the following tasks: (i) examined proposed "peace projects" in the region with major implications for privatization in the energy/environment context; (ii) identified key privatization and related private sector issues associated with each project in relation to its energy/environment context; and (iii) put forth options for addressing those issues, including recommendations for specific research in order to address issues practically. Emphasis was placed on oil refineries, power plants, cement factories, and related types of facilities, especially where effluents and emissions associated with energy production and consumption are major considerations.

13

Following the examination of all "peace projects", the team concluded that it is unlikely that any single project will offer a sustainable panacea for the region's energy needs. Projects deserving fast-track support include those that both contribute to long-term energy independence and are environmentally friendly. Interconnection of electrical networks, development of oil pipelines, and expansion of solar and geothermal sources are preferable, using these limited criteria. A burden of proof preventing implementation of potentially destructive projects such as dams and canals should be in lace until detailed and scientifically reviewed environmental impact assessments prove otherwise.

PD-ABN-847

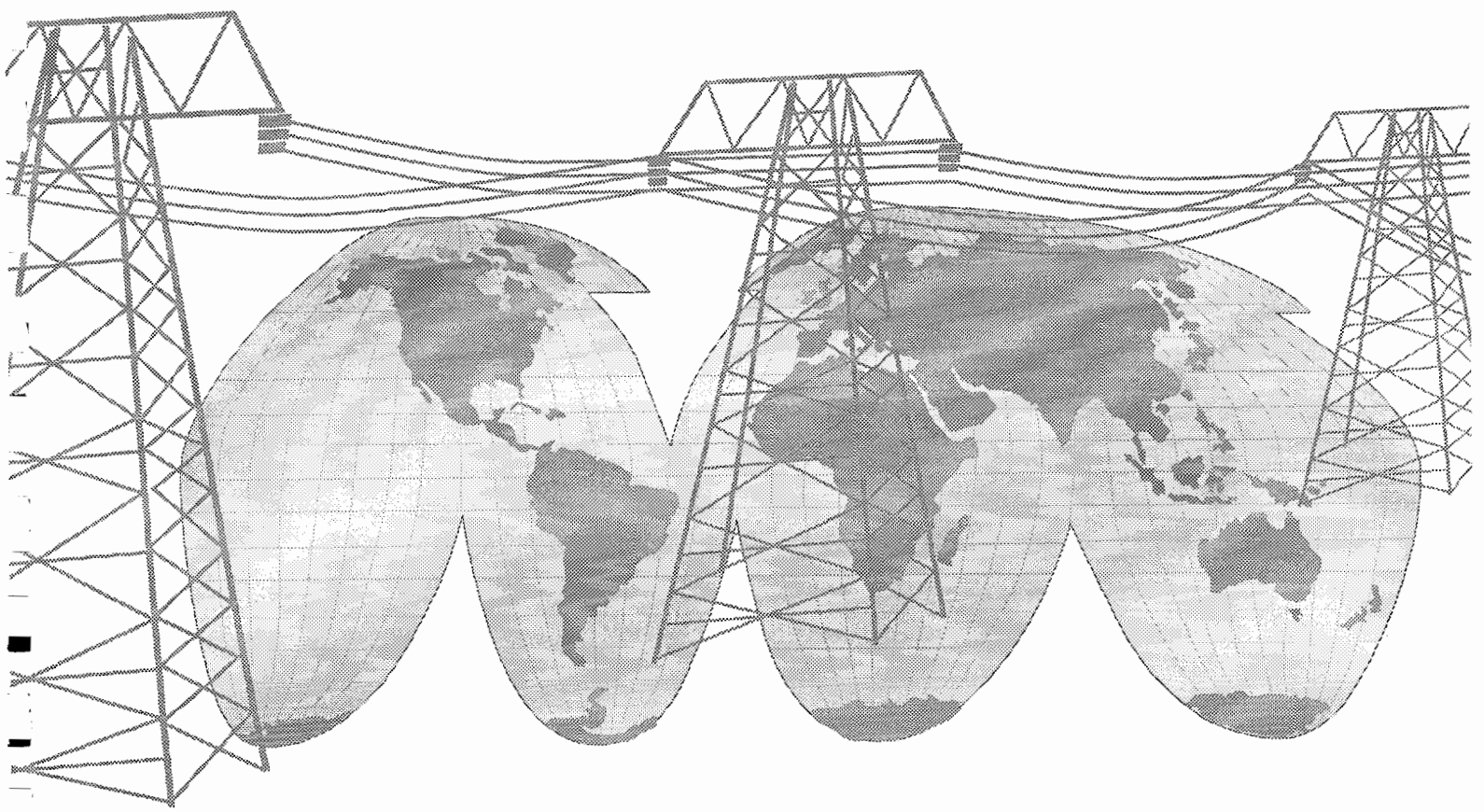
Center for Environment
Office of Energy, Environment, and Technology

ENERGY PROJECT DEVELOPMENT FUND

End of Project Report

Appendix

March 24, 1995



U.S. Agency for International Development
Bureau for Global Programs, Field Support, and Research
Center for Environment
Office of Energy, Environment, and Technology
Washington, D.C. 20523-1810

Administered by:
Price Waterhouse LLP

Contract No. DHR-5738-C-00-0097-00

INDEX FOR APPENDIX

APPENDIX A

Information and Application Packet

INFORMATION AND APPLICATION PACKET

FOR

ENERGY PROJECT DEVELOPMENT FUND

Office of Energy and Infrastructure
U.S. Agency for International Development

July 1992

TABLE OF CONTENTS

WHERE TO OBTAIN FURTHER INFORMATION OR CLARIFICATION OF APPLICATION REQUIREMENTS & PROCEDURES

Interested parties may obtain additional information and assistance with the Application requirements and procedures of the FUND from the following location:

Energy Project Development Fund
A.I.D. Office of Energy & Infrastructure
R&D/EI, Room 508, SA-18
Washington, D.C. 20523-1810

Telephone: 703-875-4052
Fax: 703-875-4053

I. ENERGY PROJECT DEVELOPMENT FUND INFORMATION

As part of its mission, the Office of Energy and Infrastructure of the U.S. Agency for International Development (A.I.D.) assists in alleviating, by environmentally acceptable means, the supply/demand gap in the energy sectors of developing countries. To accomplish this, the Office of Energy and Infrastructure (EI) has established the Energy Project Development Fund (FUND) to provide financial support for prefeasibility and feasibility studies leading to the development and application of environmentally-sound energy technologies designed to solve the energy problems of developing countries.

The primary objectives of the FUND are the following:

1) To provide financial assistance for prefeasibility and feasibility studies that evaluate public and private energy projects in the developing world with priority on those that involve proven, environmentally acceptable and clean technologies; and

2) To assist private companies from the United States and public sector entities from developing countries to identify and develop projects that support sustainable and environmentally acceptable economic development and promote U.S. trade and investment.

ELIGIBLE PROJECTS

The FUND can help finance prefeasibility and feasibility studies to determine the technical, economic, financial, legal and institutional viability of proposed energy and energy-related development projects.

PUBLIC SECTOR PROJECTS

These projects must be publicly-owned and operated and must utilize some commercially proven or advanced technology. Eligible projects may include:

- Clean coal technologies
- Energy conversion
- Advanced electric power generation
- Advanced energy transmission and distribution
- Energy related environmental control technologies

PRIVATE SECTOR PROJECTS

These projects must be owned or operated by the private sector and may include:

- Private power plants and other energy facilities
- Private leasing and rehabilitation of energy facilities
- Contracting out energy/utility functions
- Privatization

ELIGIBLE APPLICANTS

To apply to the FUND, the Applicant must be:

1. A U.S. company with a controlling ownership interest of not less than 51% held by U.S. citizens, such as energy and environmental equipment suppliers, engineering firms, utilities and their subsidiaries, and private power developers.

2. A public agency or other public sector entity from a developing country working with U.S. companies.

COST SHARING

The FUND may share with eligible applicants up to 50 percent of the cost of prefeasibility and feasibility studies. Applicants must provide written documentation that the remaining amount will be available from other private or public sources.

PROJECT FUNDING PROCEDURES

To apply to the FUND, interested parties should follow the procedure described below and illustrated in the flow chart (Figure 1).

After obtaining the FUND application form, interested parties should contact the Office of Energy and Infrastructure to obtain advice about the eligibility of their proposed project, and how to fulfill the application requirements.

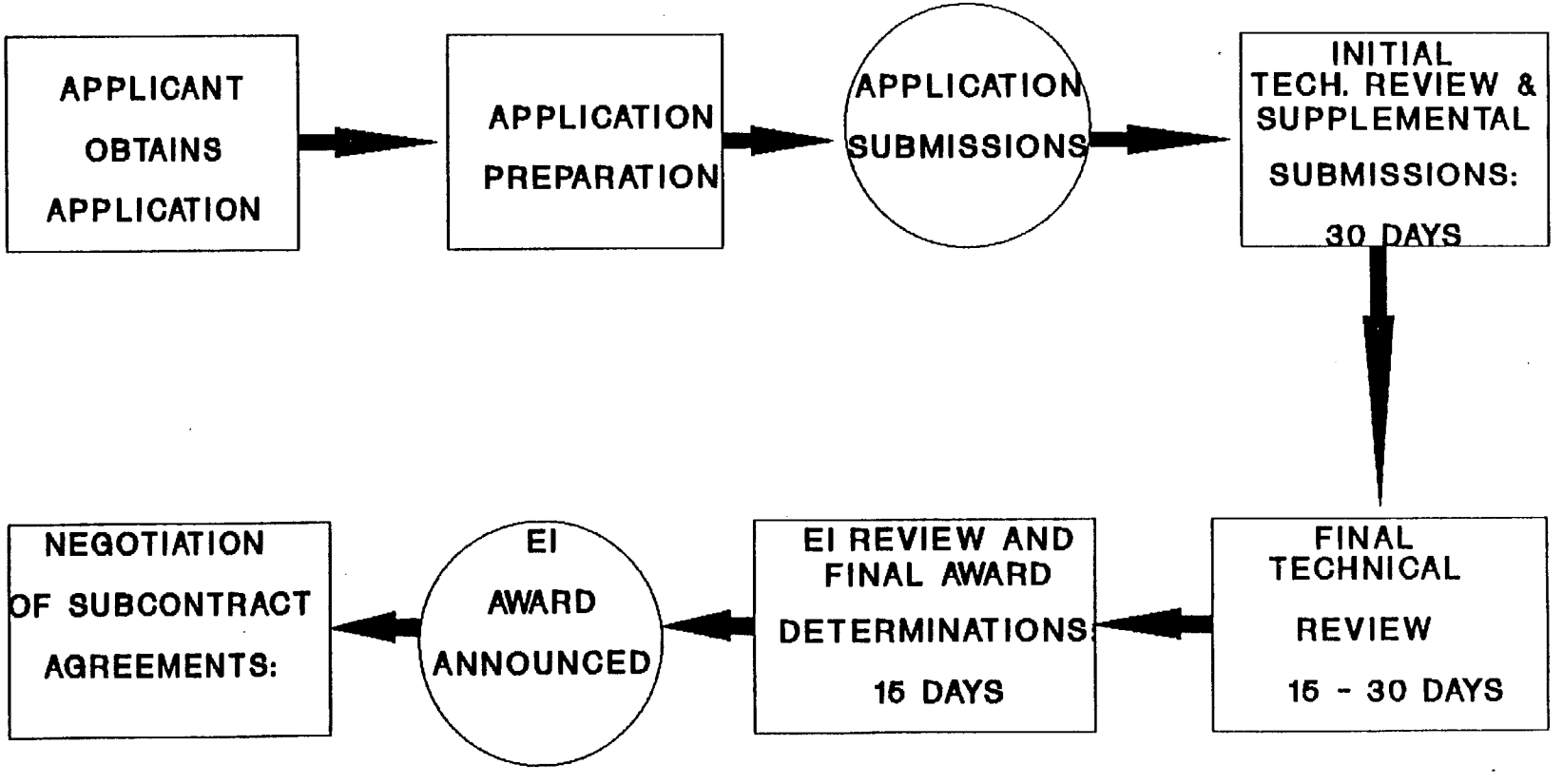
Having completed the Application, interested parties should submit (5) copies of the completed Application to the Fund Administrator (Price Waterhouse) at the address below. The Fund Administrator, with approval of EI, will establish a Technical Review Panel, which will review the Application. The Fund Administrator will be responsible for all formal communications with the Applicant. Proposed applications will be evaluated using the evaluation criteria set forth herein.

The Office of Energy and Infrastructure will announce the awards to successful Applicants. The number and size of awards will be subject to the availability of funds. After award, the Applicant will enter into an Assistance Agreement with Price Waterhouse. Price Waterhouse will disburse funds and monitor progress of the proposed activities in accordance with the executed Assistance Agreement.

The Applicant will undertake the prefeasibility or feasibility study according to the schedule, scope of work and budget agreed upon. The Fund Administrator will disburse funds based on a progress schedule, the receipt of deliverables and submittal of acceptable invoices. Eligible study costs are defined in the Assistance Agreement and will be in accordance with A.I.D. procurement regulations and guidelines. Generally, the final 25 percent of the monies from the FUND for each project will be released only after acceptable delivery of the completed study and submission of the necessary invoice.

FIGURE 1

APPLICATION PROCESS FLOWCHART



EI = Office of Energy and Infrastructure

APPLICATION EVALUATION CRITERIA

Generally, an application to the FUND must propose a commercially proven and environmentally sound energy project that supports sustainable economic development, minimizes environmental impact and promotes U.S. trade and investment in developing countries.

Applicants, if possible, should have prior and current experience with designing, manufacturing, constructing, developing, implementing, operating, and/or owning the type of project they propose to develop with the support of the FUND. Prior international and/or U.S. experience is preferred. The proposed project should provide an opportunity for the export of U.S. goods and services in the course of the project development, implementation and operation. Small and minority-owned businesses are especially encouraged to apply to the FUND.

An effort will also be made to support projects in each of A.I.D.'s geographic regions: Asia, Eastern Europe and Near East, Eastern Europe and the Newly Independent States, Latin America and the Caribbean, and Africa.

The evaluation is based on criteria for (1) basic threshold requirements, (2) project characteristics and (3) prefeasibility or feasibility study characteristics. Regarding the proposed project, the evaluation will consider its impact on economic development, the environment and U.S. trade and investment; the technical and financial soundness of the project and Applicant; the experience of the Applicant and related parties with similar projects; and the potential for the actual implementation potential of the project. Regarding the prefeasibility or feasibility study, the evaluation will focus on the study organization and scope of work, availability of cost sharing, the study schedule, and the experience of the Applicant and study team members.

THRESHOLD CRITERIA

The Threshold Criteria are listed below to assist potential applicants determine the basic eligibility of their projects.

All applicants and applications must meet the following threshold criteria:

- Applicant must be a U.S. company with a controlling ownership interest of not less than 51% held by U.S. citizens or a public agency from an A.I.D.-assisted countries that is working with a U.S. company.
- Proposed project must, at a minimum, meet the environmental standards of the International Bank for Reconstruction and Development (World Bank) and of the host country.
- Proposed project must be for a commercially proven technology and environmentally acceptable energy activity.
- Applicant must have a specific project site in an eligible country.
- Applicant must provide at least 50 percent of the cost of the prefeasibility or feasibility study.

PROJECT AND STUDY CRITERIA

Once an Application meets the Threshold Criteria, the proposed project and the prefeasibility or feasibility will be evaluated against additional criteria, which can be found in Attachment A: Evaluation Criteria.

WHERE TO OBTAIN FURTHER INFORMATION OR CLARIFICATION OF APPLICATION REQUIREMENTS & PROCEDURES

Interested parties may obtain additional information and assistance with the Application requirements and procedures of the FUND from the following location:

Energy Project Development Fund
A.I.D. Office of Energy and Infrastructure
R&D/EI, Room 508, SA-18
Washington, D.C. 20523-1810

Telephone: 703-875-4052
Fax: 703-875-4053

WHERE TO SEND APPLICATIONS

Applicants should send one (1) original and four (4) copies of completed applications to the following address:

Mr. Kami Rahbani
Fund Administrator
Energy Project Development Fund
Price Waterhouse
1801 K Street, N.W.
Washington, D.C. 20006

Telephone: 202-296-0800
Fax: 202-296-2785

II. INSTRUCTIONS FOR APPLICATIONS TO THE ENERGY PROJECT DEVELOPMENT FUND

TO OBTAIN FURTHER INFORMATION OR CLARIFICATION OF APPLICATION REQUIREMENTS & PROCEDURES CONTACT:

Energy Project Development Fund
A.I.D. Office of Energy & Infrastructure
R&D/EI, Room 508, SA-18
Washington, D.C. 20523-1810

Telephone: 703-875-4052
Fax: 703-875-4053

Please complete your application by providing the information specified below. Follow this outline in organizing your application and append additional information as necessary. Also, complete and submit the Application Cover Sheet (Attachment B) and the Certification Form (Attachment C).

Submit one (1) original and four (4) copies of the completed application to Price Waterhouse, the Fund Administrator, at the address provided above.

If you need additional information or clarification about he requirements and/or procedures of the FUND, contact the Energy Project Development Fund at telephone number (703) 875-4052 or fax number 703-875-4053.

NOTE: IF THE INFORMATION REQUESTED IN THIS APPLICATION IS NOT AVAILABLE BECAUSE IT WILL BE DEVELOPED DURING THE STUDY, PLEASE INDICATE WHERE APPROPRIATE.

I. THRESHOLD INFORMATION

A. Provide evidence that the applicant is a U.S. company with a controlling ownership interest of not less than 51% held by U.S. citizens or a public agency from an A.I.D.-assisted countries that is working with a U.S. company.

B. Explain how the project will meet the environmental standards of the International Bank for Reconstruction and Development (World Bank) and of the host country, by completing Attachment D: Environmental Issues.

C. Explain how the technology for the proposed project is commercially proven technology and environmentally acceptable.

D. Identify the specific project site.

E. Demonstrate that the applicant will provide at least 50% of the cost of the prefeasibility or feasibility study.

II. PROJECT INFORMATION

A. TECHNICAL DATA

1. Technical Description of Proposed Project

Provide a technical description of the proposed project including, but not limited to, the following:

- Type of technology
- Site description and infrastructure requirements. Provide area and site maps, and pictures, if available.
- Fuel requirements
- Air, water, and solid waste discharges
- Other relevant information

2. Project Organization

Describe the proposed organizational structure of the project and submit an organization chart. Identify the Applicant and key project participants and their organizational relationships, including U.S. companies and government sponsoring agency, and others.

B. PROJECT IMPACT

1. Describe how the proposed study and project is consistent with the host country's formal development plans, policies, laws and regulations.

2. Explain the need for the project and the impact of the project on economic development, employment levels, and living conditions of host country residents.

3. Provide written evidence that the proposed project and study have the support of the host country and the appropriate public agency(ies).

Append copies of any legally binding commitments, memorandum of understanding, letters of intent, letters of support, permits, licenses, approvals or applications for such approvals from host country government officials.

4. Provide a breakdown of the estimated project cost content, identifying the source of supply of goods and services (i.e., from the U.S., host country, or other sources).

Proposed Project	
Total Project Cost	$_____
Anticipated U.S. content	$_____
Anticipated host country content	$_____
Other content (Specify)	$_____

C. PROJECT FINANCIAL ASPECTS

1. Project Budget and Financial Data

Provide an estimate of the total cost of the project and a breakdown of these costs into major categories. **For private projects,** also provide a project financial plan (including sources of equity and debt, loan repayment terms, project cash flows, sale price of energy, etc.) and letters of interest or commitment from potential equity partners and lenders.

2. Applicant Financial Soundness

For private companies, provide copies of audited financial statements on the Applicant for the past three years and other pertinent materials to evidence the financial soundness of the Applicant.

D. PROJECT SCHEDULE

Provide a schedule for the completion of the development and implementation of the project.

E. EXPERIENCE OF APPLICANT AND RELATED PARTIES

Provide information on the experience of the Applicant and other parties involved in designing, developing, constructing, financing, and/or operating similar projects. Provide the names, locations, descriptions and references for previous projects by Applicant and study team members of a similar nature. Describe the nature of the work done.

F. IMPLEMENTATION POTENTIAL

1. State whether, or not, the proposed project is being, or will be, tendered by a public agency through a formal solicitation. If yes, attach a copy of the solicitation. If no, explain the situation.

2. Describe the specific agreements and/or actions that will result from the completion of the study activities, i.e., what additional approvals, permits, licenses, clearances, etc. will be needed to implement the project.

3. Describe how the private sector in the host country will be involved.

4. Provide evidence that the A.I.D. Mission in which the project is located has been informed of the project and the proposed study.

III. PREFEASIBILITY/FEASIBILITY STUDY INFORMATION

A. Scope of Work and Organization

1. Provide a detailed scope of work. If available, include the following study components and identify study team members responsible for, and participating, in, each component:

- Technical feasibility
- Economic/financial feasibility
- Environmental assessment
- Project management and organization
- Project operation and maintenance
- Other

2. Describe the proposed organizational structure of the study team and submit an organization chart, corresponding to the Study Scope of Work provided above. Identify responsibilities and reporting relationships.

B. STUDY FUNDING

1. Study Budget

Provide an estimated Study Budget with a breakdown corresponding to the components of the study as set forth in the Study Scope of Work.

2. Source of Matching Funds

Clearly identify the source of the matching funds and provide a letter certifying to their availability.

C. SCHEDULE

Provide a schedule for the completion of the study broken down into each of the subcomponents of the study.

D. EXPERIENCE

Provide examples of previous experience in the performance of studies similar in nature to the proposed study by the Applicant and study team personnel. Provide the names, locations, descriptions and references for previous projects by Applicant and study team members of a similar nature. Describe the nature of the work done.

ATTACHMENT A: EVALUATION CRITERIA

EVALUATION CRITERIA

I. THRESHOLD CRITERIA

All applicants and applications must meet the following threshold criteria:

A. Applicant must be a U.S. company with a controlling ownership interest of not less than 51% held by U.S. citizens or a public agency from an A.I.D.-assisted countries that is working with a U.S. company.

B. Proposed project must, at a minimum, meet the environmental standards of the International Bank for Reconstruction and Development (World Bank) and of the host country.

C. Proposed project must be for a commercially proven technology and environmentally acceptable energy activity.

D. Applicant must have a specific project site in an eligible country.

E. Applicant must provide at least 50 percent of the cost of the prefeasibility or feasibility study.

II. PROJECT CRITERIA

A. PROJECT IMPACT

1. Need for environmentally acceptable energy in the host country and for the proposed project, and the potential contribution of project to solving energy and environmental concerns.

2. Export potential for U.S. goods and services.

3. Impact on the environment, especially of fuels and technology utilized.

B. PROJECT TECHNICAL ASPECTS

1. Use of indigenous resources.

2. Use of advanced and proven technology that is environmentally sound.

4. Appropriate sizing and efficiency of proposed project.

5. Appropriate siting.

6. Presence, or assurance of construction, of supporting infrastructure.

C. PROJECT FINANCIAL ASPECTS

1. Aggregate level and reasonableness of proposed project costs and energy prices, and for private projects, the reasonableness of energy prices and cash flow projections.

2. Strength of commitments from potential sources of capital financing (debt & equity).

3. Financial ability of project sponsor to complete the project.

D. PROJECT IMPLEMENTATION SCHEDULE

1. Reasonableness of project development/implementation schedule.

E. EXPERIENCE OF APPLICANT AND GOVERNMENT AGENCY SPONSORS

1. Depth of experience in performance of work similar to the proposed project (as evidenced by similar projects).

2. Level of international experience, especially in developing countries.

F. PROJECT IMPLEMENTATION POTENTIAL

1. Degree of host country policy commitment to the project as evidenced by presence of supportive laws, regulations, procedures and institutions.

2. Demonstrated level of support for the project by the host country government and government agency sponsors through legally binding agreements (such as power purchase agreements), firm and unambiguous letters of intent, permits, licenses, and other approvals or letters of commitment.

3. Level of host country private sector participation.

4. Level of previous project development work completed for the proposed project

5. Level of financial participation by Applicant or government agency sponsor.

6. Potential for near-term implementation of the project.

III. STUDY CRITERIA

A. STUDY ORGANIZATION AND SCOPE OF WORK

1. Evidence of sound study organization.

2. Thoroughness and relevance of proposed scope of work.

B. STUDY FUNDING

1. Amount and verifiability of matching funds, if any, to finance the study.

2. Reasonableness of proposed budget.

3. Financial soundness and capability of the Applicant.

C. STUDY IMPLEMENTATION SCHEDULE

1. Reasonableness of study implementation schedule.

D. EXPERIENCE OF STUDY TEAM MEMBERS

1. Depth of experience of study team members in performing work similar to the proposed study.

2. Level of international experience, especially in developing countries.

ATTACHMENT B: APPLICATION COVER SHEET

ENERGY PROJECT DEVELOPMENT FUND

APPLICATION COVER SHEET

PROJECT NAME: _____

PROJECT LOCATION: _____

APPLICANT NAME: _____

_____

PLACE OF INCORPORATION: _____

MAILING ADDRESS: _____

_____

_____

NAME OF CONTACT: _____

TITLE OF CONTACT: _____

TELEPHONE NUMBER: _____

FAX NUMBER: _____

PARENT COMPANY: _____

PLACE OF INCORPORATION: _____

ATTACHMENT C: CERTIFICATION FORM

CERTIFICATION FORM

(To be signed by a senior corporate officer with verifiable legal authority to commit the Applicant.)

I (Applicant) HEREBY CERTIFY THAT THE INFORMATION PROVIDED IN THIS APPLICATION IS TRUE AND CONTAINS NO FALSE STATEMENTS, TO THE BEST OF MY KNOWLEDGE.

SIGNATURE: _____

NAME: _____

TITLE: _____

DATE: _____

ATTACHMENT D: ENVIRONMENTAL ISSUES

ENVIRONMENTAL ISSUES

Please answer the following questions to the fullest extent possible and provide explanatory attachments, if available. If information on these matters is to be developed during the prefeasibility or feasibility study, please indicate.

I. Impact Identification

If known, will the proposed project meet the appropriate environmental standard of the International Bank for Reconstruction and Development (World Bank) and the host country? Provide supporting calculations.

Does the proposed project have an impact on any environmental sensitive areas? Explain.

What are the significant beneficial environmental effects of the project? Have the risks been evaluated? Explain.

Have any probable off-site effects (so-called upstream and downstream effects) been determined, including transboundary effects, and what is the time-lag before effects are exhibited? Explain.

II. Mitigation Measures

What mitigation measures are proposed and what alternative sites have been considered?

What lessons from previous similar projects will be incorporated into the environmental assessments of this project?

How will the study take into consideration the local populations and concerned groups and their interests? Is resettlement involved? What, if any, compensatory measures are planned?

III. Procedures

How have host-country and other environmental guidelines been taken into consideration?

Explain how the study will evaluate the beneficial and adverse environmental effects of the project.

How will host country authorities responsible for environmental protection be consulted in the preparation of the project? How do you plan to make the central authorities aware of the environmental impact of the project and have they approved the environmental measures to be included?

APPENDIX B

Marketing Brochure

FEASIBILITY STUDY AND EQUITY INVESTMENT FUNDS FOR ENERGY AND ENVIRONMENTAL PROJECT DEVELOPMENT

A Summary

The Office of Energy and Infrastructure supports a variety of projects and programs that seek to address the energy and environmental problems faced by developing countries. One common mechanism used by these different programs is the funds for prefeasibility and feasibility studies and equity investments outlined in this summary. This brochure has been developed to inform potential applicants about the different funds offered by or supported through the Office of Energy and Infrastructure and to summarize important distinctions between these funding programs. Please contact the program of your interest directly for more detailed information and applications.

Office of Energy and Infrastructure
Bureau of Research and Development
U.S. Agency for International Development
Washington, DC

April 1993

Energy Project Development Fund (EPDF)

The Energy Project Development Fund provides financial support for prefeasibility and feasibility studies for energy projects in USAID-assisted countries. The primary aim of EPDF is to foster the development of energy projects which will ultimately lead to construction of energy facilities, especially electric power plants. EPDF also supports a broad range of energy-related activities such as power plant rehabilitation and conversion, energy efficiency, and energy-related environmental control technologies.

EPDF provides up to 50% of the cost of prefeasibility and feasibility studies, with a maximum contribution of $250,000 by USAID. Awards made by EPDF include both conditional loans (for privately-owned projects) and grants (publicly-owned projects). Conditional loans must be repaid if projects are financed. Projects must employ commercially proven technologies and exhibit a high potential for actual development. Applicants must be U.S. companies that are majority-owned by U.S. citizens. However, applicants do not have to have majority-ownership in potential projects.

The Office of Energy and Infrastructure recently expanded EPDF to include both privately and publicly-owned energy projects. Previously, EPDF was called the Private Sector Energy Development Fund.

The International Fund for Renewable Energy and Energy Efficiency (IFREE)

The International Fund for Renewable Energy and Energy Efficiency provides limited support for prefeasibility studies related to renewable energy (biomass, geothermal, small hydropower, solar photovoltaic, solar thermal, or wind energy), energy efficiency, or natural gas projects.

IFREE offers conditional grants of up to $50,000 to support up to one-half of prefeasibility study costs. This money must be repaid if the project is financed. Projects must be commercially viable and replicable. IFREE requires that potential funding for the subsequent full feasibility study be identified, a capable in-country participant must exist, and the project must utilize predominantly U.S. equipment.

Conceived by the U.S. Export Council for Renewable Energy, IFREE is funded by USAID, the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the Rockefeller Foundation.

Renewable Energy Pre-Investment Support (REPS) Fund

The Renewable Energy Pre-Investment Support Fund offers financial assistance to private companies to support feasibility and prefeasibility studies for renewable energy projects in developing countries. The REPS Fund is operated under the Renewable Energy Applications and Training (REAT) and Biomass Energy Systems and Technology (BEST) projects. REAT seeks to catalyze investments in sustainable and replicable renewable energy projects. BEST focuses more specifically on promoting electric power generation and the production of fuels from waste biomass associated with agricultural and forest products industries.

The REPS Fund can provide up to 50% of the costs of prefeasibility or feasibility studies to private developers for projects using commercially-proven biomass, geothermal, small hydro, solar, and wind energy technologies. Cost-sharing takes the form of an interest-free reimbursable grant to the project developer, to be repaid if the project reaches financial closure. Both host country developers and U.S. developers working with a local company are eligible to apply.

In certain focus countries, USAID has established Renewable Energy Project Support Offices (REPSO's) to provide a variety of support services to project developers. Currently, USAID has REPSO's in Costa Rica and Indonesia. REPSO's periodically conduct in-country solicitations for proposals from private developers. Only solicited proposals will be evaluated. Grants are awarded on a competitive basis.

Environmental Enterprises Assistance Fund (EEAF)

The Environmental Enterprises Assistance Fund invests in projects and companies in developing countries. EEAF's purpose is to catalyze small-scale renewable energy and environmental companies by providing loans and equity capital for environmentally attractive projects that are commercially viable, but require financing to move ahead.

EEAF will provide financial support for projects under $2 million in renewable energy systems, energy efficient energy conversion technologies, and environmentally responsible management of organic waste. Proposals submitted to EEAF will be evaluated on their financial viability as well as their environmental, economic, and social impact. Direct loans are made at concessional rates, but equity investments are expected to provide higher returns than conventional financing arrangements. EEAF is a nonprofit corporation that was established in 1990 with the help of USAID, Winrock International, and the Rockefeller Foundation.

For more information, contact:

Energy Project Development Fund
Price Waterhouse, Fund Administrator
Mr. Kami Rahbani
1801 K Street, NW
Washington, DC 20006
Tel (202) 296-0800 Fax (202) 296-2785

International Fund for Renewable Energy and Energy Efficiency
750 First Street, N.E., Suite 930
Washington, DC 20002
Tel (202) 408-7916 Fax (202) 371-5115

Renewable Energy Pre-Investment Support Fund
Renewable Energy and the Environment Program
1611 N. Kent Street, Suite 600
Arlington, VA 22209-2134
Tel (703) 525-9430 Fax (703) 243-1175

Environmental Enterprises Assistance Fund
1611 N. Kent Street, Suite 202
Arlington, VA 22209
Tel (703) 522-5928 Fax (703) 522-6450

APPENDIX C

Mission Clearance Form

USAID Mission Clearance Form

Applicants to the Energy Project Development Fund (EPDF)
should submit this form
to the USAID office in the appropriate country

The Office of Energy and infrastructure has a number of funds that support feasibility studies for power generation projects. One of these funds is the Energy Project Development Fund, which is administered by Price Waterhouse.

The EPDF supports both private and public-sector projects with cooperation from the Private Sector Energy Development (PSED) program and the Energy Technology innovation Project (ETIP), respectively. In addition to sharing the costs of feasibility studies, these programs sponsor seminars and workshops to promote energy development in USAID-assisted countries.

Before an application for EPDF funding is submitted, applicants are encouraged to solicit the appropriate USAID Mission's concurrence. The applicant below has expressed an interest in receiving USAID funds from the EPDF in order to conduct a feasibility study in your country.

Please provide the following information to the Mission:

Applicant: _____
Project Location: _____
Name of Contact: _____
Address: _____
_____
_____
Telephone Number: _____
Fax number: _____

Also attach an executive summary of your proposal for the Mission to review.

For Mission Use Only
Please indicate whether you have:

No objections to the proposal: ____
Objections to the proposal (see below): ____
Need additional information: ____

Please return, with any comments, to the EDPF office.

_____
_____
_____
_____

ENERGY PROJECT DEVELOPMENT FUND (EPDF)
Attn: Price Waterhouse
1601 N. Kent Street, Suite 912
Arlington, VA 22209
Tel: (703) 522-4849 Fax: (703) 528-2280

APPENDIX D

Sample Certification of Acknowledgement of Receipt of Payment

ACKNOWLEDGEMENT OF RECEIPT OF PAYMENT

REPAYMENT OF FEASIBILITY STUDY LOAN FROM THE
ENERGY PROJECT DEVELOPMENT FUND
ADMINISTERED BY PRICE WATERHOUSE LLP

CONTRACT NO. DHR-5738-C-00-0097-00
PROJECT NO. 936-5738

In Consideration of mutual covenants and the Contract Amount of ONE HUNDRED FOURTEEN THOUSAND FIVE HUNDRED DOLLARS AND ZERO CENTS ($114,500.00), the United States Agency for International Development (hereinafter referred to as USAID) hereby acknowledges receipt of Contract Amount from Hidroelectrica Aguas Zarcas, S.A. (hereinafter referred to as Subcontractor). Subcontractor hereby releases and discharges Price Waterhouse LLP (hereinafter referred to as PWLLP), the United States Government, their officers, partners, agents and employees from all liabilities, claims, actions, causes of action, lawsuits, and demands whatsoever which the undersigned now has or may hereafter have on account of or arising out of a Subcontract dated the 15th day of October 1991, between Subcontractor and PWLLP for the performance of a feasibility study in Costa Rica.

USAID hereby certifies that Subcontractor has reimbursed in full the Total Actual Funds of ONE-HUNDRED FOURTEEN THOUSAND FIVE-HUNDRED DOLLARS AND ZERO CENTS ($114,500.00) that Subcontractor received through a Subcontract with PWLLP. This payment releases and discharges the Subcontractor from any financial obligation to PWLLP and/or USAID based on a Subcontract dated the 15th day of October 1991, between Subcontractor and PWLLP for the performance of a feasibility study in Costa Rica.

DATE: _____

USAID OFFICE: _____

AUTHORIZED SIGNATURE: _____

PRINT NAME: _____

This day personally appeared _____, of USAID, and stated that he/she is authorized to execute this Acknowledgement of Receipt of Payment on behalf of USAID, and acknowledged his/her signature before me.

Given under my hand this _____ day of _____, 1995.

_____
Notary Public

My Commission Expires: _____

If this release is executed outside the United States of America it must be Notarized/Certified by a U.S. Consular Official.

APPENDIX E

Bangladesh: International Forum on Private Sector Participation in the Bangladesh Power Sector

INTERNATIONAL FORUM ON PRIVATE SECTOR PARTICIPATION IN THE BANGLADESH POWER SECTOR

May 8-12, 1994
Dhaka, Bangladesh
Dhaka Sheraton Hotel

Sponsor

The Ministry of Energy and Minerals, Government of the People's Republic of Bangladesh, with the support of the U.S. Agency for International Development. The Secretary of Energy has designated the Rural Electrification Board as the local agency responsible for planning and coordinating the forum.

Objectives

To provide an opportunity for Bangladeshi officials to become more fully acquainted with the most important aspects of private power.

Participants

The Prime Minister, the Minister of Energy and Minerals, the Minister of Finance, the Secretary of Energy, and other senior officials of the Government of the People's Republic of Bangladesh.
USAID/Bangladesh.
The U.S. Ambassador.
Senior investment managers from the Asian Development Bank, the World Bank, the International Finance Corporation and commercial and investment banks.
Representatives of the Bangladesh private sector and press corps.

Agenda Overview

The forum will begin with a review of the current status and future needs of the power sector in Bangladesh, followed by a two-day discussion on power sector privatization concepts and the requirements of multilateral and commercial financial institutions in lending to Bangladesh. Senior government and utility officials from India, Indonesia, Pakistan, and the Philippines will present their country's and their own experiences with private power in the remaining sessions.

Agenda Items

- Overview of Private Power
- Financing Private Power/Project Financing
- Regulatory and Policy Framework
- Private Power Development Process
- Security Package and Commercial Agreements
- Private Banking Perspectives from Multilateral, Institutional, and Commercial Banks
- Country Presentations: India, Indonesia, Pakistan, and the Philippines
- Summary of Forum Proceedings and Suggested Follow-up Activities
- Round-table Discussion of Key Issues
- Discussion on Future Policies for Bangladesh

International Forum on Private Sector Participation in the Bangladesh Power Sector

(May 8-12, 1994)

TIME	SUNDAY - May 8	MONDAY - May 9	TUESDAY - May 10	WEDNESDAY - May 11	THURSDAY - May 12
Morning	Welcome and Introduction Speeches by Officials of: • Forum Chairman • Opening of Forum by the Prime Minister of Bangladesh • USAID Mission Director/U.S. Ambassador • GOB Presentation - Keynote Address by Secretary, Ministry of Energy - Address by Chairman of REB	Overview of Private Power: (Continued) • Typical Project Structures • Agreements/Risks • Tariffs, Incentives and Permits • Private Power Development Process	Financing Private Power: (Continued) - Commercial Banker - Investment Banker • Multilateral Financing Issues: - World Bank - International Finance Corp. - Asian Development Bank	Country Presentation: INDONESIA • Government's Experiences (Including Q&As) • Utility's Experiences (Including Q&As)	Country Presentation: PHILIPPINES • Government's Experiences (Including Q&As) • Utility's Experiences (Including Q&As)
	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
Afternoon	Overview of Private Power: • A Perspective on Private Power • Benefits and Challenges of Private Power • Overview of Project Financing • Regulatory and Policy Framework • Review and Discussion Session	• Evaluation and Review of Projects • Security Package and Commercial Agreements • Wrap-up of Overview of Financial and Discussion Session Financing Private Power: • Private Banking Perspectives - Institutional Investor	Country Presentation: INDIA • Government's Experiences (Including Q&As) • Utility's Experiences (Including Q&As)	Country Presentation: PAKISTAN • Government's Experiences (Including Q&As) • Utility's Experiences (Including Q&As)	Summary of Workshop Sessions and Suggested Follow-up Activities: Chaired by Energy Secretary • Discussion of Key Issues and Policy Implications • Discussion of Next Steps For Bangladesh • Closing Remarks by GOB - Minister of Finance - Minister of Energy
Evening	GOB WELCOMING RECEPTION/DINNER	RECEPTION WITH AMBASSADOR	REB DINNER & CULTURAL ACTIVITIES		

International Forum on Private Sector Participation in the Bangladesh Power Sector
May 8-12, 1994

FORUM AGENDA

Saturday May 7, 1994 - Evening

Early Registration - Dhaka Sheraton Hotel

Sunday May 8 - Morning Session

TIME		
8:00	I.	Registration
9:00	II.	Welcoming and Introductory Speeches by: **(To Be Held at the International Conference Center)** · Forum Chairman, **TBD** · Opening of the Forum by the **Honorable Begum Khaleda Zia, Prime Minister of Bangladesh** · USAID Mission Director/U.S. Ambassador to Bangladesh
10:30		**BREAK**
	III.	Presentations by Government of Bangladesh Officials
11:00		o **KEYNOTE ADDRESS** - Privatization Policies and Incentives Provided by the Government of Bangladesh with Special Reference to the Power Sector **The Honorable Faizur Razzaque**, Secretary, Ministry of Energy
11:30		o Economic Development and the Power Sector **Brigadier Muhammad Enamul Hug**, Chairman of the Rural Electrification Board
12:00		LUNCH

Conference Moves to the Dhaka Sheraton Hotel

13

TIME		Sunday May 8 - Afternoon Session
		OVERVIEW OF PRIVATE POWER
2:00	IV.	A Perspective on Private Power **Speaker - Mark Peterson, Private Power Specialist** · Terminology and Frame of Reference · Basic Components · Worldwide Status · Need for Institutional Structure and Political Support Benefits and Challenges of Private Power · Need for Predictability and Certainty · Meeting Development Needs · Implications for Government, Utilities, and Political Support
2:45	V.	Overview of Project Financing **Speaker - Jeffrey Humber, Director of USAID's Private Sector Energy Development Program, Private Power Specialist** · Identification and Allocation of Risk · Commercial Concepts · Lenders Perspectives and Objectives · Acceptance and Pricing of Risk · Legal Protection of Expectations
3:30		BREAK
3:50	VI.	Regulatory and Policy Framework **Speaker - Roger Wagner, Private Power Specialist** · New Rules to Private Capital to Meet Public Ends · Institutional/Organizational Structures · Political/Policy Considerations · Legal/Regulatory Framework
4:35	VII.	Review and Discussion Session **Speaker - Roger Wagner, Private Power Specialist** · Review of Concepts · Preview of Criteria for Successful Project Financing · The Market Environment
5:00		ADJOURN
7:00		**Welcoming Dinner hosted by the Government of Bangladesh**

Monday May 9 - Morning Session

TIME

8:30* **I.** Opening Remarks - Forum Chairman **TBD**

8:35 **II.** <u>What Does a Typical Project Look Like</u>

Speaker - Jeffrey Humber, Director of USAID's Private Sector Energy Development Program, Private Power Specialist

- Key Elements of a Typical Project
- Alternative Ownership Structures
- Relationships and Responsibilities of Participants

9:20 **III.** <u>Commercial Agreements: Key Elements of the Business Deal</u>

Speaker - Mark Peterson, Private Power Specialist

- Power Sales Agreement
- Fuel Supply Agreement
- Construction Agreement
- Operation and Maintenance Agreement
- Risk Allocation

10:05 **BREAK**

10:30 **IV.** <u>Tariff, Incentives and Permits</u>

Speaker - Roger Wagner, Private Power Specialist

- Transparency, Clarity, and Timing
- Alternative Tariff Structures: Cost-Based, Itemized, Fixed Formula
- Government Incentives/Assurances
- Permitting Process

11:15 **V.** <u>Development Process</u>

Speaker - Mark Peterson, Private Power Specialist

- Identifying Opportunities
- Development Phases and Key Milestones
- Development Costs

12:00 LUNCH

* Early Start Necessary Because Hotel Must Be Vacated By 4:30 pm

Monday May 9 - Afternoon Session

TIME		
1:30	VI.	Project Evaluation

Speaker - Jeffrey Humber, Director of USAID's Private Sector Energy Development Program, Private Power Specialist

- Institutional Roles
- Preparation of Request For Proposal (RFP) Documents
- Evaluation Criteria
- Selection Process

2:05 VII. Security Package and Financing Agreements

Speaker - Roger Wagner, Private Power Specialist

- Legal Terminology
- Overview of Documentation
- Implementation Agreement
- Financing Agreements
- Foreign Investment Requirements

2:35 VIII. Wrap-up of Overview on Private Power and Discussion Session

Private Power Specialists

3:00 BREAK

3:20 **FINANCING PRIVATE POWER - INTRODUCTION**

Mark Peterson, Private Power Specialist

Private Banking Perspectives

3:30 - Presentation by Institutional Investor **TBD**

4:15 IX. Question and Answer Session

4:30 ADJOURN

7:00 Reception hosted by U.S. Ambassador

Tuesday May 10 - Morning Session

TIME		
8:45	I.	Opening Remarks - Forum Chairman **TBD**
	II.	Financing Private Power (Continued)
9:00		· Presentation by Commercial Banker **TBD**
9:45	III.	Question and Answer Session
10:00		BREAK
	IV.	Multilateral Financing Issues
10:15		· Presentation by **Representative,** The World Bank **(Tentative)**
10:45		· Presentation by **Representative,** The International Finance Corporation **(Tentative)**
11:15		· Presentation by **Mr. Constantine Pappas,** Senior Project Engineer, The Asian Development Bank **(Invited)**
11:45	V.	Question and Answer Session
12:30		LUNCH

117

Tuesday May 10 - Afternoon Session

TIME		
	<u>Regional Experiences with Private Participation in the Power Sector</u>	
2:00	**VI.**	**Country Presentation - INDIA** Presenter: **Mr. S. Rajgopal** - Former Secretary of Power **(Confirmed)** · Government's Experience · Question and Answer Session
3:15		BREAK
3:45	**VII.**	**Country Presentation - INDIA (Continued)** Presenter: **Mr. Ajit Nimbalkar** - Chairman, Maharashtra State Electricity Board **(Tentative)** · Utility's Experience · Question and Answer Session
5:00		ADJOURN
7:00		**Dinner and Cultural Activities hosted by the Government of Bangladesh Rural Electrification Board**

18

Wednesday May 11 - Morning Session

TIME		
8:30*	I.	Opening Remarks - Forum Chairman

Regional Experiences with Private Participation in the Power Sector

8:45	II.	**Country Presentation - INDONESIA**

Presenter: **Mr. Ir. Moeljadi** - Director-General for Electricity and Energy Development, Ministry of Mines and Energy **(Confirmed)**

- Government's Experience
- Question and Answer Session

10:00	BREAK

10:15	III.	**Country Presentation - INDONESIA (Continued)**

Presenter: **Dr. Ir. Zuhal** - President-Director, Perusahaanumum Listrik Negara **(Invited)**

- Utility's Experience
- Question and Answer Session

11:30	LUNCH

* Early Start Necessary Because Hotel Must be Vacated By 4:30 pm

Wednesday May 11 - Afternoon Session

TIME		
		Regional Experiences with Private Participation in the Power Sector
1:30	**IV.**	**Country Presentation - PAKISTAN** Presenter: **Representative,** Ministry of Water and Power **(Confirmed)** · Government's Experience · Question and Answer Session
3:00		BREAK
3:15	**V.**	**Country Presentation - PAKISTAN (Continued)** Presenter: **Representative,** Private Power Cell **(Confirmed)** · Utility's Experience · Question and Answer Session
4:30		ADJOURN
Evening		**No scheduled event**

120

Thursday May 12 - Morning Session

TIME		
8:45	I.	Opening Remarks - Forum Chairman

Regional Experiences with Private Participation in the Power Sector

9:00	II.	**Country Presentation - PHILIPPINES**

Presenter: **Honorable Flordeliza Andres**, Assistant Secretary, Department of Energy **(Confirmed)**

- Government's Experience
- Question and Answer Session

10:15 BREAK

10:45	III.	**Country Presentation - PHILIPPINES (Continued)**

Presenter: **Mr. Jose Ramas**, Former Senior Vice President, National Power Corporation **(Confirmed)**

- **Utility's Experience**
- Question and Answer Session

12:00 LUNCH

12

Thursday May 12 - Afternoon Session

TIME

IV. Summary of Forum Sessions and Suggested Follow-up Activities

Chairman: The Honorable Faizur Razzaque, Secretary, Ministry of Energy

2:00 · Discussion of Key Issues, Policy Implications and Next Steps for Bangladesh

3:30 · Forum Summary and Closing Remarks by

- o Minister of Finance
- o Minister of Energy

4:30 Adjournment and Distribution of Forum Handbook **(USAID/REB)**

FORUM VENUE AND ACCOMMODATION ARRANGEMENTS:

The Dhaka Sheraton Hotel is the official hotel for the forum. Arrangements may be made through the reservation desk.

DHAKA, SHERATON HOTEL

TEL: 880-2-863391/861191
FAX: 880-2-832915/832975

12 1A

APPENDIX F

Thailand: Independent Power Policy Review, Phase I

Trip Report

Independent Power Project Solicitation and Contracting
National Energy Policy Office of Thailand
June 18-26, 1994

The purpose of the assignment was to review, on behalf of the National Energy Policy Office of Thailand (NEPO), a draft independent power project Request for Proposals (RFP), accompanying model power purchase agreements (PPA), and grid code. The draft documents had been prepared by Price Waterhouse on behalf of the Electric Authority of Thailand (EGAT). Additionally, NEPO requested a review of the existing regulations for the purchase of power from small power producers.

June 20: Met with Dr. Dr. Bhasu Bhanich Supapol of NEPO and other NEPO staff for a background briefing.

Reviewed draft RFP and began preparing proposed modifications to the draft.

Met with Dr. Piyasvasti Amranand, Secretary General of NEPO, Dr. Bhasu and other NEPO staff, as well as representatives from SwedPower (who were retained by NEPO primarily for grid code review) to discuss the documents and coordinate the workplan for the week.

June 21: Completed modifications to draft of the RFP, reviewed draft PPA, and began preparing proposed modifications to the draft PPA. Reviewed draft grid code to assess its impact on IPP project development.

June 22: Completed modifications to the draft of the PPA. Met with Dr. Piyasvasti, Dr. Bhasu and NEPO staff and SwedPower to review proposed changes and prepare for meetings with the EGAT.

Met with Mr. Peter McPartlin of Price Waterhouse and SwedPower representatives to review comments on RFP, PPA and grid code in advance of meetings with EGAT.

June 23: Full day meeting with EGAT, NEPO, Price Waterhouse and SwedPower. Presented proposed modifications to the documents and participated in discussions on policy, procedures and scheduling. Following these policy and higher level technical discussions, the meeting continued at a more detailed technical level, with the focus on RFP price and non-price evaluation criteria, methods and weighting factors.

June 24: Full day meeting with EGAT, NEPO Price Waterhouse and SwedPower. Morning session continued at the detailed technical level, with the focus on project cost evaluation, treatment of environmental requirements, and

other matters in the RFP. Discussions continued on the PPA. Dr. Piyasvasti joined the meeting in the afternoon. During the afternoon session, the areas of agreement were discussed, those items that remained open for an upcoming EGAT internal working session were clarified, and scheduling for the IPP investors conference was covered.

In addition, comments on small power power producer regulations as well as comments on the revised RFP have been provided to NEPO.

Submitted by New England
Electric Resources, Inc.

June 30, 1994

APPENDIX G

Thailand: Chiang Mai Solid Waste Disposal Analysis

U.S. Agency for International Development
Office of Energy, Environment and Technology
Center for Environment
Bureau for Global Programs, Field Support
and Research

CHIANG MAI SOLID WASTE DISPOSAL ANALYSIS

Final Report

November 16, 1994

Prepared by:
Energy Project Development Fund
Contract No. DHR-5738-C-00-0097-00

Prime Contractor: Price Waterhouse

126

TABLE OF CONTENTS

Executive Summary

Chiang Mai is currently facing a solid waste disposal crisis. Developing a complete waste disposal system has taken on increased urgency due to the fact that the city will host the South East Asian Games in December of 1995. Currently, Chiang Mai is developing and utilizing interim disposal sites, leased on a short-term basis to satisfy its disposal requirements. In addition to the collection and disposal of the refuse collected from the current city of Chiang Mai, the city is faced with planning for an expansion to about 200 square kilometers and a potential doubling of its population in the foreseeable future. In addition to being faced with a near term disposal problem which is expected to compound with growth, the city is not recovering any significant portion of their operating cost through fee collection. Current revenues average Baht 20 per unit per month and can only be collected from approximately 30% of the serviced population.

The city has taken various steps to deal with this situation. It recently privatized half of the city's waste collection services. In addition, the city is currently considering the implementation of a materials recovery facility, as well as various other options, in an effort to increase efficiency and reduce costs.

As a result, Price Waterhouse has been contracted by the U.S. Agency for International Development to analyze the current situation, and make recommendations for solid waste management in the future. Our analysis was constrained due to the unavailability of detailed budgetary information and other exact technical information. As a result, we have relied on the information and estimates as provided by the officials of the Municipality of Chiang Mai, as well as the Department of Environment al Engineering at Chiang Mai University. The unavailability of detailed information regarding the actual incineration units to be used and their final implementation methodology has severely hampered our cost estimates for the incineration portion of this study. In addition, we did not attempt to perform a quantitative analysis of the potential economic and health benefits resulting from the different solid waste management options.

The brief nature of our visit to Chiang Mai provided us with an understanding of the situation and a general framework for analyzing various options for the city. Our study should be used by the city of Chiang Mai as one of many pieces of information to consider while developing its own short and long-term solid waste management policy.

I. Understanding of the Situation

A. Recent History

The city's landfill has been closed after approximately 20 years of operation due to poor disposal practices, increased population surrounding the site, public opposition to the operation and an increase in land value. Studies indicate that the site was primarily operated as an open dump which generated large amounts of landfill leachate. Migration of the leachate offsite was tied to public opposition to continued operation of the facility. As in many landfills worldwide, the site initially operated outside the metropolitan area of Chiang Mai. Population growth and municipal expansion moved the "dump" into the public eye and created sufficient public opposition to close the facility.

Prior to closure of the original dump site, the Government of Thailand provided money for the construction of a 20 to 24 tonne per day incinerator as a pilot project to remedy some of the conditions at the original site. The incinerator never operated properly and has since been abandoned.

In addition to the incinerator, a pilot composting project was also established at the original landfill site. This project was intended to reduce the quantity of material going into the landfill, and as a result, extend its life. The poor quality of the resulting compost combined with a lack of readily available markets for the composted material doomed this project to early failure.

In terms of solid waste collection, such services for one-half of the city were privatized within the last year. A Baht 73,000,000 contract spanning five years was awarded. In addition to the Baht 73,000,000, the contractor was awarded 50% of the monthly collection fees in their sector, estimated to be worth an additional Baht 1,200,000 per year.

B. Current Situation

Chiang Mai currently faces a situation in which it is developing and utilizing interim disposal sites, leased on a short-term basis from private individuals or companies, to satisfy its disposal requirements for the approximately 200 to 240 tonnes per day of refuse it generates. The facility we visited appears to be a gravel operation which the owner is allowing the city to backfill. The current mine will be completely filled within the next few weeks and operations will move to a second open pit mining operation across the road. Despite the transient nature of this disposal methodology the actual operation itself is quite well organized with very little litter or smell and

cover material being applied promptly to the in place refuse.

In addition to the collection and disposal of the 200 to 240 tonnes of refuse collected from the existing population of approximately 163,000 people in the 40 square kilometer city, staff is faced with planning for an expansion to about 200 square kilometers and a potential doubling of its population in the foreseeable future.

Chiang Mai staff, in addition to being faced with a near term disposal problem which is expected to compound with growth, is not recovering any significant portion of their operating cost through fee collection. Current revenues average Baht 20 per unit per month and can only be collected from approximately 30% of the serviced population.

Coverage of operating costs is a serious near and long-term concern. Presently, staff is concerned with collecting fees from a higher percentage of the serviced population. The inability to collect fees for solid waste management programs is not an unusual problem in nations that are developing a high-quality, environmentally-sound, integrated solid waste management program. Residents are used to receiving public services and generally have the impression that the service is free or costs very little to perform. The "public perception" of the value of the solid waste management program speaks to the root of the majority of the problems identified in our visit to Chiang Mai. Although the staff is very knowledgeable regarding issues, alternatives and solutions, there has been little or no real effort made to educate the public on the importance of solid waste management strategies and their impact on the environment.

People are generally not willing to pay for something that they feel has little or no value to them. Past disposal practices have given the public little reason to trust staff recommendations regarding solid waste management disposal options. And, regardless of a resident's willingness to pay or not, their refuse continues to be collected. Clearly, an important task facing the municipality is the education of its population regarding solid waste management issues.

The municipality has not capitalized on the potential savings to be realized from privatizing its collection services. It is relatively clear that no firm numbers exist which readily substantiate the various costs of operating the solid waste collection portion of the Sanitary Engineering Department. As a result of privatizing half of the city, 42 collection laborers went to the private sector with a commensurate salary savings. However, no trucks have been eliminated from the system and our best information indicates that no collection drivers have gone to the private sector. There appears to be little in the way of audit procedures in place to allow the municipality to determine whether they will in fact save the estimated $2,000,000 anticipated over the five year contract life.

II. Solid Waste Management: Options

A. The McGill Proposal

Chiang Mai is seriously considering recycling and composting as strategies for managing present and future disposal tonnages. In an effort to reduce the current 200 to 240 tonnes per day going to the landfill, a contract Material Recovery Facility (MRF) has been proposed by McGill Environmental Systems. McGill has proposed a build, own and operate combination MRF and transfer station. Conceptually, all material collected would be transported to the McGill facility where it would be separated into recyclables, compostables and residual material. The residual material would be baled and landfilled, or incinerated, depending on the implementation of a new Thai national government incinerator project. The current proposal will pay McGill approximately Baht 190 per tonne for a minimum of 200 tonnes per day. McGill Environmental will also have the rights to market all compostable material and recyclable material recovered from the waste stream. It is our understanding that McGill has also agreed to deliver the baled residual material to the disposal site for this Baht 190 per tonne price (note: the final disposal site has not yet been identified). Chiang Mai is considering this proposal since it would offer the city the opportunity to avert the cost of building a long-term sanitary landfill and continue to utilize whatever site will ultimately be developed as a landfill site for the near-term. Additionally, the city hopes to save money on truck fleet operations by having such a transfer facility.

At this time, we cannot confidently determine whether there would be any future cost savings to the city from implementing this proposal until the following two issues are more fully developed:

1. Disposal Location

A vital issue to be considered before a determination can be made regarding potential savings from delivering solid waste to a transfer station/MRF versus direct haul to a landfill, relates to the final location of the disposal facility in relation to the transfer station. It is our understanding that there is still some question regarding the actual availability of the military base as a temporary disposal facility. In any event, this location is less than 34 kilometers from the transfer station/MRF. As a general rule, it has been determined that it is not economical to utilize a transfer station if haul distance is less than 34 kilometers one way. There are no documentable savings in terms of the cost of transfer over the cost of direct haul unless there are serious travel restrictions related to traffic or transportation infrastructure. To determine if there would be any actual savings in terms of transfer over direct haul, an exact location for a landfill should be determined and the cost of direct haul versus transfer could be compared based on actual capital

and operational scenarios.

2. Landfill Requirement

Under any scenario, a landfill must be included in Chiang Mai's overall solid waste management strategy. Reducing the tonnage from 240 tonnes per day to 60 tonnes per day because of the MRF will not significantly decrease the operating requirements in terms of personnel costs and equipment and supply costs. As a result, landfill costs on a per tonne basis will be much higher in the near term, with the only savings being the avoided cost of future landfill space. Even if the material being landfilled is just the residual from an incineration process, the operational requirements and capital investment will still see little reduction. The toxins from the incinerator ash will leach readily into the city's groundwater unless a proper containment process is designed into the disposal site. This type of containment may be more costly than managing regular refuse.

B. Incineration

In discussing the above MRF proposal, it is important to discuss incineration in detail as Chiang Mai municipal staff are faced with incineration as part of a national strategy. McGill's proposal to design, construct and operate an MRF facility could divert as much as 70% of all waste delivered to it. The diversion is expected to come from varying degrees of recycling and composting. At the average daily tonnages of approximately 200 tonnes per day, the City of Chiang Mai would expect approximately 60 tons per day of solid waste to be delivered to a site for either incineration and/or landfilling.

Any incineration scenario would be tied directly to the composition and moisture content of the waste, being delivered as residue, from the recycling-composting facility. Any organic waste holding moisture quantities above 30% would not be conducive to incineration without a costly preparation step added (i.e. drying/shredding). Readily combustible material such as wood products, plastics and contaminated recyclables could be directed for incineration. It is understood from interviews with Chiang Mai Solid Waste Management personnel that the 200 tonne per day average of solid waste generation may increase dramatically during the tourist season between October and March. Special attention should be paid to evaluating tonnages from month to month in order to generate an annual operating plan. It is also noted that dramatic increases in the amount of waste generated in Chiang Mai have occurred since 1986 according to the *Thailand Innovative Administration Consulting Institute-August 1990 Seminar*.

Additionally, consideration of potential annexation in areas contiguous to the City limits will also increase current estimates of tonnage. These increases will impact long term plans and evaluation

132

criteria based on transportation costs to facilities that will, to some degree, process solid waste, (i.e., incinerators, energy-from-waste facilities, composting facilities, recycling processing facilities, and landfills).

Tender documents bid this year by the Public Works Department at the Ministry of the Interior to design, construct and operate and maintain a 60 tonne per day incinerator within or near the City of Chiang Mai including ash/slag and fly-ash landfills on a site of approximately 27 rai, have produced a bid of 360 million baht. Limited interviews have indicated that fourteen companies bid this project, of which four were shortlisted as finalists. All finalists were Japanese companies. Subsequent to this bid phase, the Thai Government decided that the site would have to be at the slaughterhouse located within Chiang Mai. The slaughterhouse is smaller than the original area, which caused the four companies to re-bid the project. This has been described as a turnkey project which includes training of personnel and operation of the incinerator for two years. The program coincides with the national government mandate to incorporate incineration into solid waste disposal activities. As of this report there is no written policy for disposal. However, the Ministry of Science and Technology is generating a national code.

The following observations are made with reference to the outlook of incineration playing a significant role for Chiang Mai in the near future:

- Above average moisture content of the solid waste that would be handled by an incinerator system will be problematic and will need front-end modifications to treat the refuse and dry it to allow for adequate combust

- Highly skilled technicians will be needed to operate the incinerator(s) to maintain proper combustion levels and acceptable air quality standards. Improper operation of units will lead to premature failure of incinerators, above average residue to handle and dispose of, and air pollution, all which will cause significantly higher costs and community resentment

- Of all scenarios reviewed, incineration is most likely the most expensive and creates special problems with reference to ash landfilling

- Incineration is only a partial solution to Chiang Mai's solid waste situation since it does not deal with the fact that this waste stream has usable resources for energy production.

III. Recommendations and Conclusions

- Open Pit Mine

It is our recommendation that the open pit mine, which is less than 1/4 mile from the existing site, be properly prepared and used as a near term landfill. This pit is estimated to have sufficient air space to accommodate over 200,000 tonnes of refuse if it is filled to ground level (possibly a minimal crown above ground level for proper runoff of ground water), and if compaction levels meet expected operational requirements. A detailed survey of the open pit mine should be accomplished to get specific dimensions and a better estimate of life expectancy. This could serve as a benchmark in which to develop longer term solutions to handling solid waste properly. Immediate engineering design and construction of a lining and leachate collection system should begin for the new interim landfill.

- Compaction

All studies and discussion to this point have looked at the possibility of reducing the amount of material going to the landfill as a way to save airspace (defined as the volume, in cubic yards, of land used to dispose of a certain amount of refuse). The method used to decrease the amount of airspace required for a given amount of refuse involves increasing the in-place compaction of the refuse (the number of pounds per cubic yard of airspace). This approach can significantly increase the life of a given facility at a lower cost than the implementation of recycling, composting and incineration programs which will reduce the incoming volume. In-place compaction can be facilitated by compacting the refuse in a compacting collection vehicle or by compacting it when it has been off loaded at the fill site or both. The City should procure a landfill compactor sized for the open pit mine and develop operational criteria to achieve a compaction ratio of 1600 lbs per cubic yard.

Consideration should be given to converting to rear-loading compaction trucks. Five of these vehicles, collecting two loads a day, could collect 100 tons a day or the equivalent of the amount in the city controlled zones. Consideration should be given to purchasing spares at a rate consistent with current fleet management practices. Rear-loading compactors would reduce fleet requirements, personnel requirements and the number of trips required to landfill waste collected. It would also increase the compaction of the waste to approximately 750 lbs./cubic yard in the truck.

- McGill MRF

If the city decides to move forward with this proposal, Chiang Mai should negotiate to create operational standards that mandate a minimum of the proposed 70% reduction of the waste stream with monetary incentives for greater reduction (consequent penalties if 70% reduction is not reached). Because of the crisis situation that exists with landfill options, these negotiations should commence immediately.

- Incineration

Refuse in Chiang Mai may be too wet to incinerate without additional treatment. The possible environmental problems combined with the high cost make incineration a less attractive option.

- Increasing Profits

Fee collection can be tied to a municipal services bill which bills for all municipal services such as water, sewer, sanitation and electric on one bill. Non-payment of this bill allows for services to be terminated which will readily affect the household or business and cause the bill to be paid. It would also appear that hotels do not pay their fair share based on their waste production. A careful look at the fee structure in relation to hotel generation rates versus fees charged seems in order. The team was informed that municipal service is not extended to businesses. Businesses would be a good source of revenue, which could offset residential costs, and should be explored both as a business opportunity and as a control on their environmental impact.

It would seem that the municipality has not gained the maximum advantage from it's privatization initiative. Although sanitation workers went to the private sector as a result of the contracting of 1/2 the city no trucks or drivers appear to have left the system. Given the physical size of the city and even allowing for three to four collections per week there is room to reduce resources and as a result costs. A general rule should be that refuse should be out by a certain time in the morning and collection vehicles pass that point only once on any given day. At present collection vehicles continue to rerun their area until the close of their business day. This is costly and nonproductive.

- Public Education

A citizens advisory committee should be established to help educate the public regarding solid waste issues. The value of employing a public relations firm to provide a conduit to educate the public regarding solid waste issues, programs and facilities cannot be underestimated. Proper public relations are even more effective when they are coupled with the employment of a citizens

committee, empowered by the mayor, to work with staff in the development of solid waste policy. This committee should adequately represent all sectors of the population if it is to be effective. A citizens committee should be appointed to work with staff on solid waste issues relating to Chiang Mai.

IV. Appendix: Financial Analysis

A. Approach

It is apparent that several near-term options exist to increase Chiang Mai's existing landfill life. In addition, there are several long-term solutions to deal with the city's solid waste problem for the future. As a means to differentiate between the various options, we have performed a cost analysis of various combinations of collection and disposal scenarios. The cost analysis can be used by the city as one of many deciding factors to consider in their process of deciding which method or combination of methods should be used in solving the city's solid waste problem. Issues such as environmental benefits were not factored into our cost analysis.

We have developed six scenarios for Chiang Mai to consider in the development of their solid waste plans for the future. These six scenarios do not represent the only options available to the city. The results of our financial analysis can only be applied to the scenarios which we have explored herein.

B. Cost-Analysis Methodology and Results

Our approach to analyzing the costs were based on the following information: We projected operating costs based on historical operating figures as given to us by the city. We built capital cost projections based on prices and assumptions concerning capital goods as described in proposals to the city, as well as from comparable figures of such goods in the United States. Our results in terms of cost per tonne were based on projected amounts of garbage to be generated as given to us by the city.

The cost analysis is divided into two areas, collection and disposal costs. The collection costs are assumed to be the same for all of the proposed scenarios, and will be described below. The disposal costs are different for each scenario, and will be described below after each scenario is listed. For disposal costs, the costs include the landfill, and any other garbage reduction machinery. At the end of the disposal costs analysis, there are reductions to the disposal cost. These reductions come from the ability of any garbage reduction machinery employed to extend the life of the current landfill. This ability to extend landfill life allows the city to push off into the future its need to purchase a permanent landfill area. This 'avoided cost' is the benefit associated with buying the garbage reduction machinery, and is represented in our analysis by the cost savings portrayed by a present value of analysis of buying the permanent landfill at a later date, whenever the current landfill is full.

Collection Cost Methodology:

The average collection cost per tonne of US$20.89 equals the average of the public sector and the private sector collection costs. This is because of the fact that one-half of the city's garbage collection was recently privatized. The city pays the private contractor approximately US$17.32 per tonne of garbage collected. This figure represents the annual cost of the privatization contract, made up of a five-year, Baht 73 million agreement, as well as 50% of collection fees (approximately Baht 1.2 million annually). The other 50% of the garbage collection is done by the city itself, at a cost of approximately US$24.46. This calculation was based on the budget figures given to us by the city, in terms of employees, energy, trucks, equipment and supplies, and divided by the estimates given to us concerning garbage to be collected.

Disposal Cost Methodology:

Scenario 1: Disposal Cost: US$4.75/tonne.

Collect refuse and direct haul to a landfill. A new landfill will be required after 1 year. In place compaction assumed to be 800 lbs. per cubic yard.

This scenario represents the current state of operations in Chiang Mai today. The disposal costs involve the operation of the landfill, which include land rental costs. We have calculated the disposal costs of the current site to be US$4.75 from the data given to us by city officials. After this site is filled up, it is possible that the military demo site will be used as the next landfill. We have calculated this site to have a slightly higher disposal cost, US$6.85 per tonne, because of higher projected land purchase costs. We have chosen to use the current site to represent today's unit disposal costs for this scenario. This scenario predicts that the current landfill site will fill up with garbage by 1996, which would require the purchase of the permanent site at that time. Since this serves as the base case scenario, and employs no garbage reduction machinery, there is no avoided cost.

Scenario 2: Disposal Cost: US$11.97/tonne.

Collect refuse and implement the McGill MRF. A new landfill will be required after 3 years. In place compaction is assumed to be 800 lbs. per cubic yard.

The McGill Materials Recovery Facility proposes to separate the garbage at an interim facility, and to recycle and compost a portion of it, so as to reduce the resulting waste going to the landfill by 70%. The cost proposed by McGill to accomplish this is US$7.50/tonne. This would extend the life of the current landfill to 1998. This translates to an avoided cost of US$0.28/tonne on the $4.75/tonne current landfill.

Scenario 3: Disposal Cost: US$93.17/tonne.

Collect refuse and implement the McGill MRF. Utilize incinerator for the balance of the material not volume-reduced at the MRF. Landfill will be required after 5 years. In place compaction assumed to be 800 lbs. per cubic yard.

The Incinerator would be used to burn the 30% of garbage not treated by the McGill Materials Recovery Facility. There would be some ash created by the incinerator, which would need to be landfilled. The total cost provided to us of such an incinerator divided by garbage estimates comes to US$81.45/tonne. This would extend the life of the current landfill to 2000. This translates to an avoided cost of US$0.53/tonne on the $4.75/tonne current landfill.

Scenario 4: Disposal Cost: US$5.06/tonne.

Collect refuse and direct haul to landfill. Utilize a compactor to increase in-place compaction to 1600 lbs per cubic yard. New landfill required after approximately two years.

This scenario represents the current state of operations in Chiang Mai today, with the addition of implementing a compactor at the landfill site. To the current landfill disposal costs of US$4.75, we add the unit cost of the compactor of US $0.45. This compaction allows more garbage to be dumped into the landfill, extending its life an extra year to 1997. This translates to an avoided cost of US $0.15/tonne on the $4.75/tonne current landfill.

Scenario 5:

Same as scenario 2 except increase compaction to 1600 lbs per cubic yard. Landfill life approximately 6 years.

This scenario is the same as the incorporation of the McGill MRF, except that here we also assume the use of the US$0.45/tonne compactor at the landfill site. The combination of the MRF and the compactor would potentially extend the life of the current landfill to 2001, representing an avoided cost of US$0.64/tonne on the $4.75/tonne current landfill.

Scenario 6:

Same as scenario 3 except increase compaction to 1600 lbs per cubic yard. Landfill life is extended to approximately 10 years.

This scenario is the same as the incorporation of the McGill MRF plus incinerator, except that here we also assume the use of the US$0.45/tonne compactor at the landfill site. The combination of the MRF, incinerator and the compactor would potentially extend the life of the

current landfill to 2005, representing an avoided cost of US$1.00/tonne on the $4.75/tonne current landfill.

C. Assumptions and Data Used:

The following assumptions were made as a basis for our analysis:

- This will be a ten-year present value analysis, in real terms
- No interest expense is assumed, Exchange rate utilized is Baht 25 = US$1
- Current amount of refuse equals 200 tonnes per day (tpd) in 1994 increasing to 300 tpd by the end of 1995. A growth rate of 15% per year is assumed thereafter.
- If the 200 tpd is divided into categories we would assume the following distribution of tonnage by scenario:
  - scenario 1 and 4: 100% to a landfill
  - scenario 2 and 5: 30% to a landfill, 16% recycled, 54% would be composted.
  - scenario 3 and 6: 30% incinerated (10% residual ash taken to landfill), 16% recycled and 54% composted.

The following data was used as a guideline in developing our net cost numbers:

One of the most important factors in developing projections for landfill life is the level of compaction that should be attained by proper operational equipment and procedures. The table that follows develops landfill life based on consistent landfill size and refuse composition with variable compaction ratio. (source: Caterpiller Performance Handbook #24)

COMPACTION		LANDFILL LIFE	GAIN
590 KG/M3	1000 LB/YD3	9.6 YRS	0
710 KG/M3	1200 LB/YD3	11.5 YRS	1.9 YRS
830 KG/M3	1400 LB/YD3	13.4 YRS	3.8 YRS
950 KG/M3	1600 LB/YD3	15.3 YRS	5.7 YRS

Open Pit (Interim Landfill) Waste Capacity Calculations

Dimensions:	150 yds. X 150 yds. X 20 yds.
Capacity:	337,500 cubic yards (450,000 cubic yds. * .75 - compensation for side slopes)
Compaction:	1600 lbs. per cubic yard - proper Compactor needed to achieve this level.
Cover Material:	25% maximum volume for proper daily cover
Total Tons Capacity:	202,500 tons - (337,500 X 1600 X .75/2000)
Operational Life:	@ 65,000 tons per year - 3.11 years * @ 20,000 tons per year - 10.13 years

* 20,000 tons per year reflects an approximate 70% reduction in the waste stream if McGill proposal is accepted and produces as promised. It is important to note that certain specifications should be considered in designing the interim landfill. A clay or polyethylene liner for the bottom and slopes should be considered for leachate containment. A leachate collection system should also be considered for proper protection of the groundwater resource.

TABLE 1	**Scenario 1** (landfill)	**Scenario 2** (W/McGill)	**Scenario 3** (+ incinerator)
Collection Costs:			
Private Sector	$17.32	$17.32	$17.32
Public Sector	$24.46	$24.46	$24.46
Avg. Cost Per Ton	$20.89	$20.89	$20.89
Disposal Costs:			
MRF Costs (McGill):			
*Today's Cost Per Ton:	$00.00	$7.50	$7.50
Incinerator Costs:			
Annual Cap. Amort.\Tonne	$00.00	$00.00	$61.45
Operating Costs Per Tonne	$00.00	$00.00	$21.00
*Total\Tonne	$00.00	$00.00	$81.45
Landfill Disp. Costs:			
Current Cost\Tonne	$4.75	$4.75	$4.75
Military Demo Site:			
Cost Per Tonne:	$6.85	$6.85	$6.85
Date When Current Land-fill and Demo Landfill Will Be Full: (est.)	1996	1998	2000
Total PV (@8%) Land Cost For a 50 Rai Perm. Site 10 Year Annual Life:	$1,455,026	$1,247,451	$1,069,488
Annual PV Land Cost For 50 Rai Perm. Site Per Tonne:	$1.99	$1.77	$1.47
Avoided PV Unit Land Cost Compared to Scenario 1:	$0.00	($0.28)	($0.53)
Today's Effective Landfill *Disposal Unit Cost Per Ton:	$4.75	$4.47	$4.22
SOLID WASTE DISPOSAL UNIT COST PER TON:(*1,*2,*3)	$4.75	$11.97	$93.17

142

TABLE 2	**Scenario 4** (landfill)	**Scenario 5** (W/McGill)	**Scenario 6** (+ incinerator)
Collection Costs:			
Private Sector	$17.32	$17.32	$17.32
Public Sector	$24.46	$24.46	$24.46
Avg. Cost Per Tonne	$20.89	$20.89	$20.89
Disposal Costs:			
MRF Costs (McGill):			
*Today's Cost Per Tonne:	$00.00	$7.50	$7.50
Incinerator Costs:			
Annual Cap. Amort.\Tonne	$00.00	$00.00	$61.45
Operating Costs Per Tonne	$00.00	$00.00	$21.00
*Total\Tonne	$00.00	$00.00	$81.45
Landfill Disp. Costs:			
Current Cost\Tonne	$4.75	$4.75	$4.75
Compactor Cost Per Tonne:	$0.45	$0.45	$0.45
Total Cost Per Tonne:	$5.21	$5.21	$5.21
Military Demo Site Cost Per Tonne:	$6.85	$6.85	$6.85
Date When Current Land-fill and Demo Landfill Will Be Full: (est.)	1997	2001	2005
Total PV (@8%) Land Cost For a 50 Rai Perm. Site 10 Year Annual Life:	$1,347,247	$990,267	$727,875
Annual PV Land Cost For 50 Rai Perm. Site Per Tonne:	$1.85	$1.36	$1.00
Avoided PV Unit Land Cost Compared to Scenario 1:	($0.15)	($0.64)	($1.00)
Today's Effective Landfill *Disposal Unit Cost Per Tonne:	$5.06	$4.57	$4.21
SOLID WASTE DISPOSAL UNIT COST PER TON:(*1,*2,*3)	$5.06	$12.07	$93.16

APPENDIX H

Thailand: Bangkok Medical Waste, Phase I

US Agency for International Development
Office of Energy, Environment and Technology
Center for Environment
Bureau for Global Programs, Field Support
and Research

Bangkok Medical Waste Privatization

Final Report
December 1, 1994

Prepared by:
Energy Project Development Fund
Contract No. DHR-5738-C-00-0097-00

Prime Contractor: Price Waterhouse

The opinions expressed in this final report are those of the contractor, Price Waterhouse, Administer of the Energy Project Development Fund, and not the U.S. Agency for International Development.

Table of Contents

Executive Summary

Since 1988, the Bangkok Metropolitan Administration (BMA) has been collecting and disposing of infectious waste separately from the rest of Bangkok's solid waste stream. Even today, however, differentiating between infectious waste and other solid waste is impossible because there is no legal definition of infectious waste. As a result, much of the "questionable" waste is disposed through the regular solid waste stream; it is believed that as much as two-thirds of the potentially contaminated waste currently ends up in the regular solid waste stream.

There have been surveys performed recently which conclude that while the hospitals do recognize the dangers associated with infectious waste, they do not want to be responsible for disposing of it properly; in fact, they would be willing to pay a reasonable fee to have it properly taken care of by someone else. Currently, that someone else is BMA for their own hospitals, as well as for some other health care facilities. BMA, however, is not equipped to handle the vast amount of infectious waste, which is growing every day. While most private hospitals currently are supposed to dispose of their own infectious waste in on-site incinerators, only one hospital is said to actually use a small incinerator on-site; there is no enforcement of violations.

Until a legal definition of infectious waste is developed and implemented, it will be difficult for BMA, hospitals, and clinics to determine how much infectious waste actually exists, and where the waste is generated. In addition, without a legal definition, it will be difficult to attract private companies to bid on an infectious waste collection/disposal contract for Bangkok because users could potentially avoid using the service, claiming their waste to be uncontaminated. Without a legal definition, a private contractor would likely require BMA to guarantee a minimum level of waste quantity and revenues.

With proper incentives, however, a private company could be enticed to enter into a contract to collect and dispose of infectious waste in place of BMA. If the private sector is allowed to operate the service, we believe that the process will be performed more efficiently, with more of the waste being removed, and in a cleaner manner. At the moment, however, the law requires BMA to perform this function, even if the hospitals do not pay the modest fees charged for this service.

In anticipation of a change in the law requiring BMA to perform this service, we have undertaken a study to compare the costs to BMA if they continue to perform the service themselves v.s. the costs required to pay a private company to perform that role. The results herein show that while it is not likely to be cheaper on a per unit basis to pay the contract price for a private company to perform the service, there are other benefits to be garnered, while maintaining current costs. These include:

- More of the infectious waste being collected and disposed
- The private sector will use a cleaner disposal incineration method
- BMA will incur fewer costs
- Future private sector costs may be even lower

The amount which the private company could charge the hospitals, however, would be fixed in the contract. Currently, there is a study which the Ministry of Public Health is reviewing concerning maximum fees per unit which the private sector would be allowed to charge. As a result, BMA would likely move to a regulatory role, thus eliminating the need to use its own funds, equipment, and personnel, while accomplishing infectious waste collection and disposal more efficiently.

In order to solicit the private sector, we recommend that BMA engage in a Request for Proposal (RFP) process. The RFP document should enumerate minimum requirements but should not discuss specific operational details that the private sector should follow. By allowing the private sector maximum latitude in determining operational details, BMA would allow the private sector the opportunity to propose innovative ways of improving the efficiency of the service, thereby reducing costs to a minimum.

We also recommend that BMA choose between two privatization options: a Lease-Develop-Operate option or a full privatization option. While certain efficiencies in operations can be attained though an O&M contract, an O&M contract would not give the private sector maximum incentives to increase efficiency in all parts of the operation (procurement, for example). The two recommended public-private partnership options should allow BMA to attain the best possible service and price.

Even if BMA chooses to provide the service itself, BMA must tackle certain issues, the most important of which are:

- *The definition and sources of medical waste.* These are the first steps required in any of BMA's options. Without defining the market for medical waste, it will be impossible to provide an efficient service, protect the environment, and to test performance.

- *The amount BMA is willing to subsidize the service.* Regardless of whether BMA retains operation of the service or contracts it to a private firm, BMA must decide how much of the cost of collection and disposal it is willing to pay, and how much should be paid by the users of the service.

- *Legal constraints.* BMA must amend certain laws which constrain its ability to provide the service effectively. For example, BMA should be allowed to levy penalties to those who fail to pay the agreed upon fee for either collection or disposal.

- *The billing system.* BMA should, at a minimum, contract with the private sector to set up an automated billing system.

I. Understanding of the Situation

The Bangkok Metropolitan Administration (BMA) is the local government administrative agency in Bangkok operating under Royal Thai Government regulations. BMA consists of the Bangkok City Council and the Governor of Bangkok, elected by the people. According to Article 89 of the BMA Act of 1985, the 27 principal functions of BMA include various city planning, maintenance, and development objectives. Each of these is managed by individual departments and offices within BMA.

The Department of Public Cleansing (DPC) is one department within BMA's structure. Within the DPC, the Solid Waste Collection Sub-Division has responsibility for all solid waste collection throughout Bangkok and the surrounding areas, which has been divided into three geographical sub-sections (1,2 and 3). The amount of solid waste collected by the Public Cleansing Service Division totals approximately 6,000 tonnes per day over the past 12 months.

Another division within the DPC, the Garbage Disposal Division, has responsibility for solid waste disposal at three major sites within Bangkok: Nong-Khaem, On-Nut, and Ram-in-Tra. Only Nong-Khaem and On-Nut have furnaces for medical waste disposal. On-Nut has received recent additions to its disposal capability, including two, 10-tonne incinerators, set to come on-line before the end of calendar year 1994.

In 1988, BMA laid down a policy to collect infectious and hazardous waste from many hospitals in the Bangkok area separately from municipal solid waste in order to prevent the spreading of disease. Starting in November of that year, BMA began to separately collect this waste from four of the main BMA hospitals. Later, the service was expanded to include government hospitals, private hospitals, health centers and clinics. Currently, BMA collects this waste from 581 sites, including public hospitals, government hospitals, associations and institutes, public health centers, private clinics, and some private hospitals. The waste is collected by BMA employees in special air-conditioned trucks, and then disposed of in the furnace at either the On-Nut or Nong-Khaem sites. When the two new incinerators come on line later this year, all of the waste will go to On-Nut.

Current conditions make it extremely difficult to collect and dispose of all of the infectious waste being produced in and around Bangkok. The main reasons for this are:

- *Lack of definition for medical waste.* The biggest obstacle for infectious waste collection and disposal is that there is still no legal definition of infectious waste. Without a legal definition, there is no way to know how much actually exists, or to easily prevent it from ending up in the regular solid waste stream. This definition must be determined before the infectious waste problem can be successfully tackled.

- *Cost constraints.* Since there is no separate BMA budget for infectious waste collection and disposal, BMA must consistently try to find the funds to provide the service from its solid waste operating budget.

- *The dispersion of health care providers.* It is not known exactly where all of the health care providers are located. This is because it is common practice in Bangkok for doctors to have their own small practices, without formally notifying BMA.

II. Current Collection and Disposal of Medical Waste

The current procedure performed by BMA can be divided into two main sections: collection and disposal of infectious waste.

A. Collection

Currently, hospital and clinic personnel must separate infectious waste from the regular solid waste stream. Although BMA provides special red bags and training, it remains the responsibility of the hospital to put the infectious waste out in BMA containers in the parking lot area. The health care facility is also responsible for denoting a special parking area for the BMA truck to park when collecting the waste. This is where the BMA collection role begins. BMA has divided the city of Bangkok and its environs into three geographical sections. From these three sections, BMA has stated that it collects from 581 facilities as of July 1994. This data needs to be updated; after we analyzed the number of sites visited on a daily basis from August 13 and 14, 1994 records from 13 of the 14 collection trucks, we counted only 119 sites. The total amount of infectious waste reported to be collected per day on average, had the opposite result: while BMA reported approximately 8 tonnes per day, we counted just over 10 tonnes on a daily basis using August 13-14 actual data.

Costs

Currently, BMA provides fourteen specialized trucks designed specifically for the transport of infectious waste. All of the trucks were purchased in 1990 and 1991. We assume that they all have seven-year useable lives despite some claims that seven years may overstate their useful lives. The operating costs for these vehicles and other collection requirements include: salary and welfare, 'sola' truck fuel, brake and machine oil, boot shoes, gloves, and disinfectant solution, which the drivers must use on the trucks after each day of usage. Periodic maintenance for all scenarios are assumed either covered by manufacturer's warrantee or are completed by BMA personnel.

According to our analysis, which projects costs if BMA were to collect infectious waste for the next 10 years, the unit cost to collect infectious waste is 0.88 Baht per kg collected.

B. Disposal

BMA currently disposes its infectious waste in either of the old 4.4 tonne furnaces at On-Nut or Nong-Khaem, depending on from which of the three geographical sections of Bangkok that the infectious waste originates. For our analysis, we assume that the new, two 10-tonne incinerators at On-Nut will come on line immediately, and will be used for all future disposal of infectious waste. Since all of the 10 payments have already been made on the new incinerators, we treat the incinerators as a sunk cost which is not included in our analysis.

This is also true of the cost of the sanitary landfill, which already exists outside of Bangkok, and will receive the ash residue from the incinerator. This sanitary landfill is an area which will require future costs from the regular solid waste budget in the future because of the public outcry concerning the current location and performance of the landfill. In addition, we project that at the end of the year 2001, BMA will need another 10-tonne incinerator, the cost of which we also did not include in our analysis.

Costs

It was stated by BMA that 17 people will be trained to operate the new incinerators. While these training costs were also included in the sunk cost of the incinerators, we must include the future salary and wage expense for these people. Other disposal related costs include the operating items for the incinerator; gas, electricity, water, Sodium Hydroxide and scrubber surficant, as well as incinerator spare parts; gas burners, pump and motors, capacity meters, chemical dosing pumps, thermocouples, and spray nozzles.

According to our analysis, which projects costs if BMA were to dispose of infectious waste for the next 10 years, the unit cost to dispose of infectious waste is 13.06 Baht per kg disposed by the new incinerators. As a result, the total cost per kg collected and disposed if BMA were to continue is projected to be 13.94 Baht/kg.

C. Revenues

BMA does charge a fee to remove the infectious waste; it is the same fee structure charged for household waste. BMA has not been allowed to raise this fee for 20 years, although they told us that they have requested an increase various times. Although BMA is required by law to continue to collect even if the hospitals do not pay, we are told that most pay the fee because:

- The fee is low.
- The fee is collected by personnel unassociated with the physical collection. (Household waste disposal payments are made directly to the vehicle drivers, who often pocket the money.)

BMA revenues from these low fees are far below the costs which we calculated. For example, a typical fee would be 4 Baht per month if up to 20 liters per day were collected. Depending on the density of the waste, this comes to approximately .01 Baht per kg of revenue for every 13.94 Baht per kg of expense. The difference is the amount that is coming out of the Department of Public Cleansing's solid waste budget.

153

III. Collection and Disposal of Medical Waste if Privatized

The actual cost of a private contract to perform collection and disposal of infectious waste can only be estimated, since it will ultimately be determined by the competitive bidding process. We estimated a private bidder's proposed rate based on what it would cost the private company to perform the service plus a profit margin. As a result, we have attempted herein to estimate the contract by determining costs for a private company to perform the service, and then have added a 20% gross profit margin to these costs to come up with an estimate cost to BMA or the hospitals (or a combination) for this contract. The results show that although the private company can perform the service at only slightly lower unit costs (per kg of infectious waste) than can BMA, the private company will have the capability and resources to collect and dispose of more units of waste than BMA, which, in addition to keeping costs down, is also a primary goal of the Department of Public Cleansing.

A. Collection

We have assumed that the infectious waste separation will continue to be done by hospital staff, at no charge to the private contractor. The amount of waste collected, however, should be much higher as explained in the costs section below.

Costs

Based on industry norms, we estimate that the private company would expand the infectious waste trucking fleet faster than would BMA. Also, we estimate that they would only use two people per truck, instead of the three that BMA sometimes uses. We also estimate that the private company would design a more efficient truck routing plan, which maximizes waste collection and kilometers per liter. For these three reasons, the private sector will be able to collect more waste than BMA. The trucks will also have to be replaced every seven years. The operating costs for these vehicles and other collection requirements include: salary and welfare, 'sola' truck fuel, brake and machine oil, boot shoes, gloves, and disinfectant solution, which the drivers must use on the trucks after each day of usage.

According to our analysis, which projects costs if the private company were to collect infectious waste for the next 10 years, the unit cost to collect infectious waste is 0.78 Baht per kg collected. This is 11.4% lower than the cost we estimated for BMA to collect. Once we add the 20% profit, however, the private cost to collect becomes 5.7% higher than BMA's.

B. Disposal

BMA currently disposes of its infectious waste to either of the old 4.4 tonne furnaces at On-Nut or Nong-Khaem depending on from which of the three geographical sections of Bangkok

that the infectious waste originates. For our analysis, we assume that the new, two 10-tonne incinerators at On-Nut will come on line now, and will be used for all future disposal of infectious waste by the private contractor. Since all of the 10 payments have already been made on the new incinerators by BMA, we treat the incinerators as a sunk cost which is not included in our analysis. This is also true of the cost of the sanitary landfill, which already exists outside of Bangkok, and will receive the ash residue from the incinerator. This sanitary landfill is an area which will require future costs, whose source has not yet been determined or included in our analysis. In addition, we project that at the end of the years 1998 and 2002, the private company will need another 10-tonne incinerator, the cost of which we also did not include in our analysis.

Costs

BMA stated that 17 people will be trained to operate the new incinerators. We have assumed that the private company will be able to reduce the number of supervisory personnel at the new incinerators because of their experience in operating similar facilities. The salary and wage expense for these people is included in our analysis. Other disposal related costs include the operating items for the incinerator; gas, electricity, water, Sodium Hydroxide and scrubber surficant, as well as incinerator spare parts; gas burners, pump and motors, capacity meters, chemical dosing pumps, thermocouples, and spray nozzles.

According to our analysis, which projects costs if the private company were to dispose of infectious waste for the next 10 years, the unit cost to dispose infectious waste is 12.73 Baht per kg. This is 2.5% lower than the cost we estimated for BMA to dispose. Once we add the 20% profit however, the private cost to dispose becomes 17% higher than BMA's.

As a result, the total cost per kg collected and disposed by the private company is projected to be 13.51 Baht/kg. This is 3.1% lower than BMA's total unit cost. Once we add in the profit margin, however, the private company's total unit cost becomes 16.3% higher than BMA's.

C. Revenues

The private company would likely price its contract based on the cost to perform the service plus a certain profit margin, as discussed above. BMA must determine how the fees will be paid: it could pay these fees out of the solid waste budget, since there is no separate infectious waste budget it, thus giving the hospitals this service for free. It could let the hospitals pay these fees in full, or in part with BMA paying some or none. It must then be decided as to whether BMA allows the hospitals to pay the contractor directly or through BMA. BMA could also charge the private hospitals more per unit, so as to subsidize the cost for public health care institutions. Regardless of the structure, a revenue source must be found to pay for the service.

155

IV. BMA's Service Options

In the previous two sections, we have discussed the estimated costs and revenues of the medical waste system if BMA maintains control of the system compared to a privatized system. This section discusses BMA's options for implementing changes in the medical waste field. The three options discussed are:

- BMA continues to perform the service
- BMA issues an Invitation to Bid (IFB) to private firms
- BMA issues a Request for Proposal to private firms

Each of the options are discussed in turn below.

A. BMA Continues to Perform the Service

This option would have BMA continue to perform the service of collecting and disposing of medical waste. BMA would use existing staff with the possible help of outside consultants to improve certain functions such as route planning and marketing. Even if BMA were to choose this approach, several issues would require resolution because of the many problems associated with the current system; this option does not imply maintaining the status quo. These issues are:

- *Setting the definition of medical waste.* Currently, since there is no definition of medical waste, BMA cannot possibly define the scope of the service it is expected to perform. As a first step, BMA must understand what types of waste it is seeking to collect and dispose. The potential for later alterations in the definition should not prevent setting an initial definition as soon as possible.

- *Determining the sources of medical waste.* As mentioned earlier in this report, once the definition of medical waste is determined, BMA must determine all of the sources of such waste. Knowing the sources of waste is vital for efficient operation of the service.

- *Defining the service parameters and costs.* The service parameters include the types of medical waste to be disposed, the interval between pickups, etc. Before developing an efficient operating plan, BMA must define all of the service elements to be provided. Once the above three items are completed, BMA must develop as efficient an operating plan as possible for the service.

- *Identify capital equipment replacement schedules and sources of funds.* Proper long-term financial planning requires planning for replacement of capital equipment. Such planning must include a source of the funds that will be used to pay for the capital replacement.

- *Engage in an operational review of the service.* An operational review should include a review of the general and administrative procedures as well as a review of the procedures used to collect the waste. The object of the review would be to increase the efficiency in the administrative and collection systems.

- *Develop an effective marketing system.* Currently, many potential users of the service do not utilize BMA for disposing of medical waste. This causes three problems:
  - Some of the waste is being disposed of unsafely
  - Potential revenues are not being collected
  - Average cost reductions due to economies of scale are not being attained

  It is therefore imperative that BMA establish a marketing program to market the service and ensure that all potential customers are using the service.

- *Develop a cost recovery system for the service.* The cost recovery system should, at the least, recover all of the costs associated with providing the service, including allocated capital costs.

This option will be very difficult for BMA to implement efficiently. Currently, there are no national systems in place for disposing of medical waste. Therefore, there are no local staff trained in that field. Hiring consultants would help in training local staff, but consultants would not be able to remain with a new program long enough to make it viable and cost effective over the long haul. In addition, BMA staff are inexperienced in many of the issues listed above, such as marketing, pricing, and optimal routing. Therefore, this option is the least likely to produce a successful long-term program.

B. BMA Issues an Invitation for Bid to Private Firms

An Invitation for Bid (IFB) is designed to find a private sector company which will provide the service under strict guidelines set up by BMA. The IFB establishes specific operating and other criteria to which the private bidders must adhere. For example, the IFB may include specifications on the routes, the prices to be charged, the frequency of service, which party will be responsible for capital improvements, etc.

Each of the responses to the IFB are evaluated based on pre-determined criteria. Since all of the bidders will be bidding based on the same basic operating plan, the criteria should stress experience and price considerations. Any of the criteria can be given more weight based on the priorities of BMA. For transparency, it is vital that the criteria and the weights are determined prior to the receipt of the bids, and preferably that they be outlined directly in the IFB.

This method would be effective in bringing a group of experienced contractors to operate the service. After the initial contract period, BMA can elect either to perform the work themselves (based on the system established by the contractor), to continue to contract, or to rebid the work.

There are a number of key issues that need resolution if this option is used, including:

- *Definition of the service.* As with all of the options, BMA must define the service it wants performed, including the definition of medical waste and the frequency and scope of waste collection and disposal.

- *Appropriate legal framework.* Is there an existing legal framework which allows BMA to enter into a contract with the private sector based on an IFB format? Risk mitigation is very important to the private sector when they enter into such agreements; the less risk they perceive in a project, the better the price BMA will receive in response to its solicitation. This is one risk BMA can mitigate, preferably by passing legislation specifically granting BMA the explicit right to enter into such contracts with the private sector.

- *Length of the contract.* The private contractor must be granted sufficient time to amortize his/her capital investment in the project and to earn a reasonable rate of return. Given the nature of the current service, if the private sector were to fund the necessary capital improvements, the private sector would likely require a minimum of five to seven years of operations. The proper length of the contract is dependent, in part, on the type of public-private partnership chosen; these options are discussed later in this chapter.

- *Price regulation.* This will be the most important issue to resolve prior to soliciting the private sector. BMA must decide what price the private sector will be allowed to charge for the service for the entire life of the contract. Choices for regulation include capping prices or limiting the rate of return. In addition, BMA must decide how much, if any, it is willing to subsidize the price faced by the user.

- *Billing and collection responsibility.* This will be another important issue for the private sector. BMA must decide whether it will choose to bill and collect from the service users itself or have the private operator responsible for billing and collections.

- *Contract monitoring.* BMA will be required to monitor compliance with the provisions of the contract. If BMA does not currently have staff designated to monitoring contracts, some staff must be assigned that responsibility.

158

In addition to the above items, BMA must decide which type of public-private partnership it desires. There are many options from which to choose including:

- *Operations and maintenance contract.* This arrangement would have BMA contract to a private firm to provide the service only. BMA would retain the "license" to provide the service, ownership of the assets, and therefore the responsibility to pay for all capital improvements.

- *Lease-Develop-Operate.* In this arrangement, BMA would lease to the private sector the ability to operate the service and the assets it currently owns, but BMA would maintain ownership of the assets. The private contractor would agree to make all necessary capital improvements during the lease period, in exchange for a fee which would cover costs plus a profit. Leases differ from O&M contracts in that all capital improvements are the responsibility of the private sector. At the end of the lease period, all assets, including any improvements, would be turned over to BMA.

- *Temporary or permanent privatization.* In this arrangement, BMA would sell its assets and the right to provide the service to the private sector. Although in private hands, the service can be regulated, similar to the regulation faced by public utilities.

Because of the increased fiscal responsibility of the latter two options, either the price paid for the service will be higher or the length of the contract will be longer than the O&M contract option. For a similar reason, the temporary privatization option may require a longer contract than the lease-develop-operate option.

Regardless of the options chosen, the key to the success of the IFB option is the amount of detail of the IFB document. The IFB should detail all of the contractor's requirements, including specific details on the constraints that the private sector will be required to work within.

If the IFB document is designed well, the private sector will be competing largely on cost and experience, in addition to the responsiveness to the specifications in the IFB document. In addition, a detailed IFB should significantly reduce the negotiation time between establishing a winner of the bidding process and the final contract, because the IFB should anticipate the potential contract issues and establish the contract provision in its terms of reference. There are a number of drawbacks to using this method. By detailing many of the operational specifications of the project, BMA may prevent the private sector from using innovative cost cutting or revenue enhancing measures. This technique is often best used for operations for which efficiency gains are not a priority. Thus, it may not be best option for this case.

Other drawbacks relate to the monitoring contract performance and payment issues. Without resolution of these issues to the satisfaction of the private sector, the proposed bid prices may be significantly higher than they would otherwise be. In addition, BMA may have to retrain some of its employees on how implement BMA's new monitoring function.

C. BMA Issues a Request for Proposal to Private Firms

A Request for Proposal (RFP) process is similar to the IFB process listed in Section IV.B above. In both cases, BMA would attempt to solicit private sector involvement in order to operate the collection, disposal, and/or billing of medical waste. In both cases, BMA would evaluate the responses to the solicitation based on criteria determined prior to the process, and preferably written into the solicitation document. BMA would then contract with the winner of the proposal process.

The major difference between the two methods is the specifications detailed in the two documents. While the IFB provides for detailed specifications in order to constrain the bidders, the RFP attempts to allow the bidders latitude in proposing procedures such as frequency of collection, time of collection, type of payment, etc. By allowing the bidders to propose the specifics of the operating procedures, BMA may gain from innovative methods for providing the service efficiently that it may not have previously contemplated.

This method does not necessarily allow the private bidder to propose all aspects of service. For example, BMA should still be prepared to define a minimum standard definition for infectious waste. BMA also may propose a contract length, minimum service collection periods, and environmental regulations on the contractor. In designing the RFP, BMA should remember, however, that the purpose of the RFP is to allow the contractor the ability to provide innovative solutions to problems; the more specifications that are in the document, the fewer efficiency gains the private sector will devise. The specifications set forth in the RFP should be minimum guidelines only. Additional benefits can be attained during the negotiation process prior to contract execution.

Other than the detail in the specifications, the issues that relate to the RFP process are the same as those that relate to the IFB process. For example, BMA must still determine the definition of medical waste, if it has the legal authority to enter into a contract with a private bidder, whether the legal framework is conducive to private involvement, who will have responsibility for billing and collections, and how much to subsidize the service, if at all. These issues must be resolved before the private sector gets involved in the project.

V. Conclusions and Recommendations

Regardless of BMA's choice for providing the service in the future, BMA must tackle certain issues, the most important of which are:

- *The definition of medical waste.* This is the first step required in any of BMA's options. Without defining the market for medical waste, it will be impossible to provide an efficient service, protect the environment, and to test performance. One option is for BMA to request the Ministry of Public Health to specify a uniform, country-wide definition.

- *The sources of medical waste.* Currently, there is no centralized knowledge of the sources of medical waste in Bangkok. While the private sector may be able to increase the exposure of a program after taking over operations, BMA will not be able to properly assess the contractor's performance without a knowledge of the sources of medical waste.

- *The amount BMA is willing to subsidize the service.* Waste collection and disposal rates currently do not cover all operating and capital costs required to maintain the service. Therefore, regardless of whether BMA retains operation of the service or contracts it to a private firm, BMA must decide how much of the cost of collection and disposal it is willing to take, and how much should be paid by the users of the service.

  If BMA were to choose one of the latter two options, the private contractor could be paid its contract price completely by hospitals serviced. This structure would eliminate the need for BMA to budget funds for this activity. (An automated fee collection system would allow the contractor to easily bill the hospitals directly.) The downside of this is that some hospitals will likely attempt to pass the extra cost onto patients, which would raise health care costs. Others may refuse to pay the fee. There must be a means for the private contractor or another entity to enforce compliance with the agreed upon fee.

  Depending on the competition during the bidding process, it is even possible that BMA could actually receive a portion of the fees charged in the form of a royalty payment from the private contractor as part of a concession agreement for the rights to collect fees for performing this service. The exact structure of this payment would of course be finalized through the RFP process, as described in the next section.

- *Legal constraints.* BMA must amend certain laws which constrain the ability to provide the service effectively. For example, BMA should be allowed to levy penalties to those who fail to pay the agreed upon fee for either collection or disposal. In addition, BMA should allow the private sector to provide the service directly. If BMA chooses not to

allow the private sector to collect for the service, it should contract with the private sector to set up an automated billing system for them.

We believe that BMA's best option is to engage in an RFP process in order to solicit a private sector operator for the service. The private sector will provide the following benefits over the option of having BMA maintain responsibility for providing the service:

- A private contractor will collect more of the waste, thereby reducing the amount of dangerous waste in the regular solid waste stream. In addition, the private sector may dispose of the waste in a cleaner manner. This will improve health risks to collection and disposal workers, the general public, and hospital employees and patients.

- BMA will incur fewer costs. Although the estimated private sector-cost to provide the service was only slightly less (and actually a bit more when the profit margin is included) than the cost faced by BMA, the fee could be paid directly by the hospitals, instead of BMA. In addition, BMA would no longer have to tie up its own resources to perform the service, which would free funds to conduct other important BMA functions.

- BMA can shift all of the revenue risks to the private sector. No longer will BMA need to worry about the revenue and cost risks of conducting this service.

- Future private sector costs may be even lower. Because we included the capital cost for the new incinerators as a sunk cost, any efficiencies brought about by the private sector in replacing those incinerators in the future would reduce costs in the future.

Out of the two solicitation choices, we believe that the RFP process has more benefits in this case compared to the IFB process. Because of a number of factors, such as the lack of definition for medical waste and the lack of knowledge of the potential users, significant changes in the medical waste collection and disposal system will occur in the future. Since change is desirable, it is also desirable to allow the private sector to generate ideas as to the best way to change the system. An IFB may be too restrictive to allow for all of the positive private sector ideas. Thus, BMA should issue an RFP, which should include a list of BMA's minimum requirements for the contractor.

We also recommend that BMA choose between the latter two privatization options: the Lease-Develop-Operate option or the full privatization option. While certain efficiencies in operations can be attained though an O&M contract, an O&M contract would not give the private sector maximum incentives to increase efficiency in all parts of the operation (procurement, for example). The remaining public-private partnership options should allow BMA to attain the best possible service and price.

VI. Appendix

Table 1 - Collection Analysis: BMA vs private company

Table 2 - Disposal Analysis: BMA vs private company

Table 3 - Projection of Private Company Fees

Table 4 - Projection of BMA's Estimated Costs

164

If BMA should decide not to privatize now or in the future, it should, at a minimum, update its billing system, including its rates, to reflect the actual cost of providing service. By allowing rates to reflect costs, BMA will avoid spending money on a service which can be spent on other solid waste activities.

163

Table 1

THAILAND INFECTIOUS WASTE ANALYSIS
Collection of Infectious Waste by BMA

There are currently 14 collection trucks in use
Each truck has either 1,2 or 3 personnel
Bangkok is divided into 3 geographical sections:
Drivers collect 7 days per week, from approx. 6am-10am.

	HISTORICAL DATA FY1994				PROJECTIONS if BMA Continues to Collect and Dispose of Infectious Waste									
	Section I	Section II	Section III	Total/Avg	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
a) # Trucks	5	5	4	14	15	16	17	18	19	20	21	22	23	24
b) # Personnel	13	11	8	32	34.5	37.0	39.5	42.0	44.5	47.0	49.5	52.0	54.5	57.0
c) Avg # Personnel per Truc	2.6	2.2	2.0	2.29	2.30	2.31	2.32	2.33	2.34	2.35	2.36	2.36	2.37	2.38
d) Avg # Sites Visited per Truck per Day	5.2	7.3	16.0	9.15										
e) Avg # km Driven per Tru per Day	45.8	62.8	76.0	60.31	63.31	66.31	69.31	72.31	75.31	78.31	81.31	84.31	87.31	90.31
f) Avg # kg of Infectious W Collected per Truck per	734.0	1097.5	394.8	741.46	761.46	781.46	801.46	821.46	841.46	861.46	881.46	901.46	921.46	941.46
g) Total # tonnes of Infectio Waste Collected per Day	3.7	5.5	1.6	10.38	11.42	12.50	13.62	14.79	15.99	17.23	18.51	19.83	21.19	22.60
h) Avg # liters gas Consume per Truck per Day	8.6	17.3	-na-	12.44	12.55	12.64	12.73	12.81	12.88	12.95	13.02	13.08	13.14	13.19
i) Avg # km driven/liter gas	5.3	3.6	-na-	4.85	5.05	5.25	5.45	5.65	5.85	6.05	6.25	6.45	6.65	6.85

Historical Data Notes:

* This is based on data from trucks' routes on either August 13 or 14, 1994.
* Not all of the trucks had data available, ie. avg in table above includes 5 of the 5 Section I trucks, 4 of the 5 Section II trucks, and 4 of the 4 Section III trucks.
* # of Sites Visited includes all health care facilities, but not to On-Nut/Nong-Khaem.
* 1,000 kg = 1 tonne

Projected Data Assumptions:

* Will add 2-3 people per additional truck in the future (avg 2.5).
* Will add and replace trucks at a rate so as to increase total # trucks in service by avg of 1 per year.
* Will increase avg km driven per truck at rate of 3km/year.
* Will increase avg kg waste collected per truck at rate of 20 kg/year.
* Will get better gas mileage (due to road improvements) at rate of .2 liters/km per year.

THAILAND INFECTIOUS WASTE ANALYSIS
Collection of Infectious Waste by Private Company

	PROJECTIONS if Private Company were to Collect and Dispose of Infectious Waste									
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
a) # Trucks	16	18	20	22	24	26	28	30	32	34
b) # Personnel	36	40	44	48	52	56	60	64	68	72
c) Avg # Personnel per Truck	2.25	2.22	2.20	2.18	2.17	2.15	2.14	2.13	2.13	2.12
d) Avg # Sites Visited per Truck per Day										
e) Avg # km Driven per Truck per Day	65.31	70.31	75.31	80.31	85.31	90.31	95.31	100.31	105.31	110.31
f) Avg # kg of Infectious Waste Collected per Truck per Day	781.46	821.46	861.46	901.46	941.46	981.46	1,021.46	1,061.46	1,101.46	1,141.46
g) Total # tonnes of Infectious Waste Collected per Day	12.50	14.79	17.23	19.83	22.60	25.52	28.60	31.84	35.25	38.81
h) Avg # liters gas Consumed per Truck per Day	12.57	12.68	12.77	12.86	12.93	13.00	13.06	13.12	13.17	13.22
i) Avg # km driven/liter gas	5.20	5.55	5.90	6.25	6.60	6.95	7.30	7.65	8.00	8.35

Projected Data Assumptions for Private Company Operation: More Efficient

* Will add only 2 people per additional truck in the future (more efficient)
* Will add and replace trucks at a rate so as to increase total # trucks in service by avg of 2 per year (have funds to do so, and waste demand exists)
* Will increase avg km driven per truck at rate of 5km/year (expanded truck routing).
* Will increase avg kg waste collected per truck at rate of 40 kg/year (more waste identified).
* Will get better gas mileage (due to road improvements and better routing) at rate of .35 liters/km per year.

Table 2

THAILAND INFECTIOUS WASTE ANALYSIS
Disposal of Infectious Waste by BMA

There are currently 2 furnaces in use, 1 at Or-Nut and 1 at Nong-Khaem
Very shortly, the 2 new incinerators at Or-Nut will be in use, to replace the two aforementioned furnaces.
These will handle all the infectious waste in the future, and for this analysis
This analysis considers only these incinerators, and treats their purchase as a sunk cost

PROJECTIONS if BMA Operates New Incinerators

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
a) # Personnel	17	17	17	19	19	21	21	23	23	23
Consumables:										
b) Gas Consumption (liters/day)	17,132.9	18,755.1	20,437.3	22,179.5	23,981.7	25,843.8	27,766.0	29,748.2	31,790.4	33,892.6
c) Electricity Consumption (units/day)	1,202.3	1,316.1	1,434.2	1,556.5	1,682.9	1,813.6	1,948.5	2,087.6	2,230.9	2,378.4
d) Water Consumption (m3/day)	45.1	49.4	53.8	58.4	63.1	68.0	73.1	78.3	83.7	89.2
e) Sodium Hydroxide NAHO 50% (liters/day)	108.2	118.5	129.1	140.1	151.5	163.2	175.4	187.9	200.8	214.1
f) Scrubber Surficant (kg/day)	3.0	3.3	3.6	3.9	4.2	4.5	4.9	5.2	5.6	5.9
Spares per Year:										
g) Gas Burner (# units)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
h) Pump & Motor (# units)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
i) Capacity Meters (# lots)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
j) Chemical Dosing Pump (# lots)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
k) Thermocouples (# units)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
l) Spray Nozzles (# units)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0

Projected Data Assumptions:

* Above analysis is for the two incinerators combined.
* Gas, Electricity, Water, Chemicals and other consumables are assumed to be consumed according to tonnages projected from our infectious waste collection analysis on the previous page. The base amount of consumption of these items was learned from the Scholler operating cost information sheet based on last year's 7.6 tonnes per day consumed. We assumed that all of these consumables vary directly with tonnes of waste disposed.
* Incinerators are assumed to burn infectious waste based on 20-hour day, but chemicals are consumed based on 24-hour day.

THAILAND INFECTIOUS WASTE ANALYSIS
Disposal of Infectious Waste by Private Company

PROJECTIONS if Private Company Operates New Incinerators

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
a) # Personnel	7	7	7	9	9	11	11	13	13	13
Consumables:										
b) Gas Consumption (liters/day)	18,755.1	22,179.5	25,843.8	29,748.2	33,892.6	38,277.0	42,901.4	47,765.8	52,870.2	58,214.5
c) Electricity Consumption (units/day)	1,316.1	1,556.5	1,813.6	2,087.6	2,378.4	2,686.1	3,010.6	3,352.0	3,710.2	4,085.2
d) Water Consumption (m3/day)	49.4	58.4	68.0	78.3	89.2	100.7	112.9	125.7	139.1	153.2
e) Sodium Hydroxide NaHO 50% (liters/day)	118.5	140.1	163.2	187.9	214.1	241.7	271.0	301.7	333.9	367.7
f) Scrubber Surficant (kg/day)	3.3	3.9	4.5	5.2	5.9	6.7	7.5	8.4	9.3	10.2
Spares per Year:										
g) Gas Burner (# units)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
h) Pump & Motor (# units)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
i) Capacity Meters (# lots)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
j) Chemical Dosing Pump (# lots)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
k) Thermocouples (# units)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
l) Spray Nozzles (# units)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0

Projected Data Assumptions:

* Above analysis assumes that private company could run incinerator with less personnel, even at higher tonnage per day.

Table 3

THAILAND INFECTIOUS WASTE ANALYSIS
Projection of Private Company Contract Fees to Cover Expenses Plus Profit

All figures in real Thai Baht

Expenses:	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Collection:										
Salary and welfare	2,160,000	2,400,000	2,640,000	2,880,000	3,120,000	3,360,000	3,600,000	3,840,000	4,080,000	4,320,000
Trucks	1,070,000	1,070,000	4,280,000	5,885,000	1,070,000	1,070,000	1,070,000	2,140,000	2,140,000	2,140,000
Sola truck fuel	579,155	657,167	735,687	814,629	893,925	973,523	1,053,379	1,133,457	1,213,728	1,294,168
Machine and break oil	65,896	74,772	83,706	92,688	101,711	110,767	119,853	128,964	138,098	147,250
Truck disenfectant solution	9,920	0	9,920	0	9,920	0	9,920	0	9,920	0
Boot shoes	0	0	7,500	0	0	7,500	0	0	7,500	0
Black gloves	0	47,500	0	0	47,500	0	0	47,500	0	0
Total Collection Expenses:	3,884,971	4,249,440	7,756,813	9,672,317	5,243,056	5,521,790	5,853,152	7,289,921	7,589,246	7,901,419
Collection Fee Calculation:										
1994 Present Value of Expense	3,531,792	3,511,934	5,827,809	6,606,323	3,255,525	3,116,907	3,003,592	3,400,802	3,218,581	3,046,339
1994 PV Sum of Expenses:	38,519,603									
Projected Tonnages:	4,501	5,323	6,203	7,140	8,134	9,186	10,296	11,464	12,689	13,971
Projected kg Waste:	4,501,218	5,323,071	6,202,523	7,139,575	8,134,228	9,186,480	10,296,332	11,463,785	12,688,837	13,971,489
1994 Present Value of kg:	4,092,017	4,399,232	4,660,047	4,876,426	5,050,715	5,185,528	5,283,647	5,347,940	5,381,306	5,386,614
1994 PV Sum of kg:	49,663,472									
PV Expenses/PV kg =	0.78 Baht/kg = marginal fee per kg.									
Add 20% profit before tax:	0.93 Baht/kg = marginal fee per kg.									
Disposal:										
Salary and welfare	840,000	840,000	840,000	1,080,000	1,080,000	1,320,000	1,320,000	1,560,000	1,560,000	1,560,000
Gas	54,014,622	63,876,849	74,430,277	85,674,905	97,610,732	110,237,760	123,555,988	137,565,415	152,266,043	167,657,871
Electricity	1,042,387	1,232,711	1,436,374	1,653,375	1,883,716	2,127,395	2,384,414	2,654,771	2,938,467	3,235,503
Water	88,840	105,061	122,418	140,913	160,544	181,312	203,217	226,259	250,438	275,753
NaHO & surficant	971,316	1,148,663	1,338,439	1,540,645	1,755,281	1,982,346	2,221,840	2,473,764	2,738,117	3,014,900
Gas Burners	660,000	660,000	660,000	660,000	660,000	660,000	660,000	660,000	660,000	660,000
Pump & Motors	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600
Capacity Meters	38,500	38,500	38,500	38,500	38,500	38,500	38,500	38,500	38,500	38,500
Chemical Dosing Pumps	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000
Thermocouples	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000
Spray Nozzles	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200
Total Disposal Expenses:	57,992,464	68,238,584	79,202,808	91,125,138	103,525,573	116,884,113	130,720,759	145,515,510	160,788,366	176,779,327
Disposal Fee Calculation:										
1994 Present Value of Expense	52,720,422	56,395,524	59,506,242	62,239,695	64,281,236	65,978,035	67,080,419	67,884,059	68,189,963	68,156,083
1994 PV Sum of Expenses:	632,431,677									
Projected Tonnages:	4,501	5,323	6,203	7,140	8,134	9,186	10,296	11,464	12,689	13,971
Projected kg Waste:	4,501,218	5,323,071	6,202,523	7,139,575	8,134,228	9,186,480	10,296,332	11,463,785	12,688,837	13,971,489
1994 Present Value of kg:	4,092,017	4,399,232	4,660,047	4,876,426	5,050,715	5,185,528	5,283,647	5,347,940	5,381,306	5,386,614
1994 PV Sum of kg:	49,663,472									
PV Expenses/PV kg =	12.73 Baht/kg = marginal fee per kg.									
Add 20% profit before tax:	15.28 Baht/kg = marginal fee per kg.									

Unit cost for private company to dispose & c	13.51 Baht/kg = marginal fee/kg
Including Profit Margin:	16.21 Baht/kg = marginal fee/kg

According to Ban Chang's 1-page summary, "Medical Waste, Baseline Data, WIN-WIN Situation," comparable figures for the above unit fees include Enviro-Tech through Mr. McCoy at 16 Baht/kg.

Notes:
* The above is a present value, long-run marginal cost analysis
* Discount rate = 10%.
* 360 day per year operation.
* Only personnel in collection trucks and at incinerator; any planning or other personel are not included as part of this analysis.
* No interest cost is included becasue trucks are assumed to be paid for when purchased, and incinerators are already paid off.
* No depreciation expense because trucks are assumed to be purchased in one payment, with O&M costs as separate line item, and new incinerators are already paid for, with spares and O&M as separate line items.
* Trucks must be replaced after 7 years; so must replace the 6 bought in 1990 in 1997, the 9 bought in 1991 in 1998, the 2 bought in 1995 in 2002, the 2 bought in 1996 in 2003, and the 2 bought in 1997 in 2004.
* Private company is projected to need additional 10-tonne incinerator after yrs 1998 and 2001, the cost of which are not included in this analysis, and so some arrangement will need to be made (ie. raise fees in those years, or have BMA buy them).
* Real Baht means contractor must have provision to raise fees in some relation to an inflation index.
* It is not yet decided as to whether contractor could charge this full amount to hospitals and clinics, or whether BMA would pay a portion to contractor so as to lower burden to all/some hospitals and clinics.

Operating Costs per Unit:

Collection:		
* Salary, welfare truck driv	5,000	Baht/month
* 'Sola' for truck fuel	8.0	Baht/liter
* Machine and break oil	25.0	Baht/liter
* Cost per collection truck	535,000	Baht
* Truck disenfectant soluti	9,920	Baht/lot
* Boot shoes for personnel	7,500	Baht/lot
* Black gloves for personn	47,500	Baht/lot
Disposal:		
* Salary incinerator operat	10,000	Baht/month
* Gas for incinerator	8.0	Baht/liter
* Electricity for incinerator	2.2	Baht/unit
* Water for incinerator	5.0	Baht/m3
* NaHO for incinerator	20.0	Baht/liter
* Scrubber surfic. incinerat	100.0	Baht/kg
* Gas Burners	330,000	Baht/unit
* Pump & Motor	76,800	Baht/unit
* Capacity Meters	38,500	Baht/lot
* Chemical Dosing Pump	80,000	Baht/lot
* Thermocouples	10,500	Baht/unit
* Spray Nozzles	2,400	Baht/unit

Table 4

THAILAND INFECTIOUS WASTE ANALYSIS
Projection of BMA's Estimated Costs to Continue to Collect and Dispose of Infectious Waste Themselve

All figures in real Thai Baht

Expenses:	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Collection:										
Salary and welfare	2,070,000	2,220,000	2,370,000	2,520,000	2,670,000	2,820,000	2,970,000	3,120,000	3,270,000	3,420,000
Trucks	535,000	535,000	3,745,000	5,350,000	535,000	535,000	535,000	1,070,000	1,070,000	1,070,000
Sola truck fuel	541,976	582,419	623,064	663,891	704,880	746,015	787,283	828,670	870,167	911,763
Machine and break oil	61,666	66,267	70,892	75,537	80,201	84,881	89,577	94,286	99,007	103,740
Truck disenfectant solution	9,920	0	9,920	0	9,920	0	9,920	0	9,920	0
Boot shoes	0	0	7,500	0	0	7,500	0	0	7,500	0
Black gloves	0	47,500	0	0	47,500	0	0	47,500	0	0
Total Collection Expenses:	3,218,561	3,451,186	6,826,377	8,609,428	4,047,501	4,193,397	4,391,780	5,160,456	5,326,594	5,505,503
Collection Expense Calculation:										
1994 Present Value of Expense	2,925,965	2,852,220	5,128,758	5,880,355	2,513,180	2,367,063	2,253,677	2,407,391	2,258,996	2,122,610
1994 PV Sum of Expenses:	30,710,215									
Projected Tonnages:	4,112	4,501	4,905	5,323	5,756	6,203	6,664	7,140	7,630	8,134
Projected kg Waste:	4,111,892	4,501,218	4,904,945	5,323,071	5,755,597	6,202,523	6,663,849	7,139,575	7,629,702	8,134,228
1994 Present Value of kg:	3,738,084	3,720,015	3,685,157	3,635,729	3,573,773	3,501,163	3,419,608	3,330,665	3,235,738	3,136,097
1994 PV Sum of kg:	34,976,029									
PV Expenses/PV kg =	0.88 Baht/kg = marginal cost per kg.									
Disposal:										
Salary and welfare	2,040,000	2,040,000	2,040,000	2,280,000	2,280,000	2,520,000	2,520,000	2,760,000	2,760,000	2,760,000
Gas	49,342,708	54,014,622	58,859,335	63,876,849	69,067,163	74,430,277	79,966,191	85,674,905	91,556,418	97,610,732
Electricity	952,228	1,042,387	1,135,882	1,232,711	1,332,875	1,436,374	1,543,207	1,653,375	1,766,878	1,883,716
Water	81,156	88,840	96,808	105,061	113,597	122,418	131,523	140,913	150,586	160,544
NaHO & surficant	887,303	971,316	1,058,435	1,148,663	1,241,997	1,338,439	1,437,989	1,540,645	1,646,409	1,755,281
Gas Burners	660,000	660,000	660,000	660,000	660,000	660,000	660,000	660,000	660,000	660,000
Pump & Motors	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600	153,600
Capacity Meters	38,500	38,500	38,500	38,500	38,500	38,500	38,500	38,500	38,500	38,500
Chemical Dosing Pumps	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000
Thermocouples	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000	84,000
Spray Nozzles	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200
Total Disposal Expenses:	54,338,694	59,192,464	64,225,761	69,678,584	75,070,933	80,882,808	86,634,210	92,805,138	98,915,592	105,205,573
Disposal Expense Calculation:										
1994 Present Value of Expense	49,398,813	48,919,392	48,253,765	47,591,410	46,613,143	45,656,237	44,457,048	43,294,282	41,949,867	40,561,303
1994 PV Sum of Expenses:	456,695,259									
Projected Tonnages:	4,112	4,501	4,905	5,323	5,756	6,203	6,664	7,140	7,630	8,134
Projected kg Waste:	4,111,892	4,501,218	4,904,945	5,323,071	5,755,597	6,202,523	6,663,849	7,139,575	7,629,702	8,134,228
1994 Present Value of kg:	3,738,084	3,720,015	3,685,157	3,635,729	3,573,773	3,501,163	3,419,608	3,330,665	3,235,738	3,136,097
1994 PV Sum of kg:	34,976,029									
PV Expenses/PV kg =	13.06 Baht/kg = marginal cost per kg.									

Unit cost for BMA to dispose & collect: 13.94 Baht/kg = marginal fee/kg

Notes:
* The above is a present value, long-run marginal cost analysis
* Discount rate = 10%.
* 360 day per year operation.
* Only personnel in collection trucks and at incinerator; any planning or other personel are not included as part of this analysis.
* No interest cost is included becasue trucks are assumed to be paid for when purchased, and incinerators are already paid off.
* No depreciation expense because trucks are assumed to be purchased in one payment, with O&M costs as separate line item, and new incinerators are already paid for, with spares and O&M as separate line items.
* Trucks must be replaced after 7 years; so must replace the 6 bought in 1990 in 1997, the 9 bought in 1991 in 1998, the 1 bought in 1995 in 2002, the 1 bought in 1996 in 2003, and the 1 bought in 1997 in 2004.
* BMA is projected to need additional 10-tonne incinerator after yr 2002, the cost of which is not included in this analysis, and so some extra money will need to be bdgeted by BMA at that time.
* Real Baht means BMA must have provision to raise fees in some relation to an inflation index, even though they have not been allowed to raise fees for household waste collection (which is the same for infectious waste collection) for the past 20 years.

Operating Costs per Unit:

Collection:		
* Salary, welfare truck driv	5,000	Baht/month
* 'Sola' for truck fuel	8.0	Baht/liter
* Machine and break oil	25.0	Baht/liter
* Cost per collection truck	535,000	Baht
* Truck disenfectant soluti	9,920	Baht/lot
* Boot shoes for personnel	7,500	Baht/lot
* Black gloves for personn	47,500	Baht/lot
Disposal:		
* Salary incinerator operat	10,000	Baht/month
* Gas for incinerator	8.0	Baht/liter
* Electiricity for incinerator	2.2	Baht/unit
* Water for incinerator	5.0	Baht/m3
* NaHO for incinerator	20.0	Baht/liter
* Scrubber surfic. incinerat	100.0	Baht/kg
* Gas Burners	330,000	Baht/unit
* Pump & Motor	76,800	Baht/unit
* Capacity Meters	38,500	Baht/lot
* Chemical Dosing Pump	80,000	Baht/lot
* Thermocouples	10,500	Baht/unit
* Spray Nozzles	2,400	Baht/unit

APPENDIX I

Thailand: Independent Power Producers Conference, Phase II

Trip Report

Independent Power Project Solicitation and Contracting
National Energy Policy Office of Thailand
August 15-23, 1994

The purpose of the assignment was to review, on behalf of the National Energy Policy Office of Thailand (NEPO), a draft independent power project (IPP) Request for Proposals (RFP), accompanying model power purchase agreements (PPA), and grid code. The draft documents had been prepared by Price Waterhouse on behalf of the Electric Authority of Thailand (EGAT). The assignment also included attending a conference for potential bidders in the IPP solicitation. Following the conference, comments on the documents were provided to EGAT, on behalf of NEPO, that addressed the concerns raised by potential bidders. The consultants participated in sessions with EGAT and NEPO to negotiate changes in the documents.

August 15: Met with Dr. Piyasvasti Amranand, Secretary General of NEPO, Dr. Bhasu Bhanich Supapol of NEPO and other NEPO staff for a background briefing and to coordinate the workplan for the week. Reviewed draft RFP, model power purchase agreement and grid code.

August 16: Continued review of the documents and prepared initial comments. Sent initial comments to EGAT in advance of IPP conference.

August 17: Attended IPP conference, and focused on potential bidders reaction to the draft documents.

August 18: Attended second day of IPP conference, again focusing on potential bidder reactions. Modified initial comments on draft documents to incorporate issues raised at the conference sessions. Met with Dr. Piyasvasti, Dr. Bhasu and other NEPO staff to prepare for EGAT meeting on August 19.

August 19: Meeting with EGAT, NEPO and Price Waterhouse to discuss proposed changes in the draft documents to improve RFP response and financeability of projects. Prepared documents summarizing session, the areas of agreement were discussed, those items that remained open for an upcoming EGAT internal working session were clarified, and scheduling for the IPP investors conference was covered.

August 22: Meeting with EGAT, NEPO and Price Waterhouse to continue discussion of changes in draft documents. Prepared document summarizing session and providing draft changes for changes in the solicitation and contract documents.

(1P

August 23, 1994

Trip Report
by
Brian M. Miller
White & Case

Re: Thailand Independent Power Producers (IPP) Conference, 17-18 August 1994

This trip report is prepared pursuant to the Subcontract between Price Waterhouse LLP and White & Case. The Subcontract required the services of Brian Miller for the period 15-19 August 1994 in Bangkok, Thailand to advise and consult with the National Energy Policy Office (NEPO) in connection with the Thailand IPP Conference held on 17-18 August 1994 in Bangkok. The Conference was sponsored jointly by NEPO and the Electricity Generating Authority of Thailand (EGAT).

1. Itinerary and Daily Activities.

The itinerary and activities undertaken by Mr. Miller in connection with the Subcontract are as follows:

Sunday 14 August	Travel from Jakarta, Indonesia to Bangkok, Thailand (6.5 hours)
Monday 15 August	Meet with other NEPO consultants; review and discuss IPP documents at NEPO offices; confer with Dr. Piyasvasti and NEPO staff regarding preliminary conclusions (9.75 hours)
Tuesday 16 August	Review and discuss IPP documents at NEPO offices; confer with Dr. Piyasvasti and NEPO staff; begin preparing written comments on documents (8.0 hours)
Wednesday 17 August	Attend IPP Conference; discuss proceedings with participants; solicit comments from attendees; confer with NEPO staff (10.0 hours)

Thursday 18 August	Attend IPP Conference; discuss proceedings with participants; solicit comments from attendees; prepare memorandum of comments for meeting with EGAT; meet with Dr. Piyasvasti and staff to prepare for meeting with EGAT (12.5 hours)
Friday 19 August	Present comments and lead discussion in meeting between NEPO and EGAT regarding IPP documents and solicitation process; finalize report to NEPO regarding recommendations for IPP program. Travel from Bangkok to Jakarta (14.5 hours)

2. Report of Consulting Services.

The consultation with NEPO focused on a review of the IPP document package that had been prepared by EGAT's advisers, Price Waterhouse, for presentation at the IPP Conference. These documents consist of (1) a preliminary Request for Proposal (RFP) (2) preliminary Model Power Purchase Agreements (PPA) for Coal-fired and for Gas-fired electricity generating plants, and (3) a preliminary Grid Code. These documents were first made available to Mr. Miller at NEPO's offices on Monday, 15 August.

The review focused on the treatment of major risk issues, financiability, and comparison of EGAT's document package to the terms in other IPP programs, particularly in Southeast Asia. Detailed commentary and explanation was provided to NEPO staff regarding the treatment of natural and political force majeure, including change in law, the purpose and appropriate levels of liquidated damages for delay in plant commissioning and for plant performance shortfalls under "take-if-tendered" contracts subject to net dependable capacity availability payment formulae, the grounds for termination of the PPA by the power generator and by EGAT in default and non-default cases, cure rights of lenders, termination buy-out requirements, choice of law and dispute resolution provisions, and the relationship between the tariff structure with its inherent incentives and

disincentives, on the one hand, and the performance requirements under the PPA, on the other hand.

A detailed memorandum of comments was prepared collaboratively by the four advisers and submitted to NEPO in draft on 19 August and in final form on 22 August. A copy of that memorandum, which contains comments on the RFP process and the proposed document package for Thailand's IPP program, is attached hereto.

Brian M. Miller
White & Case

13

To: Dr. Piyavasti Amranand
Secretary General
National Energy Policy Council

From: Jake Delphia, Delphia & Gosselin
Rob Fitzgibbons, Hunton & Williams
John Levett, New England Electric Resources, Inc.
Brian Miller, White & Case

Re: Comments on Draft RFP and Model Documents

Date: August 22, 1994

This document merges comments contained in the two August 19, 1994 documents and replaces those documents. Based on the two meetings with EGAT, we have added specific wording proposals for EGAT's consideration in some areas of the RFP.

We have reviewed the August, 1994 Preliminary Grid Code, Request for Proposals (RFP) and Model Power Purchase Agreements (PPA) and attended the public conference sponsored by EGAT and NEPO. While there are numerous comments that might be made on the documents, we will limit these comments to only the major ones that might influence the final results of the solicitation and contracting process.

Our comments are aimed at the following points:

- Bidders should perceive that the process will be well structured and fair;
- Commercial terms should not be unreasonable so that bidders take the model agreements seriously and submit the lowest practical bids;
- Good potential bidders are not discouraged from bidding by the process;
- Contract negotiation following receipt of bids should be successful.

We recommend the following modifications to the documents to obtain a more favorable outcome from the solicitation process, without harming EGAT's ability to obtain affordable and reliable IPP power.

Request For Proposals

1. It is agreed that the RFP will be issued under the current

approach of broad criteria that have been assigned weights. EGAT and NEPO agree that specific measures of a bidder's response to each of the broad criteria need to be developed prior to receipt of bids. In order to assure bidders that the evaluation methodology will be fair and reasonable, the following should be added to the RFP.

> "EGAT intends to apply consistent price and non-price criteria in the bid evaluation process. The RFP contains information on the weighting of the various factors that EGAT considers most important in evaluating bids. Prior to receipt of bids, EGAT will establish defined measures for determining the degree by which the bid meets each of the price and non-price evaluation criteria. This process will be used by EGAT to rank the bids. EGAT intends to make an initial cut based on that evaluation. More detailed project investigation and contract negotiation will be conducted with projects that continue in the process following the initial cut in order to make the final selections. The decisions as to the defined measures for determining the project ranking, the initial cut analysis and subsequent final selection will be jointly determined by EGAT and NEPO."

2. The RFP appropriately states that EGAT reserves the right to reject any and all bid proposals. However, potential bidders will be concerned about how EGAT will evaluate its own construction plans against the projects they will propose in response to the solicitation. Bidders will want assurances that EGAT will not favor its own projects. The RFP should include an explanation of the relationship between the capacity being solicited and EGAT's own construction program and how project proposals will be compared to EGAT's projects. We suggest the following wording for EGAT's consideration.

> "This solicitation is being conducted pursuant to the "Guidelines for the Purchase of Power from Independent Power Producers" (Guidelines) approved by Cabinet of Thailand on May 31, 1994. To assure fair treatment of the proposals, the evaluation and negotiation will be made by a Joint Committee consisting of EGAT and NEPO chaired by EGAT's General Manager. The amount of IPP capacity solicited, 1000 MW in 1996-2000 and 2800 MW in 2001-2002, has been agreed upon by EGAT and NEPO, and is an integral element of the Guidelines.
>
> It is the intention of EGAT to purchase 3800 MW of IPP power provided that affordable proposals are received according to the evaluation process described in this solicitation. The capacity being solicited represents EGAT's estimated capacity needs through 2002 to be provided by IPP power."

3. Bidders should have confidence in the ability to recover the bid bond under appropriate conditions. We recommend that the following change be made in section 1.8 of the RFP -- "In the event that Bidder withdraws its Proposal during the Validity period, or

the Selected Bidder fails to execute the PPA as submitted in its proposal, EGAT will retain the bid Security ..." The project bid security form should be modified accordingly.

4. The treatment of transmission costs needs to be clarified and made consistent between the RFP and the PPA. We suggest the following wording in the RFP.

> "7.5.1 (3) Connection Costs - Bidders for facilities inside Thailand should not include connection cost (the cost of linking the facility to EGAT's system) in their proposal pricing. For purposes of bid evaluation during the initial cut process, EGAT intends to develop a preliminary estimate of connection costs and any additional modifications to EGAT's system to allow connection of the facility. These costs will be added to the life cycle costs and used when comparing competing bids. Bidders should note that EGAT's transmission expansion plan includes construction of new 500 KV transmission lines from Rayong to Nong Chok and from Tap Sakae to Sai Noi (See Attachment D). The cost of this 500 KV transmission expansion will not be included in the bid evaluation nor as part of the modifications to EGAT's system to allow connection of the IPP facility except in the unlikely event that a particular IPP project would cause ECAT to modify its 500 KV transmission expansion plan. In such case, the bid evaluation would include any increased or decreased cost of 500 KV transmission from ECAT's transmission expansion plan.
>
> Connection facilities, or the cost of the extension and modifications to EGAT's system to allow connection of the facility, outside the bidder's site will normally be designed, constructed and operated by EGAT. For projects that continue in the process following the initial cut, EGAT will conduct more detailed cost and feasibility studies for connection facilities. During the detailed negotiation process, EGAT will inform the bidder of the cost of the extension and modifications to EGAT's system to allow connection of the facility. EGAT may look to the bidder to pay for those costs based on the estimated cost that EGAT provides to the bidder. In such event, the bidder will be entitled to revise its pricing proposal to EGAT to reflect such costs.
>
> Bidders may, at their option, request that EGAT begin its preliminary estimate of connection cost in advance of receipt of the bid. In such event, the request should be accompanied by a payment of 50% of the bid evaluation fee for the facility. EGAT will use its best efforts to provide connection cost information in a timely manner. EGAT reserves the right to deny any such request, based on the anticipated time requirements of preparing the estimate or on personnel availability. Alternatively, Bidders may wish to have independent engineering estimates of connection cost performed in advance of their bids."

176

Transmission losses should be considered in some fashion. We recommend considering losses either explicitly in the cost evaluation or in the non-price location factor. The easier of the two to administer would be to include "losses" as one of the items to be covered in the location value measure. "Proximity to load centers" is already included in that measure, and adding losses to the measure would seem to be a practical means to account for this variable.

5. In spite of the importance of dispatchability, there are no threshold requirements to grant EGAT dispatch rights; rather, it is a 2 point scoring factor. If all projects are intended to be dispatchable, dispatchability as an evaluation criteria with a weight of 2 is not strong enough. Also, since most projects are likely to be dispatchable, the evaluation criterion may become irrelevant. If dispatchability is expected of all projects, we recommend that dispatchability becomes a threshold requirement. One means of accomplishing this would be to add 7.5.3 (3) to the RFP.

> "7.5.3 (3) Conventional IPP generation must be flexible to meet the dispatch needs of EGAT. Projects that are not dispatchable by EGAT will be rejected. Dispatchability is also an evaluation criteria that will measure the degree of dispatchability such as number of starts permitted over a period of time, minimum run time, minimum down time, and the level of minimum generator output. The dispatchability characteristics of non-conventional IPP sources will be considered on a case by case basis."

6. The current draft of the model power purchase agreement is very one-sided. Although it may establish a strong negotiation position for EGAT, it invites significant revision in the bid proposal and will require a significant amount of negotiation following project selection. Assigning points for contract modifications will be very subjective and not all elements of the power purchase agreement are equally important to EGAT. During development of the measurement criteria, it would be advisable for EGAT to identify the contractual topics that are of particular importance to application of this evaluation criterion.

7. The text of Section 9.2.4(6) should be revised to clarify that all that is being requested is a description of the funding commitments anticipated and progress to date. It is impossible to finalize funding commitments adequate to bring the project to commercial operation at this stage of the project.

8. The term "renewable energy" in Section 7.5.2 (2) (i) and Attachment A 10 should be changed to "non-conventional". Also, a question has arisen as to the use of refinery residues as an acceptable fuel source for an IPP. NEPO believes that this could be an accepted fuel, distinguished from "fuel oil", which is not acceptable for an IPP. This would be considered a "non-conventional" fuel.

Model Power Purchase Agreement

1. It is recognized that the proposed level of development security is excessive in comparison to similar projects in other countries under comparable circumstances. The most striking hurdle to obtaining reasonable bids in the solicitation process is the level of development security. At time of contract signing, the bidder is required to provide security at levels approaching 20% of the project cost. This security would be lost if the bidder fails to obtain permits. Given the uncertainty of licensing and financing outcomes, this high level of security (roughly 10 times security levels required elsewhere) may cause many potentially good bidders to elect not to participate and would increase the cost of project proposals. We recommend a level of 500 Baht/kw development security.

We suggest the following changes.

Section 13.1 (a) change 3,125 to 500 Baht per kilowatt; delete Section 13.1 (b) and (c).

Section 13.3 Substitute 200 Baht/KW for 1,250 and substitute 300 Baht/KW for 5,000.

2. Liquidated damages for schedule delays in Section 13.2 are out of line. A 30 day delay would cost the bidder 10% of the plant. Damages are not likely be of that magnitude. We recommend a level of 4 Baht/kw/day liquidated damages for schedule delay (roughly the carrying costs of peaking capacity to meet capacity needs).

3. The liquidated damages provision and the amount of the security deposit is designed to protect EGAT from the consequences of not obtaining contracted capacity (based on splitting the cost of replacement open cycle gas-fired capacity). This approach is essentially an attempt to recover consequential damages, which is inconsistent with the contractual provision barring recovery of consequential and indirect damages. This approach to security is also inconsistent with prevailing international standards.

The major element of direct damages due to delay in commercial operation is interest during construction (IDC). In independent power projects, IDC is borne by the IPP rather than EGAT. Accordingly, the power purchase agreement's assessment of liquidated damages subjects the IPP to both IDC and damages payable to EGAT. It will be very expensive and difficult for the IPP to shift this level of damages under the current draft of the power purchase agreement to the construction contractor.

4. There appears to be a double penalty for capacity shortfalls in Section 13.4. There are liquidated damages established at the time of commercial operation to cover the deficiency between Adjusted Contract Capacity and Contract Capacity. The generator sees a lower availability payment due to not meeting his anticipated capacity rating. A second financial penalty is not

necessary.

5. Section 8.2 imposes the risk of change in environmental laws on the developer until the project enters commercial operation. This provision is not workable and is not consistent with international practice. We recommend that the Generator be entitled to additional payment from EGAT for change in environmental law subsequent to execution of the agreement that requires stricter environmental performance (as compared to the levels specified in the RFP). Bidding abuses have be protected against by including objective environmental standards in the RFP that all bidders must design their projects to satisfy. New environmental standards stricter than those specified in the RFP should be viewed as changes in law.

In addition, Section 17 assumes that the project will be modified to accommodate the changes in law and that the tariff will be adjusted to allow recovery of additional costs. It may be advisable to allow EGAT to make a choice as to whether to have the modification made (and pay the adjusted tariff) or to abandon the project with payment of appropriate compensation to the developer. This is particularly true for new environmental requirements that become applicable during the latter years of a power project's life.

6. Similarly, the situation regarding change of law generally needs to be clarified. The definition of "change of law" establishes the operative date for change of law as the commercial operation date rather than the execution date for the contract. The definition also seems to contemplate changes in the Grid Code as a change of law, although it is not clear that a revision to the grid code would be the result "any action by any Governmental Authority." It should be clarified that changes in the Grid Code that adversely impact the bidder would be treated as changes in law.

7. The model power purchase agreement does not reflect the intent expressed at the conference that the developer is only to bear risks for actions within its control. The best example of this are the force majeure clauses. Government force majeure is recognized, but not defined. EGAT's obligations regarding government force majeure are very limited (fifty percent of availability payments for one year).

The force majeure provisions do not adequately address terminations due to force majeure and the compensation that will have to be paid. Does EGAT have the right to terminate for political force majeure that lasts longer than a year? If so, developers will expect the government or EGAT to shoulder the risks associated with government force majeure. Also, how will the uninsured loss due to natural force majeure be divided up between EGAT and the developer? What happens to the developer's security deposit if there is a force majeure termination?

8. Rights upon termination need to be refined and clarified. Lenders' step in rights must be able to be exercised (i.e., no termination before lenders have an opportunity to cure). Thirty days for lenders to exercise their rights is not sufficient. In addition, EGAT appears to have the right under Section 12.4 to take over the project without assuming debt responsibility and without paying the developer anything for its equity interests. At a minimum, EGAT must expect to assume the debt if it elects to take over the project. The impact of termination and EGAT's takeover of the project on the developer's equity interest should depend on the grounds for termination.

9. There are inadequate grounds for termination by the developer. Developers would expect to be able to terminate the agreement for EGAT's bankruptcy, reorganization or privatization (that adversely affects the developers), and nationalization. The power purchase agreement will also have to address compensation to the developer for EGAT's default.

10. It is not clear whether the power purchase agreement becomes effective upon execution or after satisfaction of the conditions precedent. How does financial closing fit into the effectiveness of the agreement? Failure to reach financial closing within a defined period of time should be grounds for termination and it is not realistic to expect the developer to lose its entire security deposit provided it has diligently pursued development of the project.

11. The remedies for breach of contract are not clear. On one hand, the reduction in availability payments would seem to cover damages. On the other hand, Section 3.3.2 states that the generator shall ensure that the Net Output does not fall below Minimum Net Output due to failure of plant and equipment. What is the remedy for default of this obligation other than adjustment of compensation under the tariff formula?

12. Objective standards need to be used to determine whether the plant is ready for interconnection and energizing. It cannot be left to EGAT's sole discretion. In addition, the contract does not address the financial consequences if the developer has completed plant construction on a timely basis, but EGAT is unable to accept power because EGAT has not completed construction of transmission facilities for reasons unrelated to developer's performance under the PPA. If the project is completed and ready for commercial operation, availability payments should be made.

13. Developers will have trouble with the combination of Thai law, Thai arbitration, and Thai forum for dispute resolution. EGAT should consider international rules (UNCITRAL or ICC) and a neutral forum. If adherence of the arbitral body to its role under the power purchase agreements required, that should be provided for in the agreement or in supplemental undertakings.

14. Is fuel minimum payment under Section 7 intended to cover the

full amount of take-or-pay requirements resulting from EGAT dispatch? If not, why not?

15. The agreement should require EGAT to undertake some level of effort to support project permitting and licensing. This could be added to Section 2.2.5.

Model Grid Code

The Grid Code is intended to govern the operation of the power system and, among other things, provide developers assurance that EGAT will dispatch units based on merit and without discrimination against independent power developers. The model grid code addresses this concern by developing rules for system operation. However, there must be an effective enforcement mechanism to ensure that EGAT complies with the grid code.

APPENDIX J

Thailand: Assistance to Bang Saphan Steel Industries

U.S. Agency for International Development

- USAID/Bangkok
- Office of Energy, Environment, and Technology
  Center for Environment
  Bureau for Global Programs, Field Support, and Research

Environmental Management Program Strategy for Bang Saphan Steel Based Industrial Development

January 1995

Prepared by
Energy Technology Innovation Project
Contract No. DHR-5741-C-00-1061-00
Contract No. DHR-5738-C-00-0097-00

Contractor
Bechtel Corporation and Price Waterhouse

Contents

List of Figures

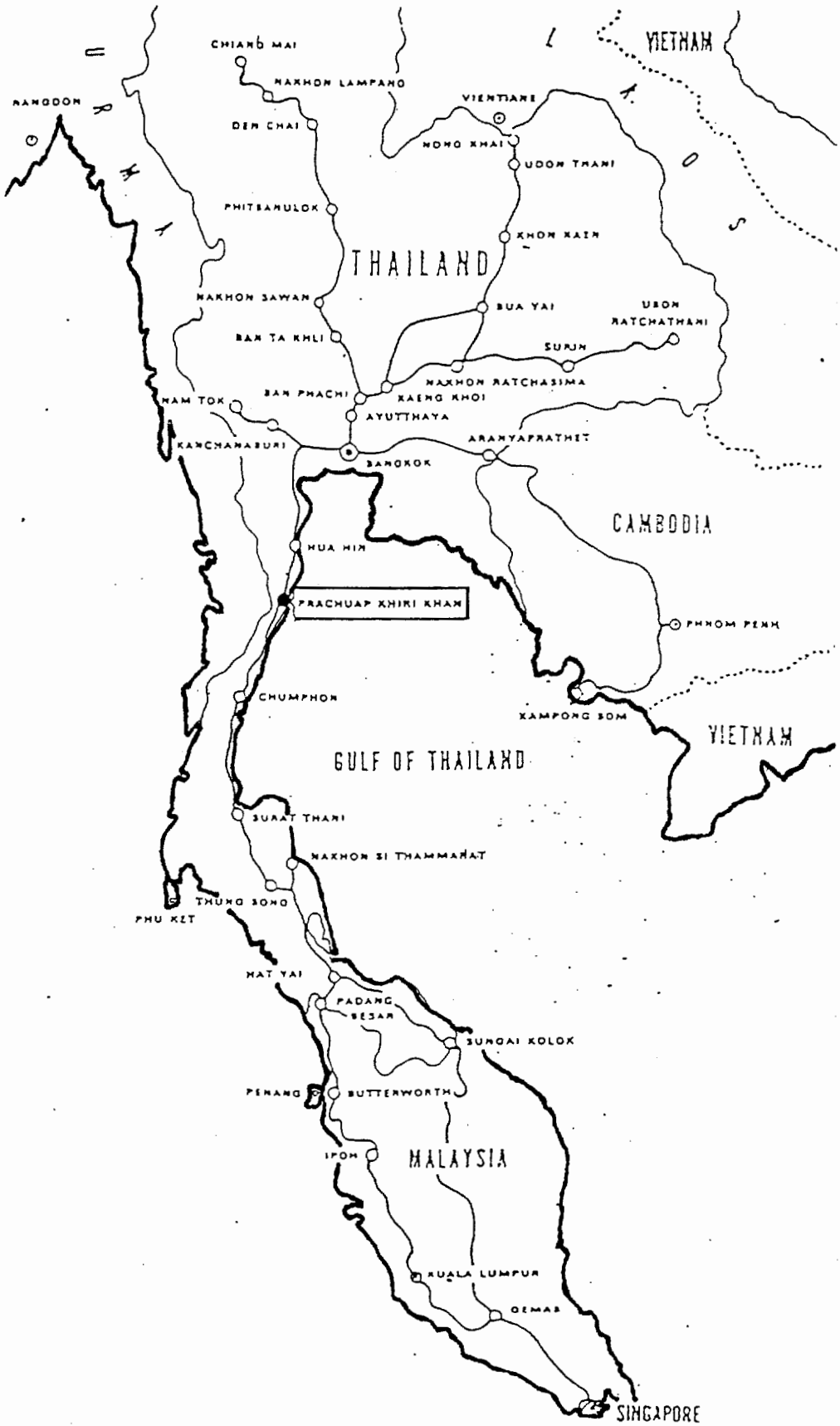


Figure 1
Project Location
Environmental Management Program Strategy

I. Introduction

Sahaviriya Steel Industries Public Company, Ltd., a division of the Sahaviriya Group, has completed the first development phase of a steel industrial complex on Thailand's western seaboard. The site is a 1,750 rai (280 hectare) industrial complex located near Bang Saphan in Prachuab Kirikhan Province (Figure 1).

This strategy paper addresses environmental program management issues related to phases I and II of Sahaviriya Steel industrial complex. Phase I development includes three existing projects: 1) a hot strip mill plant, 2) a steel coating plant, and 3) the Prachaub deep water port. These three projects were constructed within the past two years and are currently in operation. Each project has been the subject of a separate Environmental Impact Assessment (EIA) prepared by in-country technical experts.

Four proposed projects are included in the phase II development: 1) a cold strip mill, 2) a bar mill, 3) an electric arc furnace, and 4) an oil/coal power plant. As required by Thailand's Enhancement and Conservation Environmental Quality Act, separate EIAs will be prepared for each project. Completion of Phase II is anticipated by the year 2000.

This paper has been commissioned by the Office of Energy, Environment, and Technology, Center for Environment, Bureau for Global Programs, Field Support, and Research, U.S. Agency for International Development (USAID) and is intended to provide an initial evaluation of environmental management issues associated with the Sahaviriya's two industrial development phases. Its purpose is to develop an overall strategy for addressing environmental considerations related to this development. This paper includes a discussion of four basic environmental management program elements with identified objectives and general implementation strategies.

Information contained in this strategy paper is based on review of existing technical studies and initial consultation with public agency representatives (listed under References, Section VI), discussions with Sahaviriya staff, and a one-day site visit to the industrial complex.

87

II. Background

In recent years, steel consumption in Thailand has drastically exceeded the domestically-produced steel supply. Other factors including a continuing trade deficit, a regional imbalance of income level, and an over-concentration of industry and population in the Bangkok area also represent national level policy concerns. In response to these problems, government-sponsored studies have recommended that new steel production facilities be constructed in outlying, less developed regions of Thailand.

Beginning in 1978, technical studies that address both iron and steel industrial development and industrial location in Thailand have recommended Bang Saphan as a potential integrated steel complex site. A major advantage of the Bang Saphan location is the availability of a deep water port site.

A. Industrial Estate Authority of Thailand

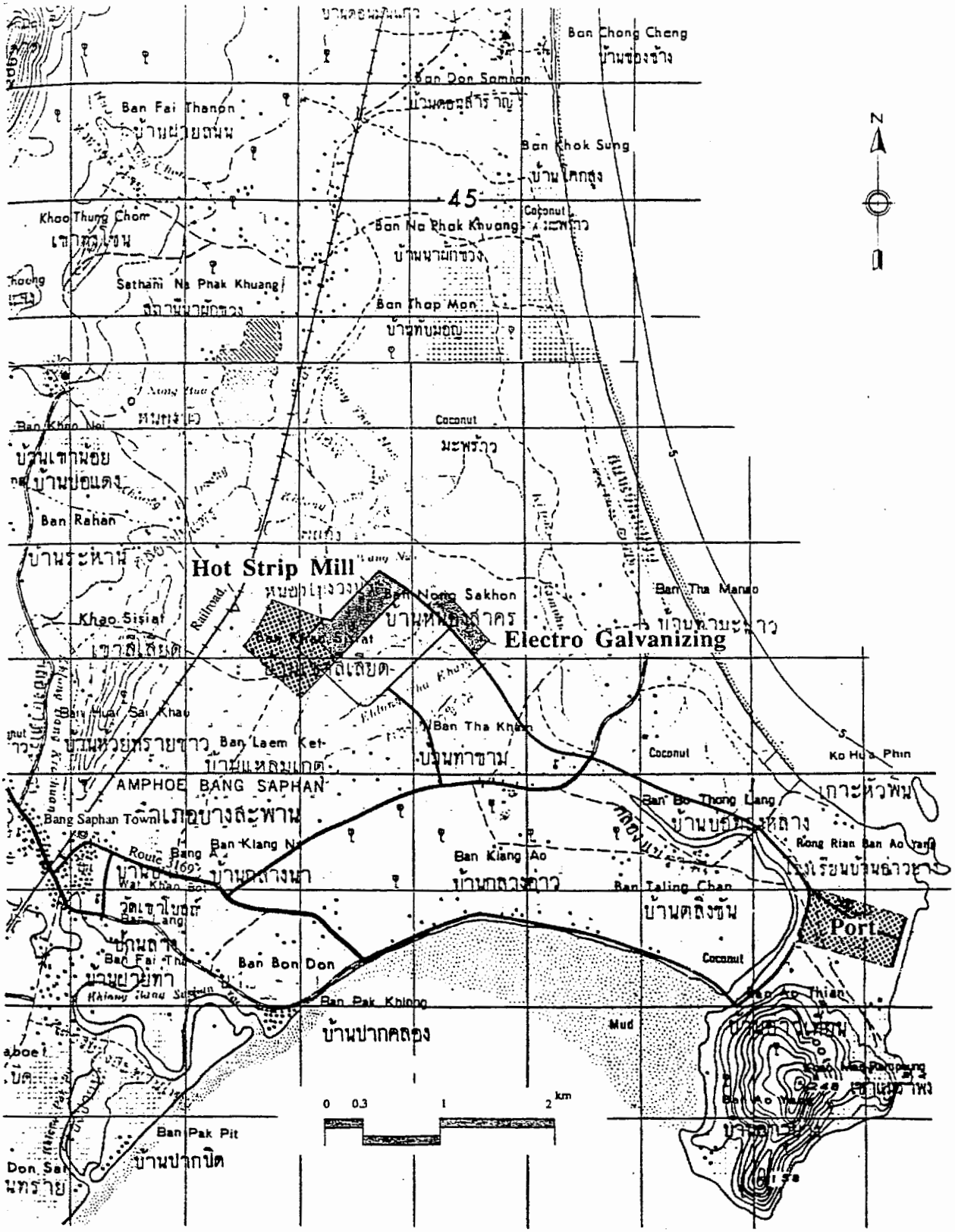
In March 1994 the United Nations Industrial Development Organization (UNIDO) published a conceptual study commissioned by the Industrial Estate Authority of Thailand (IEAT). The study, entitled "Steel Based Industrial Estate in Western Seaboard of Thailand", includes general planning, engineering, economic, and environmental analysis and recommendations for an iron and steel industrial complex in the Bang Saphan area. Sahaviriya's existing steel industry and port development are noted as principal elements of the development plan (Figure 2).

As summarized below, the UNIDO land use plan outlines the development of approximately 20,000 rai (3,200 hectares) by the year 2010. The report proposes two phases for steel industry-related development build out; the first phase includes approximately 4,870 rai or 25% of the total planned development area and its completion is projected for the year 2000. Sahaviriya's two development phases represent approximately 25% of UNIDO's first phase project. The second phase, an additional 15,000 rai, will be built out by the year 2010. Sahaviriya's phase I and II projects represent about 9% of the total development area described in Table 1 and shown on Figure 3.

The UNIDO report contains considerable planning and environmental background information that could prove quite useful to further development planning efforts in the Bang Saphan region. For example, the report identifies environmental issues such as industrial development compatibility with mangrove habitat (discussed in Section B), local fishing communities, and recreation areas (Figure 4).

It should be noted that while the emphasis of the UNIDO's plan is on steel industry-related development, almost 50% of the planned area is designated for new town development and natural resource areas (reserves, rivers, etc.). UNIDO suggests a joint public/private approach to new town (housing) construction.

Primary elements of the UNIDO report's land use development recommendations are outlined on Table 1.



Source: UNIDO, 1994

Figure 2
Sahaviriya's Existing Development
Environmental Management Program Strategy

Table 1. UNIDO Land Use Plan for Bang Saphan Iron & Steel Industrial Complex*

Land Use Type	Size (rai)	(ha)	% of Area
• Port	1,000	160	5.0
• Iron & Steel Industry	2,750	440	13.8
• Coal Fired Power Plant	1,750	280	8.8
• General Industrial Estate	2,440	390	12.2
• Export Processing Zone	1,120	180	5.6
• New Town & Business Park	3,940	630	19.6
• Roads & Utilities	1,500	240	7.5
• Other (natural reserve, river, etc.)	5,500	880	27.5
Total	20,000	3,200	100.0

* UNIDO (1994)

B. Coastal Conservation Plan

A coastal conservation planning study is currently being prepared by natural resource experts at a Bangkok university. Scheduled for completion in December 1994, the plan will include natural resource inventories of the entire industrial complex planning area and will include about 100 kilometers of western seaboard coastline. Figure 5 shows the Coastal Conservation Planning area.

The plan is expected to designate specific development zones for land located between Route 4 and the shoreline, the area in which Sahaviriya's project sites lie. Conditions for development will be stipulated for the three following zones: 1) Conservation, 2) Preservation, and 3) Development.

Previous environmental studies of the industrial complex area have characterized portions of the area as environmentally sensitive coastal marsh land with valuable mangrove swamp habitat. It is likely that the coastal conservation plan will recommend some protection measures for this habitat.

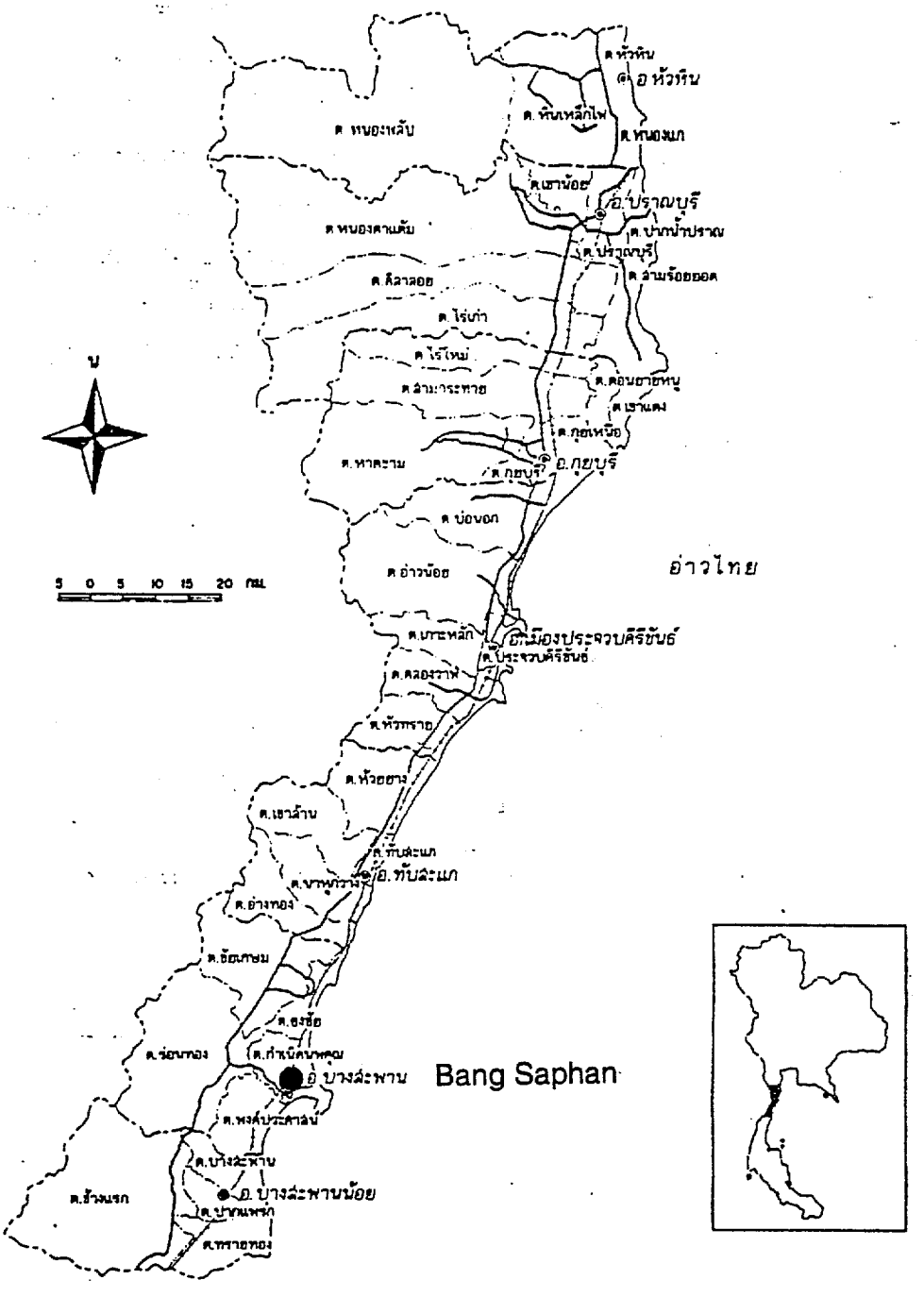


Figure 5
Coastal Management Planning Area
Environmental Management Program Strategy

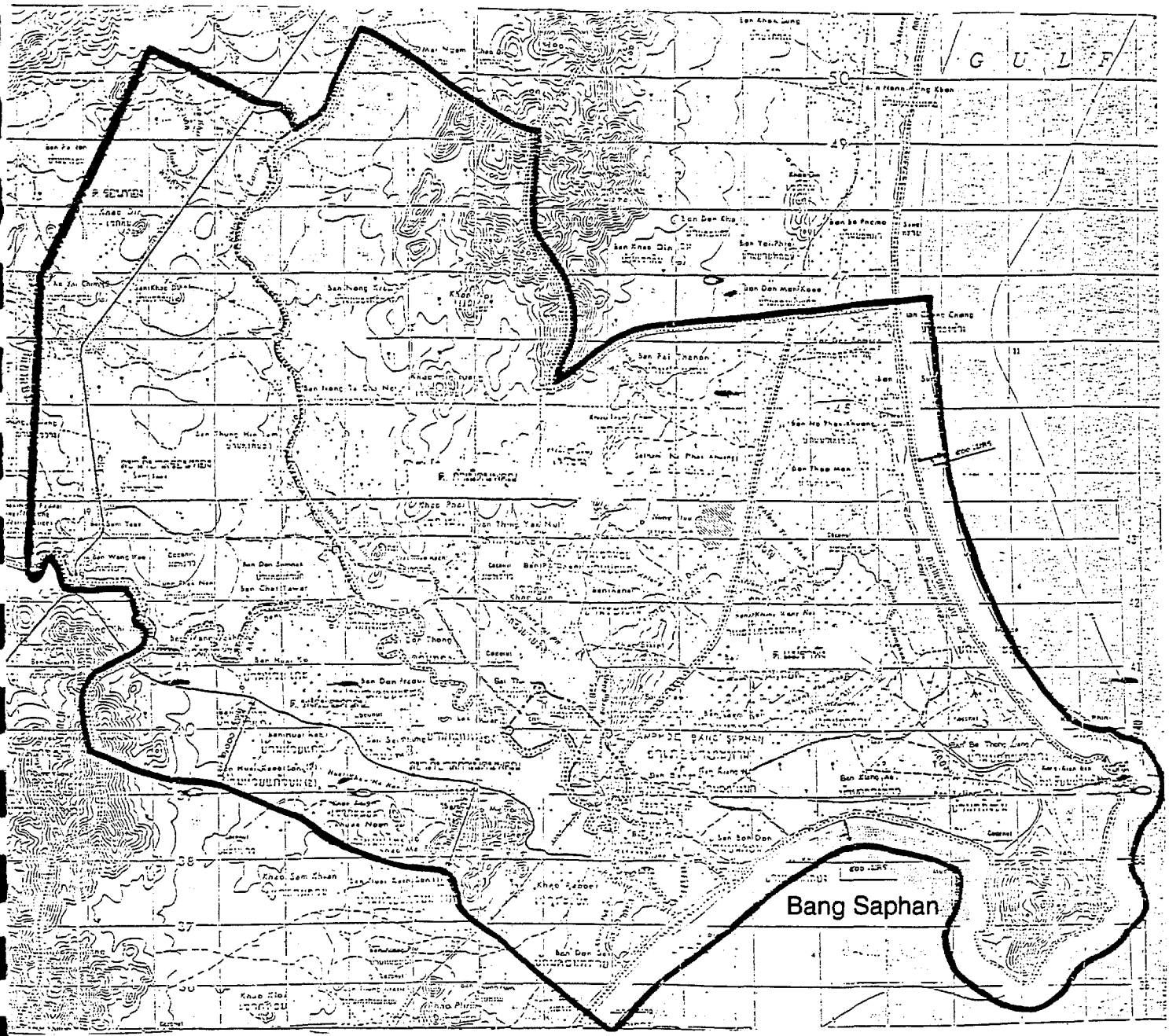
C. Government Planning Policy

In Thailand, the Ministry of Interior and the Ministry of Science, Technology and Environment are responsible for developing physical and social planning policy. These governmental planning agencies have gathered data regarding existing social and physical conditions and will, in the future, prepare plans and policies for a 170 square kilometer planning area that encompasses the Sahaviriya phase I and II project sites. Figure 6 shows this planning area boundary.

Initial background consultation was conducted with several planning agency representatives as part of this study. Consultation meetings were held in various government planning offices in Bangkok. Discussions with planning agency representatives resulted in identifying a range of community/regional scale planning issues that will need to be addressed in an overall regional planning study for the area that includes Sahaviriya's project sites. Additionally, it was suggested that consultation with local area representatives such as the provincial governor and sanitiary districts be incorporated into the planning process.

Key planning issues that were identified by government planning agencies are listed below.

- Water demand/supply constraints
- Water and air pollution
- Infrastructure requirements
- Housing requirements
- Community amenities such as greenbelts/buffers, schools and parks
- Protection of mangrove habitat
- Population growth/migration and labor force requirements
- Social/cultural effects on existing local population



Source: Department of Town & City Planning,
Ministry of Interior

Figure 6
Ministry of Interior Regional Planning Area
Environmental Management Program Strategy

III. Environmental Mitigation and Monitoring Program- Sahaviriya's Phase I Project

Sahaviriya's phase I project- the hot strip mill, the steel coating plant, and deep water port- are all currently operational and subject to specific mitigation and monitoring requirements per the governmental approved Environmental Impact Assessment documents. This section contains a brief summary of those environmental requirements. Photographs of phase I facilities are shown in Figures 7, 8, and 9.

A. Pollution Control Measures

The measures described herein are those presented in the EIAs and were designed to control emissions/effluents to the environment. Measures to protect in-plant, or occupational health and safety were not included as part of this paper.

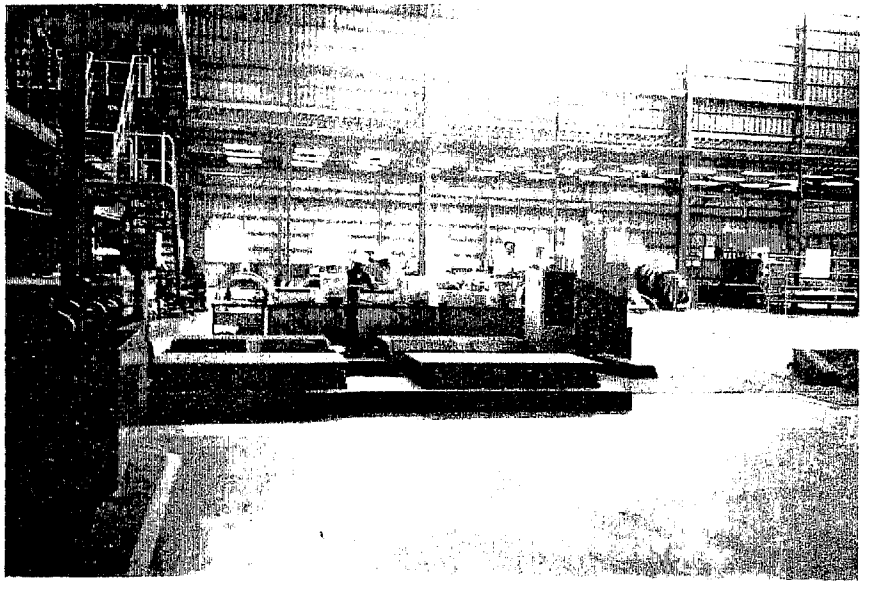
1. Hot Strip Mill

• Air Emissions: Air emissions are primarily from the burning of heavy oil in the reheating furnace. Because the heavy oil contains less than 1.25% sulfur, the emissions from the 80 m stack of sulfur dioxide (SO_2), nitrogen oxide (NO_x), suspended particulate matter (SPM), and photochemical oxidant (O_3) was calculated to be within the industrial emission standards developed by the Industrial Environment Division of the Ministry of Industry. Thus, there are no emission control equipment currently installed in the hot strip mill.

• Process Wastewater and Cooling Water: Water used in the milling process is collected and piped to the scaling pit where solid materials, particularly iron (Fe) is settled out of the wastestream. The wastewater is then pumped to the oil/water separator to remove the majority of the lubricating oils. From the separator the wastewater is piped to six sand filters for the final treatment process. Make-up water from the raw water treatment plant is added to the treated wastewater and recycled back to the process and cooling water streams. Thus, no process wastewater is currently discharged from the mill: all process and cooling water is recycled.

• Solid Waste: Solid wastes in the form of sludge is currently generated from process wastewater treatment systems, 2) the raw water treatment system, and 3) from the domestic wastewater treatment system. Scrap metal wastes is temporarily stored on-site. Sludges from the process wastewater treatment systems and from the raw water treatment system are sent to drying beds for separation. The dry material is stored on-site, then collection by a private company and disposed off-site. Fluids from the process are sent to the leech field in the northwest corner of the industrial complex.

Iron from the scale pit is periodically collected and sold to a private company for off-site reprocessing.



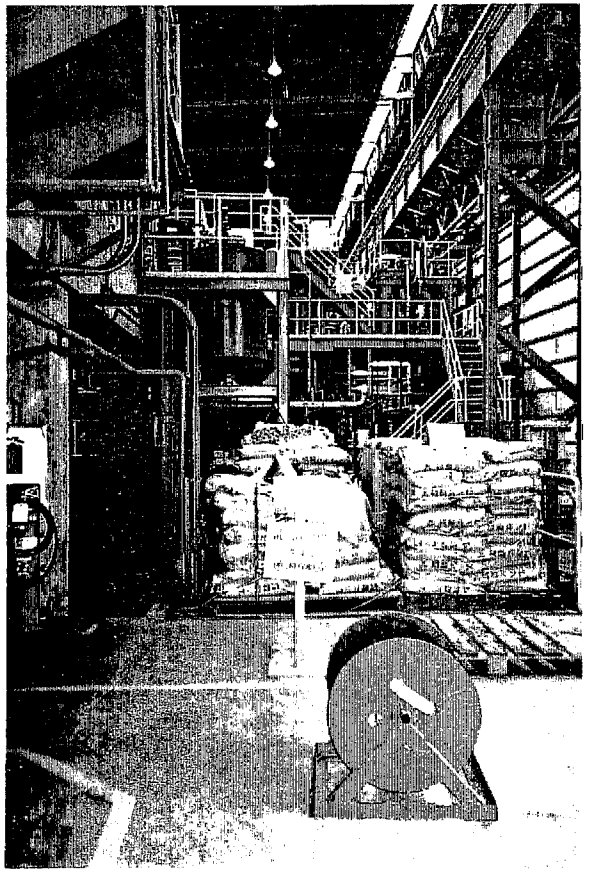


Figure 8
Photographs - Steel Coating Plant
Environmental Management Program Strategy

Figure 9
Photographs - Deep Water Port
Environmental Management Program Strategy

Scrap metal from the crop shearing step, and rejected slabs and/or cold coils are stored on site and then are shipped off site to a smelting plant either in Sarmutprakarne, or Rayong.

• Surface Runoff: Surface water runoff from the sloped slab storage yard, and the scrap metal storage area is directed to drainage ditches around each area. These ditches are currently closed although there are plans to connect the ditches to the dredged drainage canal which runs through the center of the complex. Surface runoff from other plant areas is not collected, but is directed to the dredge drainage canal.

2. Electrogalvanizing (Coating) Plant

This plant was not in operation at the time of the site visit: the following information is based on interviews conducted with plant management personnel.

• Air Emissions: As the coating process does not emit to the environment suspended particulate matter (SPM), SO_2, NO_x, or O_3, at or near the levels of the industrial emission standards, no control measures have been installed within the facility. Internal emissions of H_2SO_4 in the pre-treatment and plating processes are controlled by Lamellar mist separators. Post-treatment processes produce hazardous CO_3. This oxide also passes through a mist separator, thereby eliminating emissions to the environment. Kerosene burned in the drying oven contains less than 2.5% sulfur. The use of automatic fuel injectors and low sulfur content eliminates the emission of SO_2 and NO_x to below significant levels.

• Process Wastewater: The three major sources of process wastewater originating form the coating process. The sources are from:

- electrogalvanizing process;
- oil contaminated and blown downwater; and
- domestic wastewater systems

The wastewater from the electrogalvanizing process contains toxic substances as Fe, Zn, and Cr. Three separate waste streams (Cr-Zn, Fe-Zn, and Alkali-acid line) are treated through the chemical precipitation process. Specifically, the heavy metal stream is passed through pH adjustment tank, reduction tank, precipitation tank, clarifier and finally through a filter press to produce a dry cake. The steam is then recycled back to the production process.

Oil contaminated and blown down water resulting from contact with the various processing equipment and from the maintenance shop(s) pass through an oil/water separator. The oil from the surface of the separator is collected in a skimmer oil pit and then is pumped into a storage tank for off-site disposal.

Domestic sewage is treated by two different systems. The first, from toilets is treated by a package seepage system unit. The second, from the canteen and offices is treated by the activated sludge and sludge drying bed method.

Treated effluent from the steel coating process, and the oil contaminated and blown downstream is discharged to a hold pond (unlined). After a minimum of one day, the effluent is discharged to the complex's drainage canal. The small amount of treated effluent from both domestic wastewater treatment systems is sprayed on the surrounding landscape.

The electrogalvanizing process does not use cooling water. The finished coated sheet steel is air cooled, thus eliminating the need to use and/or treat other waste stream.

• Solid Waste: There are two types of solid wastes generated from the coating facility. The first is the domestic waste comprised of office, and kitchen wastes. These wastes are separated and temporarily stored on-site. The material is collected and disposed of off-site by a private contractor. The second type is the hazardous sludge cakes produced as the final step in the electrogalvanite wastewater treatment process. These "dry" cakes are temporarily stored in drums on site, and periodically shipped off-site for hazardous waste treatment, and disposal.

3. Deepwater Port

• Air Emissions: As currently operated there are no point source emissions from the port facility.

• Wastewater: Wastewater from sink and toilet facilities are disposed of via a septic tank and package units of anaerobic filter(s).

• Solid Waste: Solid waste from port facilities is currently collected in a open storage container with the contents burned at a nearby suitable site. Shipboard wastes are disposed of prior to docking at the port.

B. Environmental Monitoring Programs

This section presents an overview of the environmental monitoring programs stipulated in the EIA documents for the phase I facilities. Specifically, these facilities are to the hot strip mill, the steel coating plant, and the deep water port. A detailed description of each monitoring program is contained in the respective EIAs which are referenced at the end of this paper.

A. Hot Strip Mill

Parameters	No of Locations	Frequency
Ambient Air Quality:		
Dust (particulate) SO_2, NO_2, wind velocity and direction	3	Twice a year for 7 consecutive days
Emission Sources:		
Dust (particulate) SO_2, CO	1	Twice a year, for 7 consecutive days

In addition, document the sulfur content of fuel oil supplied to the plant in a report sent to the Office of Environmental Policy and Planning.

Treated Wastewater:		
pH, DS, TDS, SS, oil and grease, BOD, COD, Cl, Sulfide, Cyanide, Zn, As, Cu, Cd, Fe, Pb Hg, Mn, and Si	1 (wastewater pond)	Twice a year
Surface Water:		
pH, SS, TDS, acidity, alkalinity, COD, oil and grease, total coliform, Si, Fe, and Mn	3	Twice a year (6 months/yr)
Groundwater:		
pH, SS, BOD, oil and grease, Mn, Si and Fe	6 observation wells	Twice a year (6 months/yr)
Noise (outside of plant):	7	3 times a year (4 months/time)

199

B. Steel Coating Plant

Parameters	No. of Locations	Frequency
Ambient Air Quality:		
TSD (SPM), SO_2, and NO_2	2	Twice a year, 3 consecutive days each time
Emission Sources:		
TSP and SO_2	Stacks	Once a Year
Treated Wastewater:		
flow rate, pH, SS, TDS BOD, oil and grease, Cr, Zn, Fe, and Al	2 (one before CTP, and at end of pipe to Klong Mae Ramphung)	Monthly
Surface Water:		
Flow rate, pH, SS, TDS, COD, oil and grease, Cr, Zn, Fe, Al, NO_3^{-3}-P, PO_4^{-3}-P, total coliform, and acidity/ alkalinity	1 (Klong Mae Ramphung)	Every month BOD, dry season; every 3 months in rainy season

280

C. Deep Water Port:

Parameters	No. of Locations	Frequency
Seawater Quality SS, turbidity transparency, pH, oil and grease, DO, and fecal coliform	7	Quarterly
Benthic Fauna:	2	Once a year
Sedimentation Rate:	6	Twice a year
Strand Oil:	Every 200 m along the distance of 5 km north and south of breakwater	Twice a year
Oil/water Separator:	At oil/water separator discharge point	Every two months
Effluent from anaerobic filter:	Every anaerobic system discharge point	Every two months
BOD/COD, SS, pH, and coliform bacteria		

Legend

pH = acid
DS = dissolved solids
TDS = total dissolved solids
SS = suspended solids
BOD = biological oxygen demand
COD = chemical oxygen demand
Cl = cloride
Zn = zinc
Cu = copper
Cd = cadmium
Fe = iron
Pb = lead
Hg = mercury
Mn = manganese
Si = silicon
As = arsenic

201

IV. Anticipated Emission and Effluent Releases- Sahaviriya's Phase II Project

The pollution control and/or mitigation measures for the cold strip mill, steel bar mill, power plant, and the electric arc furnace have not been identified at this time. As separate EIAs are prepared for each project, mitigation measures and environment monitoring programs may be stipulated. References reviewed in the preparation of this section include the UNIDO report (Volumes 1 and 2, November, 1993 for the cold strip mill), the preliminary feasibility study for the steel bar mill, the interim feasibility report for the Sahaviriya Steel Industries, September 1994, and the World Bank general description documents on iron and steel manufacturing (electric arc furnace). In addition, discussions were held with Sahaviriya Steel Industry personnel regarding expected design and implementation of all the two phase facilities.

A. Potential Emission/Effluent Releases

The emissions described herein are those that may be released to the environment; in-plant emissions is not addressed in this paper.

1. Cold Strip Mill

• Air Emissions: Emissions from this facility will primarily be from the continuous pickling line and tandem cold mill units, as well as from the batch annealing furnace. The particular pollutants from these sources are not know at this time, however, the use of low sulfur fuel oil (less than 1.25%) should reduce the need of pollution control equipment in the furnace stack. The acid(s) used in the pickling process may be recovered in a recovery system, and recycled thus potentially eliminating emissions to the environment.

• Process Wastewater and Cooling Water: Water requirements for the facility will be broken into two systems; one is the filtered water used in the milling process, the second is circulated water used for cooling. The filtered water will be treated and then discharged indirectly to the complex's central drainage canal. This water may be first discharged to a retention pond on site, then discharged to the canal.

Cooling water will probably be recirculated with make-up water coming from the complex's raw water supply system.

Solid Waste: Consumable wastes includes wrapper paper, protective pads, steel ring and hoop bundling. These and other miscellaneous wastes will (may) be collected and disposed of off-site as currently done for the phase I facilities. Domestic waste from this facility as well as from the other phase II facilities will be treated in a central sewage treatment plant to be built. Solid wastes from this facility may be disposed of off-site.

Surface Runoff: Off-site fill material will be brought into the proposed mill site. Upon completion of final compaction and contouring, a drainage ditch will surround the complete facility. The runoff (rainwater and washwater) will be collected in the ditch, and then collected in a pit(s) for temporary settling. The water in the pit will be discharged to the central drainage canal which connects to the Klong Mae Ramphung.

2. Steel Bar Mill

• Air Emissions: The source of emissions from this facility will primarily be from the reheating furnace, used to prepare the steel billets for the rolling machine. As with the other projects, low sulfur fuel (less than 1.25%) will be used in the furnace. Thus, the use of emission control equipment for the removal of SO_2, SPM, NO_X, or O_3 is not anticipated at this time.

Process Wastewater and Cooling Water: The type of mill to be installed was not known at the time of the preparation of this paper. However, a general description of the process wastewater treatment and cooling water recycling is provided. A detailed description of the mill and wastewater treatment systems will be contained in the forthcoming EIA.

In general, there will be three main process wastewater streams. The pickling/coating process will be a mild/weak acid/lime solution which will be recycled with no discharge to the environment. The process streams used in shaping and cutting the bar will contain metal fines which will settle out in the scaling pit(s) and disposed of off-site. The process wastewater will probably pass through a series of filters, and recycled through the mill with make-up water supplied from the raw-water treatment plant. Finally, cooling water will be circulated through the various mill stands and cutting shears. The cooling water will first pass through a settling tank, then through an oil/water separator and then through one or more filter(s). As with other process water, the cooling water stream will be recycled through the mill with addition of raw make-up water added to the stream as needed. As currently planned, there should be no discharge of treated wastewater from the bar mill.

Domestic wastewater from the facility will be treated and discharged from the central sewage treatment plant.

Solid Waste: As in the cold strip mill, the major source of solid waste will be consumable materials as wrapper paper, protection pads, ring and/or bundle wire. These and other miscellaneous solid wastes will be collected and disposed of off-site. Scrap metal will be stored on-site and sold on a periodic basis.

Surface Runoff: As with all the other projects, fill material will be brought into the proposed site of the steel bar mill. Upon completion of final compaction and contouring, a drainage ditch will surround the facility. Surface runoff will be collected in a ditch, pass to a pit(s) for temporary settling, and then discharged to the central drainage canal.

3. Power Plant

• Air Emissions: As currently planned, the power plant will be constructed in three phases. The first phase (1997) includes the installation of a simple cycle combustion turbine (CT), the second phase will include the addition of a combined cycle combustion turbine, and around the year 2000, an integrated coal gasification combined cycle system will be added. Thus, the emissions from the power plant will change over a three year period starting in 1997. It is anticipated that low sulfur fuel (less than 1.25%) will be used in the simple and combined cycle CTs. The use of this fuel should significantly reduce the typical power plant emissions for SO_2. If this fuel is used, then no emission control equipment is expected to be installed. If and when an integrated coal gasification cycle system is installed, the emissions from the plant will change. However, what if any control equipment that will be needed will be identified in the pending Environmental Impact Assessment (EIA). Another potential source of air emissions may be particulate matter from the coal pile(s) to be located adjacent to the plant.

The specific potential air emissions and required mitigation measures for the plant will have to await the selection of fuel, and the approval of the final EIA.

Process Wastewater: As the specifics of the power plant have not been developed, the type of process wastewater treatment is not known. However, it is expected that several treatment systems will be installed to handle boiler blown down, demineralizer backwash and resin regenerator wastewater, residual transport wastewater, runoff from coal piles, and the site, as well as from domestic wastewater. Oil treatment system(s) may also be needed to treat various oil soils, and oily runoff from around the fuel oil storage tanks. The pending EIA will address these wastewater systems and appropriate treatment system will be installed at the plant.

The power plant will use once through cooling water when the plant installs the gasification combined cycle system. Depending on results of the cooling water studies, entrainment and impingement of aquatic organisms as well as potential fishery impacts resulting from the location of the outfall and the elevation of ambient water temperatures will have to be assessed. Reducing these potential impacts will be addressed in the forthcoming EIA.

Solid Wastes: Solid wastes generated by the power plant will primarily be coke from the gasification process and domestic (sewage and office) waste. Nothing is known at this time about the quantity and quality of each type of waste. This information will probably be included in the final feasibility report currently under preparation.

4. Electric Arc Furnace

Air Emissions: Emissions from this project to be in operation in 1999, will include primarily dust (particulates) and CO. This assumes a high grade iron ore will be used in the furnace. Control of the particulates may be accomplished with the use of cyclone separators followed by electrostatic precipitator(s), and bag house. A control technology for CO will have to await the results of the feasibility study for this project.

Process Wastewater: Solvents and/or weak acids solutions may be used in cleaning steel or the "raw" scrap iron to be used in the furnace. These solutions should be handled, stored, and disposed of as hazardous substances. Treatment systems and possible recycling equipment may be installed at this facility.

Furnace wall and roof cooling water is anticipated to be treated and recycled, thus eliminating the need to discharge to the central drainage canal.

Solid Wastes: The expected major source of solid wastes is the dust collected from the stack emission control system(s). Frequently this dust has some economic value because of the alloy mixture in the dust. The dust however can contain toxic metals. Analysis of the dust should be done prior to and after start-up of the power plant.

Consumable materials, like the other complex projects will be collected on-site, and disposed of off-site.

Surface Runoff: Surface runoff from the scrap iron/separation yard and scrap product yard should be tested to determine what if any treatment is necessary prior to discharge to the central drainage canal. The runoff may be held in a retention pond to settle out any suspended solids..

B. Environmental Monitoring Programs

As the EIA reports have not been prepared for the four projects to be constructed during Phase II, it is beyond the scope of this paper to identify monitoring programs to be identified and approved by the Ministry of Interior, and the Ministry of Science, Technology and Environment.

V. Environmental Management Program Strategy

Overview

The Sahaviriya phase I and II projects represent an important increment of industrial development for Thailand's western seaboard region. By developing and implementing a strategic environmental management program for Sahaviriya's projects at this time, the beneficial social, economic, and environmental aspects associated with new development can be maximized while potentially adverse effects on the natural and social environment are reduced.

The economic and environmental consequences associated with phase I development have been evaluated and specific mitigation measures designed to reduce adverse environmental effects have already been identified. Similar evaluations of the planned phase II projects are in progress. In addition to implementing specific mitigation measures and monitoring programs identified in the EIA documents, a program of broader measures or actions are suggested herein to ensure long-term environmental conservation goals and maintain Sahaviriya's positive image as an environmentally responsible company.

The strategy for an environmental management program discussed below contains four basic elements. Objectives, implementation strategies, and a general time frame are identified for each program element. The suggested timing for program implementation is based on current available information regarding Sahaviriya's schedule for phase II completion.

A. Support a Comprehensive Regional Planning Process

Objective: To ensure private development coordination with government programs in respect to infrastructure construction, natural resource conservation, and social /physical planning policy. Coordinated regional planning efforts will lead to a more efficient project approval process and potentially more government and outside (international) financial support for infrastructure improvements.

Taken together, Sahaviriya's phase I and II facilities represent about 25% of the total development proposed in UNIDO's first development phase. Sahaviriya development will certainly play an influential role in shaping future growth and environmental conservation in the Bang Saphan region. Sahaviriya's proactive participation and support for a regional planning process would, in the long run, result in strengthening financial support from the government and international funding organizations for infrastructure construction as well as potentially lead to a more expedient project approval process. Given active support, a regional plan should therefore reflect input from and meet the objectives of the area's major steel based industrial developer.

Support for a regional planning effort can be accomplished by at least two alternative means. One approach involves providing sufficient development plans and data to the appropriate governmental planning body, perhaps the Ministry of Interior or the IEAT, for use in preparing population projections, infrastructure requirements, planning/environmental policies, etc. An alternative to this approach would be to participate in the actual planning process by providing technical assistance to government planning agencies. This could involve partially funding a technical planning position or consultant efforts to assist in the preparation of a regional plan, policies, and supporting technical data base.

The first approach would be less costly to Sahaviriya, however would probably require a greater time period for actual plan and policy preparation. The second alternative would involve more direct financial cost but would likely result in a more timely planning process. Other potential sources of financial support for regional planning such as the Ministry of Science, Technology and Environment's Environmental Fund could also be explored.

Regional planning issues to be addressed include population growth/in-migration; water supply; natural resource preservation/protection; buffer/greenbelt requirements; infrastructure requirements; housing requirements, school and park requirements; and labor force/job training requirements. The planning process should also consider input from local government representatives such as the provincial governor and sanitary district officials.

Several steps could be taken within the next three months, regardless of the technical planning approach that Sahaviriya and governmental planning agencies select. These involve:

- Determining the appropriate lead planning agency (IEAT, Ministry of Interior, etc.),
- Determining the appropriate planning area/subarea boundaries, and
- Assessing the status of available data on existing physical/social conditions (population, land use, natural resources, etc.).

Terms of Reference (work program and scope) for developing the plan and actual planning activities should be undertaken as soon as practical.

B. Develop and Implement a Public Information and Community Relations Program

Objective: To communicate accurate factual information about Sahaviriya's existing and proposed operations in order to maintain a positive environmental image and build public acceptance for the Bang Saphan steel-based industrial development.

A variety of programs and techniques can be implemented to achieve public information/community relations goals. Sahaviriya could create an environmental information officer position by hiring a staff member with technical expertise in environmental issues and public communication. (The information officer could be a member of the proposed Environmental Management Group presented in Section D).The environmental information officer's primary responsibility would be to address community questions, concerns, and problems related to construction and operation of Sahaviriya's projects. The environmental information officer would also be available for speaking or distributing informational materials at local community events.

A second aspect of the program involves establishing an outreach program in local schools. Sahaviriya's environmental information officer could schedule presentations at local school sites to discuss issues of interest to students. Topics might include an overview of Sahaviriya's industrial operations, reasons for facility access restrictions, and environmental/public safety procedures. Environmental education trips could be scheduled so that school children from the community could visit Sahaviriya facilities and learn about established environmental protection measures. The school outreach program will enable local/regional students to learn more about Sahaviriya's commitment to industrial development as well as protecting the environment. As a consequence of the outreach program, the children's parents may also become aware of this information. A longer term benefit of the school outreach program will be to encourage understanding and acceptance of Sahaviriya steel industrial development in local community residents at an early age.

The overall time frame for implementing this program element is six to nine months. A job/qualification description for the environmental information officer position could be developed and the position filled within the next two to four months (See Section D). The school outreach program should be established as soon as the environmental information officer is in place, and Sahaviriya personnel are trained in conducting site visits.

C. Develop and Implement an Environmental Enhancement Plan

Objective: To ensure long-term conservation of sensitive natural resources and environmental quality in the vicinity of Sahaviriya facilities and to maintain Sahaviriya's positive public image as an environmentally responsible company.

The purpose of the environmental enhancement plan would be to develop a document that defines environmental quality and public health/safety standards for Sahaviriya's development projects. Elements to be included would be infrastructure, open space, recreation, and drainage, among others. The enhancement plan would incorporate professionally accepted international planning/design standards and criteria; the plan would be prepared in conjunction with planning and implementation of Sahaviriya's phase II and anticipated future development in the Bang Saphan area.

The plan would include identified on and off-site enhancement measures that are coordinated with regional planning goals and policies. It is anticipated that to some extent, responsibility for implementing or maintaining selected enhancement options could become a shared public/private sector responsibility. The plan could include a phased investment/construction approach for implementing enhancement measures. The following are some initial examples of planning/design issues be addressed in Sahaviriya's environmental enhancement plan.

- Facility layout criteria and guidelines that reflect efficient use of the land (and water) in order to minimize development-related environmental impacts. Where feasible and cost-effective, facilities could be centralized or consolidated to further reduce environmental impacts.

- Water discharge and drainage system design criteria for minimum alteration to existing natural drainage and off-shore hydrology patterns.

- Criteria for local community traffic circulation and industrial facility traffic including consideration of a separate roadway network to accommodate trucks/heavy equipment during construction as well as for on-going facility operations. Siting, design, and construction criteria and standards for new project access roads that are sensitive environmental considerations.

- Criteria and standards for buffer zones and development setbacks to preserve natural habitat areas and aesthetic resources and to promote public safety. These could include building/development setbacks from water courses, drainage ways, and shoreline areas and access road/entry point aesthetic treatment (Urban Land Institute, Pratt Institute, or other professionally/internationally accepted industrial development standards would be applied).

• Criteria for enhancing/maintaining public access to existing local beaches and recreation areas . Access routes could be separate from those used by facility construction and operational traffic. Measures for view protection from local recreation areas including potential for landscape screening to reduce visibility of industrial facilities from public recreation areas. Where/if applicable, criteria and standards for new/replacement recreation areas.

The environmental enhancement plan could be prepared by Sahaviriya technical staff or by technical consultants. Professionals with expertise in environmental/ urban planning and site planning/design should contribute to and review the plan. The plan could incorporate data from and build upon previous studies such as the coastal management plan and UNIDO report. A scope and work plan for preparing the Sahaviriya's Environmental Enhancement Plan should be developed within the next six months.

D. Develop an Environmental Management Division within Sahaviriya Group

Objective: To create in-house environmental expertise and capability for managing environmental/regional planning, mitigation requirements, and environmental monitoring programs

A variety of activities that are now dispersed within Sahaviriya Steel Industries (SSI) and government agencies can be facilitated by establishing an environmental management group within SSI. The group's primary function would be to assist planners, engineers, and site managers in managing environmental matters associated with facility planning, design, construction, and operation. A secondary group function would be to maintain current knowledge on environmental regulations and compliance issues so as to provide expert advise to SSI management on environmental issues.

During the phase II planning process, this group could participate in the final site selection for facilities, provide design criteria (pollution control), and identify order of magnitude cost associated with project mitigation requirements. During EIA preparation, the environmental group could supply information about expected emissions and effluent discharges, and provide consultation to government agencies on prudent and feasible mitigation measures and appropriate environmental monitoring programs. Organizationally, the environmental information officer assigned to the industrial complex could be part of the environmental group, reporting to the environmental group manager.

Technical staff within the environmental group could be responsible for long-term environmental monitoring during the construction and operation of phase I and II facilities. The staff could function as a central clearing house and /or also prepare the required monitoring reports to be submitted to regulatory agencies. Finally, members of the group could conduct environmental training programs for construction and operational personnel.

Initially, the environmental management group would work out of SSI's Bangkok office and would consist of a small core staff of three to four people including the environmental information officer. Longer term (after six months), the group could be located at the Bang Saphan complex and could be expanded to include a water quality laboratory and personnel. The initial group could be comprised of one or more environmental scientist(s), environmental engineer(s), and a biological specialist.

The environmental management group should be established at Bang Saphan within the next six to nine months. The group's staff and technical capabilities can be increased as the Bang Saphan development complex expands. Within one to two years the environmental management group could assume broader responsibilities for other Sahaviriya companies' environmental compliance activities. Eventually, and with proper planning and staffing, the proposed environmental management group could become a profit center within the Sahaviriya Group and/or a small subsidiary environmental consulting firm.

VI. References

The following documents were reviewed as background for preparing the Sahaviriya environmental management strategy paper.

Environmental Information Division, Department of Environmental Quality Promotion,, Ministry of Science, Technology and Environment, *Draft Enhancement and Conservation of Environmental Quality Act B.E. 2535,* Bangkok, Thailand, undated. Translated by Environmental Law Center.

National Environment Board (NEB), *Manual of NEB Guidelines for Preparation of Environmental Impact Evaluations*, Bangkok, Thailand, April 1979.

Panya Consultants Co., Ltd., *Environmental Impact Study for Preserving Embankment for Sahaviriya Steel Plant at Bang Saphan District Prachuap Khirikhan*, Part 1, September 1992, Part 2, October 1992.

Sahaviriya Steel Holding Company., LTD., *Preliminary Feasibility on Steel Bar Manufacturing Plant,* July 1994.

Thai-Thai Engineers Co., Ltd., *Environmental Impact Assessment Port Project,* [Executive Summary], Bang Saphan District, Prachuap Khirikhan Province, September 1992.

Tridetch, S., *Preventive Measures and Mitigation Measures, and Monitoring Program to be Observed by Sahaviriya Steel Industries Co., Ltd., for Hot Strip Mill Project at Amphoe Bang Saphan Changwat Prachuap Khirikhan*, Office of the Environmental Policy and Planning, 11 pages, June 1993

United Nations Industrial Development Organization (UNIDO), *Steel Based Industrial Estate in Western Thailand,* Final Report,, March 1994.

United States Steel, *The Making, Shaping and Treating of Steel,* 10th ed., Latest Technology, 1513 pages, 1985.

Water and Environment Consultant Corp., Ltd., *Final Report Environment Impact Assessment Electrogalvanized Coils Project,* Thai Coated Sheet Co., Ltd., Bangkok, Thailand, March 1993.

2/2

Initial consultation with government planning agencies was conducted as background for preparing this paper. Included were discussions with the following people.

Ms Kluephan, Director, Urban Environment and Area Planning Division, Office of Environmental Policy and Planning, Bangkok.

Mr. Sompong, Department of Town and City Planning, Ministry of Interior, Bangkok.

Dr. Surapol, Urban Environment and Area Planning Division, Office of Environmental Policy and Planning, Ministry of Science, Technology and Environment, Bangkok.

Mr. Pongsak Wongwisnupong, Chief, Energy Section, Environmental Impact Evaluation Division, Office of Environmental Policy and Planning, Bangkok.

Trip Report

Sahaviriya Steel Industry Environmental Management Program Strategy
Bangkok and Bang Saphan, Thailand

Prepared By
Marsha Gale, Environmental Vision
November 1, 1994

Purpose
The purpose of the trip to Bangkok and Bang Saphan, Thailand was to develop background information for preparing the Sahaviriya Steel Industry Environmental Management Program Strategy paper. The strategy paper is intended to provide an initial evaluation of environmental management issues associated with Sahaviriya's Phase I and II industrial development and to identify an overall strategy for addressing environmental considerations related to this development.

Schedule
The trip took place between September 12 and September 26, 1994. The project team consisted of Marsha Gale, Principal of Environmental Vision, and Jack Gouge of Bechtel. Trip preparation including data review, team meetings with Bechtel staff, and logistical planning occurred during the previous two weeks (August 30- Sept. 10). Follow up work including team meetings with Bechtel, preparation of the strategy paper, and document revisions was completed by October 31, 1994. A copy of the final draft Strategy Paper will be provided to Price Waterhouse under separate cover.

Activity
In-country activities included

- Data collection and review in Bangkok including EIA documents for Phase I project facilities, feasibility studies, and the United Nations Industrial Development Organization (UNIDO) report.
- Meetings in Bangkok with Sahaviriya Steel Industry and public agency (Ministry of Interior and Ministry of Science, Technology, and Environment) representatives.
- Meetings in Bangkok with US AID representative, R.J. Gurley.
- Site visit to Bang Saphan steel complex including meetings with Sahaviriya representatives and tour of hot strip mill, coating plant, deep water port, and surrounding vicinity.
- Presentation of preliminary findings to Sahaviriya Steel Industry and US-

214

Problems Encountered/Outstanding Issues
No substantive problems were encountered during the trip. The basic outstanding issue involves Sahaviriya's response to suggested program elements contained in the strategy paper. Depending on Sahaviriya's decision to pursue and implement the environmental management program strategy recommendations, some follow up technical consultation could be requested.

Next Steps
A final draft of the strategy paper has been submitted to Mr. Fred Karlson of Bechtel. The paper is currently being reviewed by US AID representatives who will ultimately submit copies to Dr. Asavin Chintakananda, Senior Executive Vice President at Sahaviriya Steel Industries. If appropriate, US AID may want to conduct briefing and follow up sessions with Sahaviriya Steel Industry representatives.

715

APPENDIX K

Egypt: Sustainability of Energy-related Development Projects in the Middle East Peace Region

Sustainability of Energy-related Development Projects in the Middle East Peace Region

A report by the:

Israel Union for Environmental Defense (IUED)

with the support and collaboration of USAID's:

Project in Development and the Environment (PRIDE), implemented by Chemonics International Inc., and

Energy Project Development Fund, implemented by Price Waterhouse LLP

March 1995

217

Sustainability of Energy-related Development Projects in the Middle East Peace Region

Authors:

IUED Technical Staff:
Alon Tal
Shoshana Lopatin
Gidon Bromberg

with the cooperation and collaboration of:

Chemonics International/PRIDE technical staff

The authors express their appreciation to Dina Kruger, Joe Kruger, Michael Gil, and Jack Stafurik for their instructive comments.

28

TABLE OF CONTENTS

SUSTAINABILITY OF ENERGY-RELATED DEVELOPMENT PROJECTS IN THE MIDDLE EAST PEACE REGION

A. Introduction: Report Perspective and Assumptions

Egypt, Jordan, Israel, and the Palestinians are eager to exploit the economic opportunities created by the newly emerging geopolitical reality in their region. Each group has put forward a broad menu of "regional projects" that promise not only to physically change this "peace region," but also the way it operates collectively.

There is no area in which accelerated development is more highly anticipated than in the energy sectors of these countries. At the same time, the proposed peace projects, almost without exception, have not been thoroughly assessed for feasibility or environmental impacts. Despite this fact, however, it is not premature to offer an initial assessment of their merits within the context of a paradigm that emphasizes sustainability in new regional development. This paper evaluates the primary energy sector projects that are on the agenda of international donors.

Energy has emerged as a major issue of concern in the peace region for obvious security reasons. Even if conservation measures prove successful, the burgeoning populations and growing industrial base of each country will require the expansion of energy-generating capacity for the foreseeable future. Hence, meeting this demand, while at the same time establishing greater energy independence, has both economic and strategic importance.

With 840 million metric tons of proved recoverable crude oil and 341 billion cubic meters of natural gas, Egypt is the only country in the peace region with meaningful commercial fossil fuel reserves. Nonetheless, with energy generation and demand more than quadrupling between 1981 and 1994, some projections suggest that Egypt will be forced to import energy by early next century. The Israeli and Palestinian territories' currently linked energy systems are largely reliant (98 percent) on imported crude oil and, to a lesser extent, coal. Jordan's 991 megawatt (mw) power generation is predominantly fueled by heavy fuel-oil and diesel units. It is therefore little wonder that so many of the peace projects are designed to expand local energy options and generating capacity.

Our evaluation of the overall sustainability of peace projects affecting the energy sector is made under the following assumptions:

- Tourism will emerge as a predominant source of foreign currency in each part of the region by the year 2000; (Israel alone earned US$2.3 billion from tourism in 1994).
- While expanded tourism increases energy demands, it also dictates that energy sources are to the largest possible extent environmentally benign.
- The lack of commercial energy reserves can be environmentally advantageous by enabling countries to select energy sources compatible with the need to preserve a clean environment (e.g., natural gas).

- The vulnerability associated with excessive dependence on a single source of energy is economically unsound and often politically unacceptable. Beyond diversifying imported energy sources, a sustainable strategy must involve expanding effective energy capacity through development of renewable resources such as solar and geothermal energy, and reduction of local demand through innovative energy conservation programs.

- Most of the region's energy sectors are dominated by direct government control or government-controlled utilities. In Jordan, 866 mw of current generating capacity is produced by the government-owned Jordanian Electricity Association, while the remaining 125 mw is generated by the private sector. Given the parallel trend toward privatization in each country, the private sector will inevitably play a growing role in the energy field—a factor that must be considered in any assessment of energy projects' sustainability.

- Privatization by itself is environmentally neutral. Because government industries in the region have never been paragons of efficiency, and have frequently been more difficult to monitor and regulate than private corporations, privatization in theory can play a positive environmental role. However, privatization will not further sustainable development unless a strong, technically competent regulatory authority is in place.

Proceeding from these assumptions, this report considers most of the peace projects affecting the region's energy sector. Given the report's limited scope, descriptions are not exhaustive, and Appendix I provides better documentation of the various proposals at hand.

B. Expansion of Thermal Power and Oil Refinery Capabilities

B1. Project Descriptions

Jordan. To meet anticipated power demands and participate in regional power systems, the Jordanian government is rapidly expanding the new Aqaba Thermal Power Station (ATPS). The two existing 130 mw heavy fuel-powered units are to be doubled by 1997, and by 1999, this capacity will increase through the addition of two more 130 mw units. This project also calls for construction of a boiler island, a turbine generator island, civil works, and heavy fuel oil storage tanks.

In addition to these proposed thermal power activities, plans exist to build an Aqaba oil refinery. The current Jordan Petroleum Refinery, which has a capacity of 100,000 barrels/day, is considered inadequate to meet the country's growing needs. Given the present low motorization rates in Jordan (60 vehicles per 1,000 people), projections of a 100 percent increase in demand by 2010 are not unreasonable. Few details of this plan are available, though implementation is set for 1996-2000 at a price of $500 million.

Egypt. Egypt is promoting plans to establish three new oil refineries in Sidi Krir, Suez, and Port Said, at a combined cost of almost $4 billion. As these facilities are to be for export production, the petroleum they create will be marketed as environmentally friendly (low sulfur, lead-free, etc.). In addition, Egypt intends to upgrade its existing refineries, including secondary processing to produce cleaner products (gasoline, jet fuel, diesel and propylene) and begin a multibillion-dollar expansion of petrochemical products (rubbers, solvents, paints, foams, wires

cables). Beyond a depiction of these new plants as "state-of-the-art," no details have been offered regarding emission control technologies or pollution prevention innovations to be used.

B2. Sustainability Considerations

Air quality. Power plants and refineries are the primary generators of sulfur dioxides and major contributors of particulate pollution. While control technologies can be extremely efficient in reducing emissions, they are also extremely costly (particularly for refineries) and not presently used by utilities in Jordan or Egypt. Since most countries in the region do not have updated ambient air quality criteria, (or, as in Jordan, have never promulgated such limits), it is not clear how design or emission standards for the new plants would be determined. Yet given the designation of the Sinai and Aqaba regions as major tourist development areas, the importance of investing in clean air technologies cannot be over-emphasized.

Particulate pollution's role in impairing visibility is especially problematic in a pristine area such as the Gulf of Aqaba. Standards such as those used to provide aesthetic protection in comparable desert vistas (e.g., in the Grand Canyon region of the U.S.) should be made a legislative priority concern in this region.

Oil spills. With 40 percent of the world's oil passing through its waters, the Mediterranean Sea will be the inevitable sight of oil spills, despite broad international participation in marine pollution prevention treaties. The Gulf of Aqaba, with its uniquely sensitive aquatic ecosystems, has a much lower threshold for environmental damage than the Mediterranean. Hence, an underlying objective of any regional strategy should be the minimization of all marine transport of oil, and of risks of spills from land-based sources. Establishing new coastal refineries inherently runs counter to such a strategy, thereby raising questions about the optimal location for such facilities, assuming they are economically essential. Furthermore, such projects would have a negative impact on tourism, destroying beaches, coral reefs, and other popular attractions.

General. Because tourism offers the primary economic opportunity in the Gulf of Aqaba and Sinai region, the above environmental concerns raise serious questions about the sustainability of the proposed Jordanian refinery and power station. International agencies must be insistent in requiring an environmental impact statement (EIS) for each project, with notice and comment provisions for Gulf States and local NGOs. Alternative sites for the oil refinery should be considered in the EIS, even within the context of the parallel Egyptian efforts. The relatively copious coastal areas in Egypt, coupled with Sinai's rich fossil fuel supplies, provide a stronger case for Egyptian refineries—even though the potential for widespread environmental havoc in the Sinai is no less acute. It is therefore important that an EIS pay considerable attention to siting, process design, and control technologies. Moreover, given the uncertainty of world petroleum demand post-2000, it is unclear whether there will be a sufficient return on an export-based investment that may preclude other, more promising areas of development (e.g., tourism).[1]

[1] Some experts, such as Amory Lovins of the Rocky Mountain Institute, hold that the world demand for petroleum will drop precipitously by the year 2010, with the widespread marketing of hybrid-electric supercars that get 250+ miles/gallon. Other experts cite the growth of developing countries as the cause of ever-increasing petroleum demand.

If the Jordanian government chooses to proceed, despite environmental concerns surrounding the power plant and refinery, there must be a meaningful expansion of technical capabilities to ensure effective monitoring and inspection at the two facilities. Assuming appropriate normative standards can be enacted, the government must purchase air pollution monitoring equipment. It is critical for Amman to recognize that it is far easier to integrate air pollution control equipment during the course of construction than to try to retrofit existing plants. Consequently, international support for these projects must stipulate that scrubbers, particulate controls, and environmentally sound methods of disposing of liquid and solid waste residues must all be part of initial facility designs.

Given the region's limited familiarity with state-of-art air quality control technologies, imposing emission controls may be easier if projects are developed by private firms (presumably involving foreign partners) with experience running facilities in regulated climates. At the same time, it is doubtful that private utilities will invest adequately in environmental controls unless a powerful regulatory agency forces them to do so. This being the case, these projects highlight the importance of a multinational environmental commission in the Gulf with regulatory powers.

C. Interconnection of Electrical Networks

C1. Project Description

Even if domestic electrical infrastructures were efficient, the present generating network is less than optimal at the regional level. A multinational link-up offers the potential to diminish spinning reserve and back-up capacity and reduce the need for peak load generation. Toward this end, several interconnection projects have been proposed, of varying magnitudes.

At the smaller end, a 500 kilovolt (kv) Egypt-Jordan linkage of 300 kilometers ($150 million cost) has been proposed. At the more grandiose end, the Egyptian-Jordanian linkage discussed above will be incorporated into a five-country, 2,000 mw power grid (Syria-Turkey, 124 km; Turkey-Iraq, 129 km; Iraq-Syria, 165 km; Syria-Jordan 210 km; and Jordan-Egypt, 300 km). This project has a proposed cost of $508 million. Other interconnection projects include expansion of Israel's connection to the West Bank and Gaza, and a $2.5 billion project connecting the 11 countries in the "Arab Meshreq" by the year 2000.

C2. Sustainability Considerations

Environmental concerns. Environmental gains from international cooperation in this field are well-documented. Since participating nations do not have to maintain a full range of facilities to support base and peak loads, more efficient planning can take place, and overall combustion of pollution-producing fuels can be reduced. In addition, inefficient configurations can be avoided. For example, coal-fired plants—highly appropriate in their design to meet base loads—should not automatically follow demand, since they become more environmentally problematic when used to supply peak loads.

Overall, transmission losses resulting from interconnection are not sufficient to outweigh the anticipated reductions in generation. The distances involved in the proposed projects are not excessive by any international standards. For example, 1,100 km high-voltage lines planned by the Quebec Hydroelectric Commission (exceeding a 604 km. existing line) are expected to have

line losses of only 5-10 percent. Under the proposed peace projects, line losses would be more than compensated by the potential in reduced generation and reserve margins through the optimization of a peace region grid.

Regional environmental concerns will naturally focus on potential electromagnetic radiation (EMR) exposures, right of way, and landscaping issues. While the scientific verdict on EMR is still out, prudence dictates distancing new lines from densely populated and sensitive areas (e.g., schools). New York State's relatively conservative guidelines may be an appropriate example for adoption by the proposed regional network. The importance of a comprehensive EIS authorized to make recommendations on line routes to reduce EMR exposures and aesthetic damage cannot be underestimated.

Privatization. Most of the proposals set forward recognize that a regional grid will require new international utilities to oversee equitable usage and expenditures within the system. Given the complexity of sovereignty issues, participating governments will be involved both during construction and at least the initial stages of utility operations.

Interconnection holds very positive implications for privatization, since it can create a market for private sector contribution. International agreements could force the multinational utility to pay "avoided cost fees" to local small producers. Moreover, in the area of renewable energy development—crucial to the long-term independence of the oil-poor countries—such a demand has the potential to offer real incentives to bring new, clean energy production facilities (geothermal stations, solar facilities) on-line.

D. Oil Pipelines

D1. Project Descriptions

With two-thirds of the world's oil resources located in the Middle East, real economic savings in crude oil transport can be made within a peaceful and stable region. Israel and Jordan have been enthusiastically promoting several crude oil pipelines. At present, most oil transport to Jordan is done overland by trucks, with all the attendant safety and environmental ramifications. Palestinians and Israelis receive their petroleum at the ports of Eilat and Ashdod. Given that in 1992 the largest portion of Middle East oil exports (26.5%) was sent to Europe, direct access to Mediterranean ports will save tanker costs involved in transport around Africa or through the Suez Canal, and will reduce the risk of oil spills in the increasingly polluted Red Sea.

Under to a Jordanian plan, an Iraqi-Jordanian Crude Oil Pipeline ending in the Gulf of Aqaba would be laid during 1996-1998, running 98 km at a cost of US$ 1.4 billion. Israel, meanwhile, is emphasizing the revitalization of the region's old lines, only half of whose 290 million ton capacity is used today due to security reasons. For example, the Saudi Arabia-Jordan-Golan-Lebanon line could transport 25 million tons of oil annually, with direct Mediterranean access. Similarly, the old IPC line, originating in Iraq and crossing Jordan to end at the port of Haifa, has a 70 million ton/year potential. Other plans, such as linking the South Suez oil fields to Alexandrian ports offer similar logistical advantages.

D2. Sustainability Considerations

Environmental concerns. Generally, pipelines are considered more environmentally benign than oil tanker or truck transport. Environmental concerns focus on the potential for leakage, sabotage, and explosions, and high-profile disasters in Russia have confirmed these fears. However, it is not clear that such experience is instructive. Russia combines the harshest imaginable climatic conditions (huge temperature swings) with overall under-capitalization and negligence (poor welding, inadequate cathodic protection), to produce the noted deleterious results.

Nonetheless, the re-initiation of old lines will require extremely methodical inspection to ensure that the pipelines meet current safety standards designed to prevent future leaks and spills, and to minimize the damage from catastrophic events. Ongoing maintenance and monitoring (e.g., shooting "pigs" down the pipeline to check welds, etc.) and adequate surface water separation facilities stations can prevent most problems. An EIS should include an expanded section on pollution prevention measures.

There appears to be little reason why pipelines could not be privately operated, although given their multinational character, government involvement is probably inevitable. Of greater importance is ensuring that private energy developers have access to pipe capacity.

E. Oil Shale Exploration

E1. Project Description

Oil shale constitutes Jordan's and Israel's sole potential commercial energy reserve, with 40 billion tons located in Jordan and 12 billion tons in Israel. The relatively low percentage of reclaimable organic material (approximately 10 percent), combined with the low price of coal and crude oil, continue to raise questions about the economic feasibility of this energy option. Yet, to the extent that conventional fuel prices rise, or energy independence becomes an increasingly important political objective, there will be greater justification (and pressure) to develop these oil shale reserves.

Jordan estimates that it can extract four billion tons from its present resource and is planning to construct a pilot plant that will ultimately produce 75 barrels/day, in addition to sulfur by-products. Israel's efforts in this field focus on oil shale fuel production and combustion commercial technologies. In the regional context, Israel has suggested joint oil shale exploration projects with Jordan, including an evaluation of deposit quantities and quality, construction of an oil shale power station, and research and development to reduce extraction costs.

E2. Sustainability Considerations

Environmentally, oil shale is not a high-priority energy source. Considered to combine "the world of coal and oil," it is both dirty and water-intensive. While commercial mining invariably causes immediate damage to landscape, reclamation is possible if adequate financial resources are reserved for it.

Israel's oil-shale development is spearheaded by PAMA Ltd., an example of a primarily government-owned company that is being transferred to private investors. If subsidies are provided, or if fuel prices rise, such an investment might be attractive. Indeed, the Ormat Corporation has already approached Israel's Electric Company regarding an exploration project to identify potential mining locations. According to Ormat officials, oil shale development is perceived as "inevitable," given the absence of alternative fuels in the country.

If indeed oil shale is to become part of Israel and Jordan's energy portfolio for security reasons, it is important that adequate precautions are taken to minimize environmental impacts. As an example, solid waste disposal problems are considered massive relative to other fuel sources. If long-term damage to the landscape is to be reduced, it is crucial that any mining of oil shale resources be conditional on sufficient investment in publicly run reclamation funds. While Israel is the only peace region country with such a legal requirement at present, even there the provision is frequently not enforced, particularly in cases of government-owned corporations (e.g., the Dead Sea Works).

The intense demand for water in existing refining technologies raises both ecological and economic questions about the wisdom of pursuing this option with present technologies. Assessment of oil shale reserves as a peace project has certain merits if it goes beyond simply mapping deposit properties and includes carrying capacity, landscape sensitivity, aesthetics, etc. The EIS for any extraction program should pay adequate attention to waste disposal and post-project land restoration.

F. Renewable Resources: Solar and Geothermal Power Development

F1. Project Descriptions

Solar energy. As all peace region countries enjoy a plentiful supply of sunlight for most of the year, solar energy has an intuitive appeal as part of any energy strategy. As of 1994, 25 percent of all Jordanian homes were supplied with solar heaters, up from 12 percent in 1986. In Israel, solar heaters help save 640 million kilowatt-hours (3.2% of the nation's energy requirements) each year. However, since the onset of the solar heater diffusion program in the 1970s, the field of solar technology has experienced little innovation in the peace region. For example, Luz, the Israeli corporation whose reflector technologies gave rise to the first "solar city" in California, has never generated a watt of energy in Israel. With proper incentives, however, development could catapult the region to the leading edge of this most sustainable of technologies. Experts estimate that by the year 2050, solar cells will produce 20-30 percent of the world's electricity. If these projections prove correct, the export of solar technology could prove to be a major source of income in this region in the coming century.

Among the projects promoted by Jordan is the expansion of solar ponds. Due to the variation in the salinity of area water, temperatures a few meters below the surface in solar ponds can rise as high as 100 degrees Celsius, and the heat trapped in between the salinity strata can be tapped. The Dead Sea, with its high temperatures and natural salinity, is an ideal natural location for applying this technology, as a now defunct Ormat pilot project demonstrated. The proposed Jordanian pilot project would establish a solar pond to generate electricity and heat a greenhouse at a cost of only $1 million.

Due to power loss during conversion from heat to electrical current, solar ponds may not yet be market competitive as a means of electrical production. Yet for certain projects such as desalinization, which require heat rather than electrical power, losing no energy to conversion, they may in fact be highly cost-effective.

An Israeli project proposes construction of solar towers with heliostat fields at the Dead Sea Works or the Jordan Potash facility. The feasibility of solar towers was first demonstrated in 1976 at the 10 mw electric generating station in Daggett, California. The Daggett facility uses a 72-acre field of mirrors to concentrate sunlight at the top of a central tower and generate thermal energy from the sunlight to heat steam that then powers electricity-generating turbines. Similar smaller projects exist in Israel, including the Weitzman Institute's solar facility.

Some analysts believe that solar power towers have relatively low net useful energy yields and are expensive to build. Indeed, while their impact on air and water is low, solar energy stations require large areas of land for solar collection. Moreover, the desert biomes in which they are often built usually lack the water needed in the cooling towers to re-condense spent steam. At the same time, new designs and innovations could make these towers economically competitive.

Photovoltaics might also be integrated into new regional solar projects. With the upscaling of U.S. projects based on this technology (most notably the recent Envron/Solarex 100 mw Nevada joint venture), there is a sense of optimism regarding feasibility. With significant economies of scale in place, costs can be reduced sufficiently to compete with more conventional technologies. The advantage of photovoltaics is its ability to generate meaningful quantities of power independent from a central grid. This holds clear advantages for the more rural and remote districts of Jordan and Egypt, even if for the foreseeable future there will be a need for a back-up power source (e.g., hybrids, using wind or standard diesel turbines).

The use of solar power cells could be limited by insufficient amounts of cadmium and gallium. What's more, without proper pollution control, the manufacture of photovoltaic cells can cause moderate water pollution from chemical and hazardous wastes. Therefore, peace projects should remain small-scale, focusing on overcoming these difficulties so that the region may become a world leader in environmentally benign solar power.

Geothermal energy. Geothermal energy can be exploited in two ways—by tapping the heat of underground geological formations, or by harnessing direct hydrothermal power. Despite its environmental merits, however, geothermal power is not a panacea. For example, only about 1 percent of total potential hydrothermal energy can be used and converted to electricity.

For geothermal energy to be successfully generated, a temperature threshold no lower than 100 degrees Celsius is required. Geothermal potential in Jordan appears limited at present to a series of hot springs, primarily in the Dead Sea region, whose combined flow is 2000 m^3 per hour. Jordan has planned a pilot plant that would entail drilling deep wells into the hot dry rock. Injected water would then be heated during transit through the fractures, and the emerging steam would be harnessed to turn turbines. Such a plant could be operational within a few years at a cost of $1.6 million.

Israel's Ormat Corporation has become a world leader in geothermal technologies, although ironically, it has established no facilities in Israel. The Ormat system does not use steam turbines, but involves a closed circulation system whereby steam is recondensed into water and reinjected into the hot rocks. This method essentially eliminates the release of underground pollutants and is capable of producing energy at relatively lower temperatures than other systems.

F2. Sustainability and Privatization Considerations

The environmental and self-sufficiency merits of solar energy are self-evident, and hardly need elaboration. The environmental advantages of geothermal power sources are also well-documented. As no fuel is burned, there are practically no emissions with steam units (at most, releases of trace quantities of natural sulfur, H_2SO_2 and silicon) and none associated with the Ormat closed system. What's more, neither contributes meaningfully to greenhouse warming through gas emissions. Aesthetically, the smaller scale and lack of smokestacks make geothermal plants less conspicuous in natural landscapes.

It is worth mentioning that because of the relatively modest costs of establishing small and medium-sized solar and geothermal plants, they may offer the most promising area for entrepreneurial participation in regional energy schemes. Funding of regional interconnection should include "buy-back" requirements to provide additional economic incentives. For instance, in Israel, the opening of the National Electric Company grid to private generators has created small solar initiatives on desert *kibbutzim*. There is also greater justification for providing market subsidies to renewable energy projects than for other technologies that weaken the balance of trade and have harmful environmental impacts.

G. Canals

G1. Project Descriptions

Proponents cite numerous benefits associated with their canal proposals, but the present context is limited to a brief review of their implications for generating power. According to Jordanian proposals, exploiting the 400-meter elevation drop between the two seas, the Red Sea-Dead Sea Canal would produce up to 360 mw of power per year. Infrastructure would include pump stations, 220 kilometers of pipeline (in addition to the open canal), four reservoirs, and four hydroelectric stations. Israel estimates that the potential power generation capacity from three power stations each in Saudi Arabia, Israel, and Jordan would generate 600 mw of electricity. A Trilateral Committee report from Israel, Jordan, and the U.S. inserts a desalinization component in the proposal.

An Israeli proposal for a Mediterranean Sea-Dead Sea Canal would convey Mediterranean seawater from Haifa to the Jordan Rift Valley, where it would be desalinated in reverse osmosis plants, making use of the hydrostatic energy created by the elevation difference. The 800 million m^3 of desalinated water produced yearly would be stored for drinking in a new lake to be created in the Rift Valley. The "Med-Dead Canal project," as this venture is known, while designed to be self-sufficient, is not expected to produce excess energy.

An alternate Israeli Med-Dead Canal proposal, designed primarily to produce hydroelectric power, would carry water from the Mediterranean Sea near Qatif to an 800 mw power station at

the Dead Sea. This project would entail two stages: a filling stage of 17-20 years, during which the Dead Sea would be restored to its pre-1930 level and electricity would be produced at 2,000 million kwh/year; and a steady state stage, during which flow to the Dead Sea would be reduced to maintain an elevation of -390.5 meters and electricity production would be 1,300 million kwh/year.

G2. Sustainability Considerations

Economists and environmentalists have raised numerous questions about the wisdom of these massive canal proposals and their ultimate benefits. Salient issues include particulate air pollution during construction, seismic risk, interference with wildlife, groundwater contamination, discharge of desalinated waste streams, modified water levels, and chemical composition of the unique Dead Sea waters. Impact assessments have yet to be prepared and are of course particularly important in projects with such broad geographical scopes and potential implications.

H. Yarmuk Dams

H1. Project Description

Construction of two dams on the Yarmuk River was included as part of the water resources agreement in the Jordan-Israel Peace Treaty. Given both parties' commitment to expeditious implementation of all provisions in the treaty, this project is most certainly on the fast track. Hence, it is unfortunate that relatively little data is available concerning the dams themselves.

The Yarmuk River flows west until it meets the Jordan River. A thumbnail description of a $300 million dam complex at Magarin, 20 kilometers north of Irbid, has been published by the Jordanian government. The dams, creating a 225 million m^3 reservoir, are primarily designated as water supply projects, and not hydroelectric facilities. Nonetheless, the 140-meter-high, concrete-covered complex will generate 15 mw of power. Construction is expected to take four years, and donors meetings have been held as early as 1988.

H2. Sustainability Consideration

The long-term benefits of dams are increasingly denounced, given the extended time horizons used in environmental impact statements. Indeed, the only major project of this type in the peace region, the Aswan Dam, is the subject of much criticism due to the impact it has had on agriculture, sand deposition in the Mediterranean, beaches, and fishing. Beyond the conventional damage caused by hydroelectric dams (lost recreational resources, silting, etc.), the location of the Yarmuk dams along the Syro-African Rift Valley raises questions about the potential for earthquakes and the impacts of resulting floods.

I. Conclusion

Table 1 summarizes the projects reviewed from the perspective of sustainability. It is unlikely that any single project will offer a sustainable panacea for the region's energy needs. As a general rule, projects deserving fast-track support include those that both contribute to long-term energy independence and are environmentally friendly. Interconnection of electrical networks, development of oil pipelines, and expansion of solar and geothermal sources are

preferable, using these limited criteria. A burden of proof preventing implementation of potentially destructive projects such as dams and canals should be in place until detailed and scientifically reviewed environmental impact assessments prove otherwise.

It is important to emphasize that *none of the projects surveyed in this report have been adequately addressed from an environmental perspective*. Given the role that tourism is to play in the region, it is crucial that international donors make future support contingent on systematic preparation of environmental impact assessments, both for individual projects and for the cumulative impact of projects for each sub-region (e,g., the Gulf of Aqaba). An institutional forum for regional oversight capacity should be established that includes participation by competent NGO professionals and independent scientists.

With oil prices low in international markets, alternative energy development has receded in recent years. Yet, even recent history shows that the fossil fuel market is subject to vast fluctuations, and that in the long run prices will rise precipitously. Common sense therefore dictates the need to diversify fuel sources and suppliers. In countries with practically no domestic supplies, this need presents an opportunity to seek out relatively benign sources of energy (e.g., natural gas or South African coal). More important, in preparing for the eventuality of higher oil prices, it would be wise to direct resources toward expanding infrastructures and exploring pilot projects that create the capacity for using locally available and *renewable* energy resources.

As is often the case, the large number and variety of peace projects on the table suggest a supply-side approach by governments in question. However, in considering their overall energy portfolios, countries must examine demand-side options as well. Opportunities for cogeneration in industrial facilities, programs to improve energy efficiency in commercial and residential sectors, and diffusion of available solar technologies may reduce the need for building massive projects that threaten to damage the competitiveness of the region as a center for international tourism.

As a result, it is important that strategic decisions in the field are not made solely by engineers, whose professional bias tends to support construction of the power plants they so well know how to build, without a parallel commitment to energy efficiency. This is certainly analogous to the case of highway construction, where investment in public transportation rarely reflects its actual economic and environmental superiority. In the case of the peace region, where all countries have a relatively low rate of motorization, investment in public transport might prevent the geometric growth in car ownership that would otherwise accompany new societal prosperity, thereby softening future demand for polluting petroleum products.

There is little doubt that competition has the potential to improve the efficiency and the performance of the energy sector in the Middle East. From a strictly environmental perspective, the success of economic incentives in Germany and more recently in the utilities sector of the United States suggests that market forces can be harnessed for net environmental gain.

While some projects more readily lend themselves to private sector involvement (oil shale development, oil refineries, and solar and geothermal power), each requires a corresponding investment to expand regulatory capacities. Without clear regulations, strong institutions to oversee them, and meaningful sanctions for violators, expanded energy development, particularly if driven by the private sector, will have negative environmental impacts.

Table 1: Summary of Proposed Peace Region Energy Projects

Project	Countries	Cost (million $)	Contribution to Energy Independence	Negative Environmental Impact
Oil Refinery Expansion	Jordan Egypt	500 4,000	No Yes	High High
Electrical Supply Interconnection	Jordan/Egypt Israel/Palestine 5 country	150 100 508	Yes Yes Yes	Medium Medium Medium
Oil Pipeline	Iraq/Jordan SA, J, I, L	1,400 NA	No No	Medium Medium
Oil Shale	Jordan Israel	NA NA	Yes Yes	High High
Solar	Israel Jordan	NA 1	Yes Yes	Low Low
Geothermal	Jordan Israel	1.6 NA	Yes Yes	Low Low
Canals	Red-Dead Med-Dead #1 Med-Dead #2	3,000 3,500	Yes No	High High High
Dams	Jordan	300	Yes	High

An objective of environmental NGOs from the peace region should be to promote alternatives to conventional supply-side solutions. Demand-side management, conservation, regional interconnections, and preferences for renewable energy should constitute the focus of regional efforts. A strong environmental framework for energy that encompasses environmental impact assessment in the planning process, progressive laws, and sound enforcement needs to be integrated into the development process, if sustainable development is to be achieved.

SELECTED BIBLIOGRAPHY

Development Options for Regional Cooperation (Draft II)., Government of Israel, presented to Middle East/North Africa Economic Summit, Casablanca, Morocco, October 1994.

Developing the Occupied Territories: An Investment in Peace, Volume 5: Infrastructure, World Bank, Washington, D.C., 1993.

Egypt's Perspective: Regional Economic Development and Cooperation, presented to Middle East/North Africa Economic Summit, Casablanca, Morocco, October 1994.

Jordan: Tomorrow, has Arrived.... Investing in People, Ministry of Planning, The Hashemite Kingdom of Jordan, presented to Middle East/North Africa Economic Summit, Casablanca, Morocco, October 1994.

Living in the Environment, G. Tyler Miller, Jr., Sixth Edition, Wadsworth Publishing Co., Belmont, Calif., 1990.

McGraw-Hill Encyclopedia of Environmental Science and Engineering, Third Edition, Parkery and Corbitt, 1992.

National Environmental Strategy for Jordan, compiled by John P. McEachern, World Conservation Union, Economic Press Co., Amman, Jordan, 1991.

Our Shared Environment, Robin Twile and Jad Isaac, eds., Israel/Palestine Center for Research and Information, Jerusalem, December 1994.

Protecting the Gulf of Aqaba, Environmental Law Institute, Washington, D.C., February 1993.

Supercars. The Coming Light—Vehicle Revolution, Amory B. Lovins, et al., presented to European Council for an Energy-Efficient Economy, Rocky Mountain Institute, 1993.

The Environment in Israel, State of Israel/Ministry of the Environment, Custom Graphics and Publishing Ltd., Jerusalem, 1992.

World Resources 1994-1995, World Resources Institute, Oxford University Press, 1994.

APPENDIX I

SUMMARY OF PROPOSED ENERGY PROJECTS

APPENDIX 1: PROPOSED ENERGY PROJECTS

1) Aqaba Thermal Power Station (ATPS) - Jordan

The aim of this project is to help meet anticipated power demands at the beginning of the next century and to prepare the Jordanian power system for its role in regional interconnection projects.

ATPS is located 19 km south of Aqaba city towards Saudi Arabia, at 35m above sea level. Stage one of this project, already completed, entailed the construction of two oil fired steam units, each 130 MW. Stage two (presently seeking funding, to be in service by 1997,) and stage three (not yet begun, to be in service by 1999,) with each to include construction of two 130 MW steam power units burning heavy fuel oil (4, p19).

Project components of stages two and three will include construction of a boiler island, a turbo generator island, civil works and a heavy fuel oil storage tanks island (4, p19).

Both stage two and three are estimated to cost US $210 million each (1994 prices) and should be completed by 1997 and 1999, respectively. Feasibility studies have already been completed (4, p20).

2) New Oil Refinery in Aqaba - Jordan

At present the existing Jordanian refinery has a maximum capacity of 100,000 barrels/day, whereas Jordanian demand beyond the year 2000 is expected to double to over 6 million tons/year (4, p24).

The new refinery will have a capacity no less than 100,000 b/d plus auxiliary units such as gasoline production, upgrading and cracking units. Surplus oil will be exported (4, p24).

The cost of the project is estimated at US$ 500 million. The project is currently under study. Implementation time is 1996-2000 (4, p24).

3) Interconnection of the Electrical Networks of Egypt, Jordan, Iraq, Syria and Turkey

The benefits of such a link-up would be substantial due to differences in peak load demand, major differences in the marginal costs of the diversified energy pool and reduced spinning reserve and emergency back-up capacity needs (1:5, p4).

Potential challenges of project implementation include the need for a regional organization representing relevant utility companies, forcing previously belligerent countries to agree as to the form and composition of this entity and a formula for sharing accrued benefits. Furthermore, operational system control at the national level must be stable to be fair to all and permit interconnection. Lastly, the financial situation of some utilities is such that it may affect their ability to meet commercial obligations under a regional agreement.

Although the project will require high voltage transmission lines and substations spanning vacant arid land, it would require little resettlement or destruction of forests.

A) Egypt-Jordan Interconnection:

On the Egyptian side this project would entail 500 kV transmission lines: 40 km in length from the Suez substation to the Oyoun Moussa thermal power station in Sinai, an underground cable of 2 km crossing the Suez, 250 km from Oyoun to a new Taba substation. Egypt would also cover the costs of this new Taba substation (500/400/220 kV, 1x750 MVA - 1x500 MVA) (3, p58).

The costs of a 400 kV submarine cable, 13 km in length, crossing the Gulf of Aqaba, would be shared by both sides (3, p58).

Jordan would be responsible for a 400 kV transmission line of 10 km length from the Gulf of Aqaba to the Aqaba Thermal Power Station (ATPS) and construction of the ATPS (see above) (3, p59).

This project will be of great economic benefit to both sides by allowing for an energy transfer of 130-400 MW in both directions and by providing support in emergency conditions. The project will also bring forth savings of 100 MW in the generation capacity of gas units in Egypt (costing US$ 32 million) and 130 MW steam units in Jordan (costing US$ 126 million).

Costs are estimated at 150 million, financed by the Arab Fund for Economic Development. This project should be completed by 1997 (3, p59-60).

B. Five countries Interconnection

To accomplish interconnection, tie lines of 400 kV must be established between the following:

Aleppo, Syria to Birecik, Turkey - 124 km
Cizre, Turkey to Kezek, Iraq - 129 km
Qaim, Iraq to Der Zor, Syria - 165 km
Adra, Syria to N. Amman, Jordan - 210 km

Furthermore, reinforcement of existing networks in participating countries must take place as follows:

Jordan - 40 km
Syria - 480 km
Turkey - 28 km

Lastly, switching stations in participating countries must be established as follows:

Jordan - one
Syria - five
Iraq - two
Turkey - two (3, p60).

235

Once completed, this project will allow for savings in reserve generating capacity in the order of 2000 MW, on the basis of reducing the reserve margin of the five countries by 5%. It should also reduce operation and maintenance costs for each country involved (3, p61).

The project is estimated at US$ 200 million, to be financed by the Arab Fund for Economic and Social Development. Additionally, each party state will bear the costs of its own components (3, p60). The project will be divided into two phases. The first, to be completed in 1998, will connect all countries except Iraq. The second phase, to be accomplished by 2002, will connect Iraq to the loop via Syria and Turkey (3, p61).

C. Interconnection - Stage II

Stage one of this project was to establish interconnection between the five countries at 300 MW. The objective of stage two is to increase the interconnection capability to 600 MW (except between Turkey and Iraq where interchange capability is at 800 MW already), and to provide improved operation security. A necessary precursor to this stage is a third 400 kV circuit from the ATPS generating station to the Amman North substation, a distance of 345 km (4, p20). The project itself will then entail construction of a second 400 kV interconnection from the Amman North substation in Jordan to the Maraba Substation in Syria (4, p21).

Total cost will be US$ 308.8 million, to be divided between Syria and Jordan. A feasibility study has already been accomplished and project implementation should start in 2002, to be completed by 2005 (4, p22).

4) Arab Meshreq Interconnection

The Arab Meshreq, consisting of Egypt, Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, United Arab Emirates and Yemen, has a considerable mix of energy resources varying from hydro resources to abundant fossil fuel reserves. Interconnection of the countries would potentially reduce load probability loss from 0.2 to 0.02 days per year, would decrease the reserve margin from 21% to 13.5%, and facilitate energy back-up in each of the systems without adverse effect on other systems. The cost of such a project, to be operational after the year 2000, is estimated at US$ 2,500 million (3, p63).

Further interconnection projects include The Arab Maghreb countries (North Africa) and a Mediterranean Power Pool (3, p68).

5) Interconnection Expansion - Israel and the Occupied Territories

At a 1991 conference in Cairo on the subject of expanding interconnection to include Israel and the Occupied Territories, the Egyptian Minister of Energy approached the European Community to organize and fund a feasibility study. In 1993 consultants from Austria and Germany (Verbund-Plan GMBH and Lahemeyer International), undertook a comprehensive evaluation of all technical and economic facets involved in linking the electrical systems of Jordan, Egypt, Israel, and a Palestinian Self-Government Authority from 1995-2010. The report, now under revision, was submitted in May 1994 (3, p70).

As described above, presently the governments of Egypt, Iraq, Jordan, Syria and Turkey have agreed to link grids. Including Israel and the Palestinian Authority in this linkage, as proposed within the framework of multilateral negotiations conducted under the Madrid Conference umbrella, would clearly lead to greater cost efficiency for all parties involved (1:4, p1).

According to World Bank estimates, a link-up of 400 kV grids between Israel, Jordan, Egypt, Lebanon and Syria (including survey and feasibility tests, planning and implementation,) will cost US $200-300 million (1, p4). (This entails approximately 500 km of electricity lines at a cost of US$ 0.5 - 0.7 million per every km of a 400 kV line).

A. 400 kV/500 kV Network Along the Mediterranean

This project would entail construction of a double circuit transmission line and substations which will connect the existing 500 kV grid of Egypt with Israel via a 400 kV line form El Arish to Zafit. Such a transmission line would offer the shortest connection between the load centers of Egypt and Israel. This project would supplement the existing line from Suez to Taba, Aqaba, Amman Jerusalem and Zafit, only the new line would be substantially shorter.

Completion of this project relies on Egyptian plans to link El Arish to the Egyptian system early in next century (1:5, p5).

B. Interconnection at the Northern End of the Gulf of Aqaba

At the Northern end of the Gulf of Aqaba, Egypt, Israel and Jordan converge within a 50 km radius. At this ideal point, several options exist for interconnection, all of which would entail the extension or construction of substations, which would include transformers and telecommunications equipment (1:5, p5).

Option 1: Erect a 400 kV transmission line through Israel from Taba to Aqaba and then connect in Israel through a161 kV line from Eilat either to Taba or Aqaba or to both.

Option 2: Erect a submarine cable instead of a transmission line from Taba to Aqaba (1:5, p5).

Option 3: Construct a double circuit transmission 400 kV line, one circuit to connect Taba with Aqaba, a second to extend from Taba to Eilat and continue from Eilat to Aqaba.

At the present time, Egypt and Jordan have already agreed to proceed with the submarine cable. With the peace process, these plans could change.

C. Interconnection of Israeli and Jordanian Load Centers Construction of a double circuit transmission line 400 kV with one circuit connecting Amman southward to the Zafit substation belonging to the 400 kV Israel network, and a second circuit linking Amman south with a substation to be erected close to Jerusalem and continuing from there to Zafit. As an alternative, both circuits could lead to the substation near Jerusalem and continue to Zafit (1, p7).

Interconnection would provide a strong kV line from Egypt to Israel in lieu of other domestic connections (such as from the load center in Cairo to El Arish and the 400 kV backbone from Eilat to load centers in Tel Aviv).

According to the Israel report, extension of the ATPS - stage 2 would be necessary to provide the additional capacity needed to permit power export to the Palestinian Authority in the event of interconnection with Israel and the Occupied Territories.

D. Interconnection of Israel Electric Corporation and Jordanian Electric Authority Networks at the Southern End of the Dead Sea.

This project involve construction of 50 km of 161 or 132 kV transmission lines connecting the IEC substation to the JEA substation at Chor Safi via Wadi el Hasa, the extension of related substations with line feeders for the interconnection link, the erection of an auto transformer in one of the two countries, and the installation of related telecommunications equipment. This project will yield additional safety of supply for the remote Ghor area, especially Ghor Safi which is connected as a double circuit t-off to the national grid (1:5, p7).

E. Transmission line from El Arish to Israel via Gaza:

This line would link El Arish on the West Sinai coast with the Palestinian Autonomy in Gaza. The project will entail construction of 80 km of 400 kV lines from the El Arish Steam Power Plant to Gaza. However,

238

the line will be operated at 200 kV until El Arish is connected to the 500 kV grid in Egypt.

A new substation in South Gaza will need to be erected which can also be connected to a 161 kV substation in the Negev.

This system will serve as an alternative power system for the Autonomy, replacing an existing system which operates only at 20 kV. The system will also provide a second HV feeding point for the sub-transmission system in Gaza, which is presently supplied from only one substation within Gaza and from eleven outside feeders of 22 kV. Lastly, this project would enable exchanges between Israel and the local Sinai network (1:5, p8).

However, this project can only work if surplus generation capacity is in Egypt.

6) Sharing Plant Capacity at the Northern End of the Gulf

Jordan's thermal power plant will play an important role to boost voltage and provide reactive power for the transmission system since the closest puissant power plants will be situated in Ayoun Musa in Egypt, Rutenberg in Israel and at the Hussein Thermal Power Plant Station in Jordan. An Aqaba power plant can be extended and operated according to maximum effective criteria (1:5. p6).

7) Iraqi- Jordanian Crude Oil Pipeline

The demand for oil products in Jordan exceeds 3 million tons per year at present. This amount is imported by overland trucks, imposing safety and environmental hazards. The goal of this project is to supply Jordan with its basic energy requirements (including 100k b/d for the Zarka refinery (JPRC) and 150K b/d for a future refinery and industries in Aqaba - see below) through construction of a 950 km long, 48" diameter pipeline with pumping stations in Jordan and Iraq. This pipeline could also be used to export Iraqi oil through Jordan at 1 million b/d (4, p22).

The project will cost US $1.4 billion ($1 billion in Jordanian territory, $0.4 billion in Iraqi). The project is presently under study and construction should begin in 1996, to be completed by 1998 (4, p23).

8) Fuel Transportation System to Western Europe

The Middle East houses two-thirds of the world's oil reserves, most of which is located in Western Saudi Arabia, Kuwait, The United Arab Emirates and Iraq. Syria and Egypt have minor stores and also export. Currently, most oil is sent through a pipeline to the Red Sea and from there it is exported via the sea by supertankers that can hold up to 300,000 tons of oil each.

As of 1992, 26.5% of the Middle East's oil was exported to Europe. In fact, Western Europe alone imports 204 million tons from the Middle East annually, or a total of 680 super tankers (1:5, p11). To reach Western Europe, tankers leaving from the Red Sea must travel either around Africa or through the Suez Canal. Israel has proposed the construction of a pipeline to carry oil from its countries of origin to a port on the Eastern Mediterranean and from there by tanker to Europe directly (1:5, p10). Such a plan would reduce costs by reducing the number of days at sea.

While several pipelines exist with a total capacity of 290 million tons, only half are currently in use. The existing pipelines include:

1) Tapline pipeline: crosses North Saudi Arabia, Jordan, and the Golan Heights across Zidon. This line, thirty inches in diameter, can carry 25 million tons per annum if utilized. However, it has not been used since 1967 and requires repair.

2) Yanbu pipeline: traverses Saudi Arabia and ends at the Red Sea export terminal, Annual capacity: 75 million tons.

3) Eilat- Ashkelon pipeline: used to transport oil purchased from Egypt from Eilat to local refineries. Annual capacity: 55 million tons.

4) Sumed Pipeline: links the south Suez Gulf oil fields with Sidi Karir next to Alexandria to the Mediterranean shores. Annual capacity: 80 million tons.

5) Historic IPC line: originating in the Iraqi oil fields along the Gulf shore, crossing Jordan and Northern Israel towards Haifa. This line splits in the Tartar Gulf region crossing Syria for the Tartus Port. Currently not operable. Annual capacity: 70 million tons.

6) Iraqi-Turkish Line: runs from the Dortoil port in Turkey along the north eastern rim of the Mediterranean. Currently not operable. Annual capacity: 80 million tons (1:5, p13).

On the basis of trying to use as much existing pipeline as possible Israel proposes to use the Tapline pipeline, stretching it from Irbid, Jordan through Emek Israel to Haifa, a distance of 170 km. Repairs on the 1,400 km of existing line would also be necessary. The original capacity would also have to be increased from its present 25 million ton per annum which is too small in relation to the potential economic opportunity.

The Yombo Pipeline in Saudi Arabia would also be extended to the Gulf of Eilat and from the mountains of the western coast of Saudi Arabia to Aqaba, and from Aqaba to the Eilat Katza line. This proposal is limited by the Katza line's small capacity of 45 million from which Israel's consumption must be deducted (1:5, p13).

Each alternative will require investments in Israeli port terminals in Ashkelon and Haifa to prepare them for handling such activity.

The price of transport around Africa is US$ 20 per ton. From the Eastern Mediterranean to Western Europe, transportation would cost only US$ 6 per ton - a profit of US$ 12-14 per ton, divided between countries

240

involved in the pipeline project and the companies investing in it. Assuming that total volume in such a project will be 50-75 mill tons/yr. (minimal consumption scenario), total income from such a project would be US$ 600-1000 million annually (1:5, p15).

Despite the potentially large economic advantage in developing such a pipeline, some quantities of oil will inevitably continue to travel to Europe through the Suez Canal anyway. Egypt can also change the calculation by lowering the fee it imposes for crossing the Suez. (The price component of crossing the Suez currently constitutes more than 50% of the transportation cost to the final destination.) Furthermore, a security coefficient must be figured in, in case a decrease in the demand for oil or an oil crisis arises. Furthermore, Iraq's international relationships are bound to improve and its existing pipelines will return to economical operation (1:5, p15).

9) Export Oriented Refineries - Egypt

Egypt plans to establish 3 modern, export-oriented oil refineries, located at Sidi Krir, Suez, and Port Said, capable of adapting to international market quality and quantity fluctuations. They will be designed to produce "environmentally-friendly products with proven export potential." Primary service will be to regional markets (3, p74).

Sidi Krir Refinery (Mediterranean Coast) - Cost: US$ 1.5 Billion
Planned capacity of 100-120 thousand barrels per day (b/d) fed from Libyan crude - Sumed crude pipeline. It will produce all major petroleum products (3, p74).

Suez Refinery - Cost: US$ 1.2 billion
Planned capacity of 100 thousand b/d fed from Gulf crude. It will produce all major petroleum products (3, p75).

Port Said Refinery - Cost US$ 1 billion
Planned capacity of 80 thousand b/d fed from Gulf and Egyptian crude. It will produce all major petroleum products (3, p75)

10) Refinery Upgrading - Egypt

Egypt hopes to achieve higher international product quality standards through the upgrading of existing refineries by installing new secondary processing facilities. Attention is also focused on facilitating the "phasing out of lead in motor gasoline" and reducing the sulfur level of gas, fuel and diesel oil (3, p76).

Proposed are three fuel oil cracking units of 30,000-40,000 b/d each, for development in Suez and possibly Cairo and Alexandria. Cost is

241

estimated at US$ 1.5 billion. Feed stock supply will consist of fuel and gas oil from Egyptian refineries. Products will include Naptha, gasoline, jet fuel, diesel fuel and Propylene (3, p76).

Financing will be by private investment, international institutions and national and international banks (3, p77).

Furthermore, gasoline upgrading units (isomerization units) are planned for Cairo and possibly Suez and Alexandria, each with a proposed capacity of 1000-1500 tons/day each. These will produce unleaded gasoline - LPG gas oil. Estimated investment is 300 million dollars. Financing will be by national and international banks, suppliers and contractor's credit (3, p77).

11) Petrochemical Projects - Egypt

Long term prospects of growth in worldwide demand for petrochemical products appear bright, especially in developing markets. The Egyptian petroleum section plans to maximize the economic utilization of primary feed stock (natural gas, condensates, and naphtha produced for Egyptian refineries) for the production of secondary feed stocks required for petrochemical production (3, p77). Particular emphasis shall be placed on the production of rubber products, solvents, paints, foam, wires, cables, bottles, pipes, jerkins and films (3, p77).

East Alamein (Mediterranean Coast) Petrochemical Complex:

The complex will have a planned capacity of 300k tons per year of Ethylene (secondary main feed stock for the petrochemical industry), Propylene and Butadiene. Feedstock supply will derive from natural gas and condensates from fields in the Western Desert and Delta, and from (primary feed stock for petrochemicals) from Egyptian Refineries. Products will include PVC, polyethylene, Polypropylene, Ethylene, Glycol, Polystyrene, Butadiene, Polyamide, Plasticizers, Epoxy Resin and Polyurethane.

The cost is estimated at US$ 2 billion dollars. Financing will derive from investors, international institutions, banks and suppliers credit (3, p78).

North Gulf of Suez Petrochemical Complex

The complex will have a planned capacity of 200,000 tons/yr. of Ethylene. The cost is estimated at US$ 1.5 billion (3, p78).

242

12) Importing Natural Gas from Egypt and the Persian Gulf to Israel, the Palestinian Authority and Jordan

Natural gas is a relatively clean fuel with no ash or sulfur dioxide residue, thereby reducing the air pollution associated with regular fossil fuels. Egypt has increasing gas reserves, producing over 9 million tons yearly, mostly for domestic use. (3, p17).

As Egypt's gas reserves increase and convenient locations for export emerge, Egypt will probably begin to export natural gas. Recently Israel's Minister of Energy and Egypt's Minister of oil agreed to implement a project that would carry natural gas from Egypt to Israel via pipeline. A joint group of experts has been nominated to deal with the required measures (3, p18).

The French company Supregas has indicated that the transport of natural gas from Egypt is economically feasible, costing approximately US$ 800 million on the Israeli side and US $500 million on the Egyptian. Such a project could be operational in three years (3, p18).

Natural gas could also be imported from Qatar via the sea. Such a project would require the requisitioning of a fleet of suitable ships for transport, the construction of a port for unloading gas, and the preparation of underground storage facilities. The cost is estimated at US $4 billion - operational in 5 years.

13) Energy Conservation and Improvement of Thermal Comfort in Existing and Future Buildings in Jordan

Between 1980 and 1985, 108, 000 dwellings were built in Jordan and in the next 20 years Jordan will need to build an additional 431,500 new dwellings. Eighty percent of these dwellings are and will be in areas requiring heating, climatic control, or else they will suffer from dampness accompanied by fungus growth (4, p26).

The proposed project will study design, construction, maintenance and legislation in the field of energy and thermal comfort, leading to improvements that will cut down on heating energy consumption of existing buildings by 20-30% (US$ 3.7 million) (4, p26).

The cost of this project will be US$ 2.5 million with implementation between 1995 and 2000.

14) Oil Shale Exploitation

12 billion tons of oil shale are located in Israel, 40 billion in Jordan. Of poor quality, only 10%-20% of the shale is organic material, but so large a deposit could nonetheless potentially fulfill the energy needs of both countries for a long time (1:5, p19).

The low cost of coal versus the high investment cost of oil shale exploitation makes such a project a challenge. However, if crude oil prices

increase slightly to US$ 55 per ton and US $20/bbl, then oil shale products will have a reasonable payoff for the incremental investment involved (4, p27). Furthermore, investment in oil shale exploitation as a long term goal makes strategic sense in case fossil fuels become unavailable for economic or political reasons.

PAMA is an Israeli government-owned company located near the Rotem oil shale deposit in the Northern Negev. Its efforts have focused on the development of commercial technology for oil shale derived fuel production and the development of commercial technology for oil shale combustion. Various methods being explored include Moving Bed Retorting and Fast Heat Retorting.

In its report to the Casablanca Economic Conference, Israel recommended that the two countries undertake joint projects in oil shale exploitation which could include:

*evaluation of deposits and properties

*construction of a commercial oil shale powered station near various oils shale sites in the region using PAMA know-how.

*accelerated R&D activities on retorting technology and the construction of pilot facilities to search for less costly oil extraction process (1:5, p20).

15) Demonstration Oil Shale Retorting Plant to Extract Oil and Other By-Products - Jordan

Jordan has oil shale reserves of over 40 billion tons from which 4 billion tons of crude oil and several million tons of sulfur are extractable via open-pit mining.

A pilot plant will be built to retort oil shale and treat it for the production of oil products at 75 b/d and by-products such as sulfur (4, p27).

The cost of the project is estimated at US$ 6 million for implementation between 1996 and 1999 (4, p28).

16) Demonstration Direct Burning Oil Shale Plant (50 MW) to Generate Electricity - Jordan

The goal of this project is to provide Jordan with electricity by using indigenous fuel. The project requires construction of a CFB unit to burn oil shale and other helping units including a turbine, generator and electricity network (4, p28).

The project is estimated at US$ 112 million, to be implemented between 1996 and 1999 (4, p29).

344

17) Canals

Israeli Mediterranean Sea - Dead Sea Canal:

A) Northern Alternative

The goal of this project is not to provide the country with excess energy reserves, but rather to create a desalinization plant for the production of drinking water that would meet its own energy needs in a secure, economic, environmentally friendly manner.

Mediterranean sea water would be conveyed across the Northern Valleys to a plateau above the Rift, where it would be pre-treated for desalinization. This water would then be fed by a pen stock into the Jordan Rift Valley, where it would be desalinated in Reverse Osmosis plants, making use of the hydrostatic energy which is available due to the 400m elevation difference between sea level and the Jordan Valley. The plants would produce desalinated water which would be stored in a new lake to be created in the Rift Valley, and a stream of brine which would be disposed of to the Dead Sea through a lined canal, operating hydroelectric facilities on its way (1:9, p28).

The complete project would take 14-15 years at a total investment of US$ 2.8-3.5 billion(1:9, p34).

B) Central Alternative

This project consists of two periods. During the first period of 17-20 years, more sea water will be pumped through the system than can be balanced by Dead Sea evaporation, and as a result the Dead sea will be raised to its pre-1930 elevation level of -390.5m. This period will be followed by a "Steady State Period" during which flow will be reduced from 1750 to 1200 million cu. m. per year (1:9, p10).

Starting at the Mediterranean, water will enter a pumping station near Qatif which will raise the water to elevation of +100m. Water will then flow through an open 20 km long canal, to the Main Tunnel near Ourim. Water will flow through the Main Tunnel to the Regulating Reservoir above the Dead Sea cliffs at a flow rate of 64 cu. m./sec (1:9, p11). Water will then flow to a newly constructed 800 MW power station at the Dead Sea (composed of four 200 MW generating units) which will operate mainly during peak demand hours. During the first "Filling" period, the Power Station will supply 2000 million kwh/year, to be reduced to about 1300 million kwh/year during the second "Steady State" period (1:9, p12).

The project would take ten years for construction and would cost US $1300 million (at 1984 prices). With interest included, the investment cost estimate rises to US$ 1550-1800 million (1:9, p14).

Jordanian/ Israeli Red Sea - Dead Sea Canal:

This project aims to generate 360 MWH per year by using the 400

245

meters difference in elevation between the two sites. Benefits of the project include a restored Dead Sea water level, production of electricity for consumption and desalinization, and ancillary benefits, mainly marine agriculture and resort lakes. Components of the project include pump stations, 220 km pipeline/open canal, four reservoirs, four hydro-electric power stations.

Water pumping will take place next to Aqaba (either on Jordanian territory or at an artificially constructed by-national gulf) and the conduit will continue for 100 km through one to three pumping phases, up to the Arava back ridge (an elevation of +220m) (1:9, p20).

From the Arava ridge, the canal alignment will return to the Jordanian territory (along an elevation line of +200m) until a width line of 31m is reached. At this point the water will turn west and flow through three Jordanian power plants with a total capacity of 600 MW. The water will then flow towards Israel, continuing north at an elevation of 100m, until close to Neot Hakikar where it will flow through three Israeli power plants with a total capacity of 600 MW. From here the water will flow around the salt ponds of the potash works and then into the Dead Sea (1:9, p21).

Water would be pumped 18 hours per day to maintain a continuous flow of 30-40m^3/second in the canal. The project is slated to cost US$ 1,900 billion (1988 prices) and to take eight years for construction. The project is expected to earn an overall rate of return of only 6% per year (including both hydroelectric components and the possible construction of a marine agriculture project). Therefore the project depends on special encouragement financing that will take into account its non-economic assets (1:9, p27).

18) Dams

Unity Dam - Jordan:

The objective of this project is to regulate the flow of the Yarmouk River (which flows westward towards the Jordan River, directly south of Lake Tiberias). and to increase Jordan's share of present water supplies to meet the rising needs of municipal, industrial and irrigation sectors (4, p142).

The project entails construction of a 140 meter high rockfill, concrete faced dam, a reservoir with a capacity of 225 million cubic meters and a 15 megawatt hydroelectric unit. The estimated cost is US$ 300 million. At present construction of the diversion tunnel for the dam is already completed and construction period of the whole dam is expected to be approximately four years from the date of award of contract (4, p143).

19) Solar Energy

In the next 10-15 years sun radiation will remain a secondary source of energy due to low fossil fuel prices. Within 20-25 years, however, a drive to increase solar share may emerge due to various causes including a perceived scarcity of oil and significant environmental concerns.

The Sinai peninsula, the Israeli Arava and Negev and the Jordanian and Saudi Arabian deserts are all deep inside the global sun-belt providing unlimited land to build and develop joint solar facilities of demonstration size, as well as joint research and training centers. Solar towers with heliostats fields could also be constructed at the Dead Sea Works or at Jordanian Potash Works for steam production or other uses.

Another potential use for solar power is the construction of a solar pond which is simultaneously a collector of solar radiation and a large thermal storage body. The gradient solar pond presents an attractive low cost solar collector for Jordan or Israel when implemented in the Dead Sea. The Dead Sea temperature reaches 100 degrees Celsius and its salinity helps to store thermal energy.

Potential applications of such a solar pond include electricity generation and heating greenhouses. According to Michael Gill of Israel's Ormat Industries, the problem with using a solar pond for such activities other than on an experimental scale, is that under current technology excessive amounts of power are lost in the transition from solar heat to electricity. However, even under current oil prices, a solar pond may be financially competitive when used for the desalinization of water, which requires only heat, not electricity. A further objective of the ponds is to utilize Dead Sea brine instead of NaCl as a medium to create storage and gradient zones (4, p25).

The cost of such a project is estimated at 1 million, to be implemented between 1995 and 1997 (4, p26).

20) Geothermal Energy for Power Generation - JORDAN

Jordan has limited geothermal resources existing in the form of hot springs located in Ma'in, Dead Sea, Zara and Hema. Their combined discharge into the Dead Sea is 2000 cu. m. per hour. These resources are useful for heating medicine and for generating thermal and electrical energy (4, p24).

This project aims to establish a pilot plant to generate electricity using local hot springs and deep hot water as a source of heat energy. This will entail creation of an artificial fluid circulation system in the hot dry rock to extract heat. Wells will be drilled into the rock from the surface. Water will be injected which will be heated during transit through the fractures. The hot water and steam which rush out can be captured for turning a turbine (4, p24).

Total estimated cost is US$ 1.6 million. The project is still under study; implementation should begin later this year, for completion in 1996 (4, p25)

21) Short-Term Investments in the Occupied Territories Power System:

The Northern Subsystem - there is an immediate need identified by the Nablus municipality for 12 km of 11 kV of underground cable, 10 km of overhead 11 kV line, a 20 MVA 11 6.6 kV substation and other rehabilitation work. Cost: US$ 45 million

In addition there is a need to expand the regional systems of all municipalities and to increase system capacity to meet a load level of 80 MW by the year 2000 (2, p39).

Central Sub-System - There is a need to rehabilitate and expand the system to a load level of 120 MW by the year 2000. Cost US$ 50 million (2, p39).

Southern sub-system - Three 33 kV feeders and a new 15 MVA substation are required in addition to other minimum rehabilitation needs. System expansion is also needed to meet suppressed demand. Total cost - US$ 35 million (2, p39)

Gaza Sub-system - Complete system must be rebuilt and expanded to meet a load of 110 MW by 2000. Order of magnitude estimate stands at US$ 40 million (2, p40).

System interconnection - A North to south transmission line, possibly 400 kV operated initially at a lower voltage, is needed to link Palestinian distribution companies. This could be a part of regional interconnections to allow for trade with Jordan, Israel and Egypt. The cost for the necessary 300 km of transmission line would be 180 million (2. p40).

22) Long-term Investment in the Occupied Territories

Gas Turbine Peaking Capacity - To complement the base load coal steam and mid-range oil steam capacity on the Israeli system in the West Bank. This would probably require two 100 MW distillate fueled gas turbines, near Atarot and Hebron. Cost: US$ 100 million.

Gas-Fueled Combined Cycle System - Assuming Egypt could supply gas via pipeline to Western Gaza, a gas fueled 2x300 MW combined cycle plant could be constructed in Gaza to provide electricity for the occupied territories. Excess electricity could be sold to Israel and Jordan. Cost: US$ 480 million

System Operating Center - A central system operation center is needed to serve as a dispatching and system switching control center for the Palestinian transition utility and also as a power pool control point for the Egypt-Gaza/West Bank-Israel-Jordan-Syria interconnection. The project will require technical support from external utility advisors. Cost: US$ 20 million (2, p41).