PUSPIPTEK ENERGY RESEARCH LABORATORY

PROJECT PAPER

Submitted by:

OFFICE OF SCIENCE, TECHNOLOGY AND ENERGY

USAID/JAKARTA

PUSPIPTEK ENERGY RESEARCH LABORATORY
PROJECT PAPER

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Let me tell you next of stones that burn like logs. It is a fact that throughout the province of Cathay there is a sort of black stone, which is dug out of veins in the hillsides and burns like logs. These stones keep a fire going better than wood. I assure you that, if you put them on the fire in the evening and see that they are well alight, they will continue to burn all night, so that you will find them still glowing in the morning. They do not give off flames, except a little when they are first kindled, just as charcoal does, and once they have caught fire they give out great heat. And you must know that these stones are burnt throughout the province of Cathay. It is true that they also have plenty of firewood. But the population is so enormous and there are so many bath-houses and baths continually being heated, that the wood could not possibly suffice, since there is no one who does not go to a bath-house at least three times a week and take a bath, and in winter every day, if he can manage it. And every man of rank or means has his own bathroom in his house, where he takes a bath. So it is clear that there could never be enough wood to maintain such a conflagration. So these stones, being very plentiful and very cheap, effect a great saving of wood.

Marco Polo, 1298.

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete) — Amendment Number: ____

DOCUMENT CODE: 3

2. COUNTRY/ENTITY: Indonesia

3. PROJECT NUMBER: 497-0303

4. BUREAU/OFFICE: ASIA — 04

5. PROJECT TITLE (maximum 40 characters): PUSPIPTEK Energy Research Lab.

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 09 DD 30 YY 89

7. ESTIMATED DATE OF OBLIGATION (Under 'B.' below, enter 1, 2, 3, or 4)

A. Initial FY 82 B. Quarter 4 C. Final FY 85

8. COSTS ($000 OR EQUIVALENT $1 =)

A. FUNDING SOURCE	FIRST FY 82 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total	3,100	100	3,200	10,295	1,455	11,750
(Grant)	(400)	(100)	(500)	(400)	(100)	(500)
(Loan)	(2,700)	(-)	(2,700)	(9,895)	(1,355)	(11,250)
Other U.S. 1.						
Other U.S. 2.						
Host Country						
Other Donor(s)		-			4,000	4,000
TOTALS	3,100	100	3,200	10,295	5,455	15,750

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1) ST	741-B	871	978			500	2,700	500	11,250
(2)									
(3)									
(4)									
TOTALS				-	-	500	2,700	500	11,250

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each): 968 | 878 | 874 | 876 | 873

11. SECONDARY PURPOSE CODE

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)

A. Code	RGEN	TECH					
B. Amount	10,000	1,750					

13. PROJECT PURPOSE (maximum 480 characters)

To assist GOI in establishing a viable, professional energy research and development center, which will a) conduct applied energy research and technology development, b) provide support to Indonesian energy-related industries, and c) undertake technical and economic feasibility analyses on potential energy programs, projects and products.

14. SCHEDULED EVALUATIONS

Interim MM 02 YY 85 | MM 08 YY 87 | Final MM 06 YY 89

15. SOURCE/ORIGIN OF GOODS AND SERVICES: [x] 000 [x] 941 [ ] Local [ ] Other (Specify) ____

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a ____ page PP Amendment.)

17. APPROVED BY

Signature: William P. Fuller

Title: USAID Mission Director

Date Signed: MM 08 DD 26 YY 82

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM DD YY

AID 1330-4 (8-79)

PUSPIPTEK ENERGY RESEARCH LABORATORY
PROJECT PAPER

I. PROJECT SUMMARY AND RECOMMENDATIONS

B. Recommendations

It is recommended that the Project be authorized for a total of $11,750,000:

Grant	$ 500,000
Loan	$11,250,000

Terms: 40 years to include a 10 year grace period on amortization; 2% interest during the grace period and 3% therafter.

GOI Contribution	$ 4,000,000
Project Total	$15,750,000

Implementation Period: 7 years from obligation

C. Description of Project

1. Borrower

The Government of Indonesia (GOI) will be the Borrower. The Agency for Development and Application of Technology (BPPT), under the supervision of State Minister for Research and Technology, will have the overall responsibility for the project. The project's administration will be located at the PUSPIPTEK Energy Research Laboratory (PERL), one of the 11 laboratories at the National Center for Research, Science and Technology (PUSPIPTEK). BPPT will staff and manage PERL.

2. Project Summary

The program goal supported by this project is the development of the scientific and technical institutions and manpower needed by Indonesia for economic growth.

This project will assist in attaining the goal by strengthening the institutional capability to develop and demonstrate alternative energy technologies. A principal element of Indonesian energy policy is to increase the domestic consumption of nonpetroleum energy resources, thus assuring continued petroleum exports and foreign exchange earnings. In tune with this policy, the project will support the Indonesian PUSPIPTEK Energy Research Laboratory (PERL)* to conduct research, develop, test, demonstrate

*In Indonesian: Laboratorium Sumber Daya dan Energy (LSDE).

and promote cost effective equipment, processes and products that make maximum long-term use of Indonesia's energy resources.

The project will finance: academic training for advanced degrees for PERL staff at U.S. and third country universities; long-term nonacademic training in U.S. energy research laboratories; technical assistance to help with the establishment of the laboratory and in the execution of its functions; the purchase of equipment and materials necessary to carry out applied energy research and technology development; the purchase of U.S. energy technology to demonstrate its capabilities and cost effectiveness; short-term training for personnel of PERL, universities and private sector and other GOI agencies; studies and analyses necessary to plan technology development programs and the purchase of reference material and equipment necessary for a technical library.

The GOI Five Year Development Plan III (1979-1984) projects a doubling of commercial energy demand by 1984. Since petroleum is the principal commercial energy source as well as the primary earner of foreign exchange, the growth in internal consumption of energy poses serious problems for the economy as a whole. To meet this anticipated demand while ensuring a continued contribution of petroleum exports to the balance of payments and public revenues, the GOI expects to: accelerate exploration of conventional energy sources, especially oil and gas; enhance conservation of oil resources and shift the present pattern of consumption to a more balanced one; diversify the domestic use of its energy sources; and intensify research, development, and utilization of renewable and nonconventional energy technologies. (See Annex II C, Indonesian Energy Policy.)

As part of this program, the GOI created PERL as the focal point for the nation's intensified research, development and demonstration of renewable, and nonconventional and underutilized conventional energy technologies. The PERL will carry out a broad energy research and development program that is supportive of conservation of petroleum products and diversification of the energy used in the rural and industrial sectors. It will conduct studies and assessments of alternate energy strategies and technologies, facilitate the transfer of new technologies into practice and expand training opportunities in energy related activites for university staff and students.

The request for U.S. assistance in developing and strengthening the PERL represents an excellent opportunity for the U.S. This request recognizes the preeminent position of the U.S. in the energy field as exemplified by the outstanding quality of the research and technology development efforts of national laboratories, universities and private industries. It also provides unique opportunities for expanding technical and commercial cooperation between the U.S. and Indonesia through collaboration with PERL. Furthermore, PERL can also be expected to become a major center in the ASEAN region for development of energy related technology. Finally, the proposed assistance is exemplary of AID's emphasis on technology transfer and institutional development.

The GOI has requested this project based on its identification of several priority programs for applied energy research. These programs encompass the following energy sources: coal, wood, solar, biomass, geothermal and hydro. The GOI has already selected several applied research projects it believes to have significant potential to resolve some of the critical domestic energy resource and economic problems and has developed its requests for training, equipment and technical assistance around them.

Although the project is organized around identified research and development programs and activities aimed at current needs, the long run benefits and nature of the project are of ultimate importance. The project is expected to lead ultimately to a laboratory with sufficient research and management training and experience to be able to perform energy-related studies and evaluations and to carry out effective energy research and development programs. The PERL lab will orient its programs to energy requirements of industry as well as support a nascent energy industry. The laboratory will also serve as a training ground for scientists and engineers in the future, and will be a medium for transferring to private industry processes and methods developed by the laboratory. The laboratory will thus be the major instrument through which Indonesia can achieve its goals of making most effective use of its coal resources, increasing the amount of energy supplied by renewable or non-conventional sources, and reducing its domestic consumption of petroleum products. Such achievements would be of great economic benefit to the country and would improve the quality of life for its people.

An objective of the project is to support the creation of private sector energy industries in Indonesia. The project will establish a cadre of technical experts trained in the design, operation and maintenance of technologies developed by PERL. This cadre will then provide industrial support needed by fledging assembling and manufacturing firms. These firms will frequently be joint ventures with U.S. companies interested in operations in Indonesia. The selection of technologies to be tested, demonstrated and adapted by PERL will be governed by the potential interest in the private sector in marketing and manufacturing technologies proven by the PERL effort. Consequently during project implementation PERL will solicit views and advice from the Indonesian private sector on its interests in commercializing energy technology. The success of this effort to transfer technology to private sector enterprise will be monitored and evaluated during the course of the project.

The four components of the project are:

a) <u>Institutional Development</u> ($2,200,000)*

*These budget figures do not include inflation and contingencies (20%) which are covered in a separate budget line.

This component will support the development of the manpower and institutional capability of PERL and through this laboratory other Indonesian institutions so that Indonesia will be able to conduct the applied energy research and technology development needed to increase the utilization of its non-petroleum energy resources. Project loan funds will be used for MS and Ph.D. training in the U.S. and a third country for 16 staff members of PERL (42 person years, $700,000). Loan funds will be used to provide long-term advisory service to PERL (2 person years, $200,000). Additional technical assistance will be provided by loan-funded seminars and nonacademic training programs for PERL staff (and other Indonesian personnel) and work visits to the U.S. (40 person years, $800,000).

This element of the project will also promote collaborative activities with Indonesian universities through research grants to faculty members for work done at the universities and at PERL. These research grants will be administered by PERL and awarded on the basis of peer review within the Indonesian technical community. The grant program will be co-financed by the GOI. U.S. loan funds will provide one-half of the cost and the GOI will provide the other half from the PERL budget appropriation. A total of 50 of these activities will be undertaken under the project ($500,000).

In recognition of the time required to develop the manpower and institutional capacity of PEPL, the life of the project will be seven years.

b. Technology Development ($5,100,000)

This component will finance the purchase of equipment needed for the applied research, technology development and adaptation and field demonstrations to be conducted by PERL. The technology development will stress product development, i.e., the goal will be to develop specific energy processes or products that can be manufactured and marketed in Indonesia. An integral element of purchase arrangements will be the hands-on-training of PERL staff in the operation of the equipment, which will take place both in the U.S. and in Indonesia. The purchase of U.S. systems to be adapted and demonstrated will support the policy of encouraging joint ventures between U.S. manufacturers of energy systems and the Indonesian private sector for the ultimate Indonesian production of these systems. Equipment needed for the coal, biomass and solar energy programs will be acquired. The GOI and USAID have developed representative lists of the necessary equipment from reports and recommendations prepared by consultants during the development of the project. Training will be included in the equipment purchases. Since the contracts for the purchases will include this training requirement, there is no explicit budget item for it.

The coal program will emphasize direct combustion in small and mid-sized industrial and utility boilers ($700,000), coal briquetting for small industry and household use ($100,000), coal gasification systems ($700,000), bench-scale studies on liquefaction and production of coke ($300,000).

The biomass program will emphasize direct combustion systems including fluidized bed systems ($500,000), biomass gasification ($400,000), charcoal production ($100,000) and fermentation techniques ($300,000).

The solar program will emphasize solar-electric systems (photovoltaics) with laboratory-scale cell production ($300,000), system testing ($360,000) and field testing ($225,000). Additional funds ($65,000) will be used for monitoring solar thermal systems and acquisition of meteorological data.

Other technology programs will stress studies on heat transfer and corrosion of materials ($400,000). Basic workshop equipment will be provided ($300,000). An analytical laboratory will be outfitted ($350,000).

c) Assessment and Evaluation ($805,000)

This component will improve the technology assessment and evaluation capabilities of PERL through technical assistance and greater access to technical information. One of the functions of the PERL will be to analyze and report on new energy products and processes of potential benefit to Indonesia's economic development. In particular, PERL is responsible for identifying energy-related products which can be produced in Indonesia. Loan funds will be used for contracts for technical and economic feasibility studies required by PERL. These studies will assist PERL to evaluate energy programs and potential products and, as appropriate, help develop agreements with U.S. manufacturers for producing the products in Indonesia ($425,000).

In addition, to fill the information requirements of PERL, this component will apply loan funds to the purchase of equipment necessary to take advantage of energy data bases and reference materials and of materials for the technical library at PERL. This information component will be closely integrated with the National Center for Technical Information (PDIN) of the Indonesian Institute of Sciences (LIPI) ($80,000). A small computer system will be purchased for project management, mathematical analysis and word processing ($50,000).

Under the policy guidance of the Planning Unit of the Technical Committee on Energy Resources (PTE), BPPT will conduct a Coal Transportation Study of the infrastructure and technology upgrading required by the Government of Indonesia to mine and transport an expected 16 million tons of coal by 1989. A previous AID project (Energy Planning for Development I) identified increased coal production as necessary to Indonesia's future energy needs and

a study of this nature as the logical way to begin examining how to increase production. The study, to be carried out in coordination with the USAID project Energy Planning for Development II, would also examine factors important for greater utilization of coal ($250,000).

d. Project Management and Administration ($1,385,000)

This last component will fund technical assistance for project management, a technical advisor/liaison to the Agency for Development and Application of Technology, three formal project evaluations and English language training for PERL staff.

A general contractor will be selected to provide overall integration of the project, including coordination of major project contracts, assistance to the GOI in finalizing plans and organization of PERL, arrangements and support for academic and nonacademic training programs, professional guidance to contractors, continuing assistance to PERL as it develops into a quality energy R&D institution (10 person years, $785,000).

The Agency for Development and Application of Technology (BPPT) has overall responsibility for assessing technology for Indonesia's economic development, including energy technology. To assist BPPT in accessing U.S. technological capacity to solve Indonesian development problems, project grant funds will provide a U.S. science and technology liaison to BPPT. This U.S. advisor is expected to be especially influential in expanding BPPT contacts with the U.S. private sector, including U.S. energy companies and organizations. A principal focus will be on technology transfer and joint operations in Indonesia. The project will finance the continuation of this activity begun with AID/Washington funding (4 person years, $500,000).

The project will also finance three project evaluations ($60,000) and provide English language training to PERL personnel ($40,000).

e. Inflation, Contingencies

In addition to the budget estimates above, funding has been reserved for inflation and unforeseen contingencies (20%), ($2,260,000, of loan funds).

A budget summary (Table I) is presented on the following page.

TABLE I

BUDGET

1.0	INSTITUTIONAL DEVELOPMENT			
	1.1	Technical Advisor (2 person years)	200	2200
	1.2	Academic Training (42 man years)	700	
	1.3	Nonacademic Training (25 man years)	500	
	1.4	Seminars, Exchange Visits	300	
	1.5	Research Grants	500	
2.0	TECHNOLOGY DEVELOPMENT			5100
	2.1	Coal Program	1800	
	2.2	Biomass Program	1300	
	2.3	Solar Program	950	
	2.4	Other	400	
	2.5	Workshop Equipment	300	
	2.6	Analytical Laboratory	350	
3.0	ASSESSMENT/EVALUATION			805
	3.1	Technology Assessment	425	
	3.2	Library Reference Materials	80	
	3.3	Computer Support	50	
	3.4	Coal Transportation Study	250	
4.0	PROJECT MANAGEMENT AND ADMINISTRATION			1385*
	4.1	Administration (10 man years)	785	
	4.2	Advisor/Liaison to BPPT (4 man years)	500 (grant)*	
	4.3	Project Evaluation	60	
	4.4	English Language Training	40	
5.0	INFLATION AND CONTINGENCIES			2260
	TOTAL			11750*

*(Of which Grant subtotal is 500.)

D. Summary Findings

The Project Committee has reviewed this proposed project. The project satisfies requirements as technically and socially sound and economically justified. No undue delays are foreseen in negotiating the final agreements or in implementing the project.

Because of the institution building aspects and the extensive training component, the project is properly designed with a seven year life of project.

The project provides an exciting opportunity for a new type of program, longer range in perspective, with a special concern given to technology, industrialization and private sector. These topics would need to be evaluated during project implementation to determine if the project is achieving these goals and objectives. The evaluation plan properly presents this issue.

II. BACKGROUND AND DETAILED DESCRIPTION

A. Background

1. The Role of Energy in Indonesian Development

The Ministry of Mines and Energy has set forth the national energy policy in the Third Five-Year Development Plan for Indonesia (1979-1984). It is an energy policy that attempts to accomplish two objectives: to assure a dependable supply of energy necessary for continued development; and to maintain or increase the revenues and foreign exchange earnings it receives from the export of petroleum and liquefied natural gas (See Annex IIC).

In the past these two objectives have more or less been met because of the ample production of oil and gas in Indonesia. Oil production from 10 of Indonesia's 40 sedimentary basins has fluctuated around a 1.6 million barrels of oil per day (mbd) mark for over the last five years. This level of production has met the domestic demand for petroleum (395,000 barrels per day in 1980) and at the same time provided a healthy exportable surplus (1.18 mbd in 1980). Its impact on the Indonesian economy, primarily its GDP growth rate and its balance of payments position, has been phenomenal. Indeed, the recently revised GDP growth rate for Indonesia for last year is over nine percent and among the highest in the world. Further, petroleum and gas exports turned Indonesia's chronic current account deficit into a $2.3 billion surplus for 1980. Due to the oil earnings, the GOI is estimated to have accumulated over $7 billion in foreign currency reserves with commercial banks holding over $4 billion more. In 1981, however, a current account deficit was recorded due to a reduction in the non-oil

export earnings. This situation underscores the importance of maintaining oil export levels.

However, future compatibility of the two energy policy objectives is questionable, especially with the rapid growth in the domestic consumption of petroleum. Petroleum is the principal energy source that is being used to satisfy the increased domestic demand and its consumption is growing at 11 percent per year. The domestic demand for petroleum products accounts for 87 percent of the commercial energy use, distributed between the industrial, household and transportation sectors. In the industrial sector energy consumption has been growing at 12.9 percent per year. The petroleum products used in generating captive electricity account for over half the petroleum purchases in this sector. Since the State Power Company (PLN) generates electricity for only six percent of Indonesia, a heavy use of diesel for captive power will continue for quite some time. In the household sector, the potential growth in petroleum consumption (kerosene) is staggering. Compared with other countries, household energy consumption is barely at a subsistence level. Kerosene subsidies have caused domestic kerosene use to grow by 9.2 percent per year. Indonesian refineries cannot keep up with demand, requiring the importation of kerosene at world price levels. Without a maximum effort of kerosene substitution, kerosene use in Indonesia by 2003 is estimated to increase by six times the 1978 level of 32 million barrels of oil. In the transportation sector, the rapid growth in the number of vehicles will continue. Indonesia's rapid modernization, urbanization, low ratio of vehicles per capita and the need to move agricultural products to market make significant growth inevitable. Consumption of petroleum products in the transportation sector by 2003 is also expected to increase by six times its 1978 level of 32 million barrels of oil.

The problem of fulfilling the growing domestic petroleum demand is compounded by the national subsidies of petroleum products, primarily kerosene and diesel. The GOI has initiated and maintained subsidies of these fuel prices to raise the real income of Indonesia's poor and keep transport costs down. The costs to the GOI of this subsidy are high: in 1981, $2.4 billion as a national budget expenditure and even higher, over $3 billion, in economic terms because of the difference between international and domestic prices of petroleum. The GOI has taken steps to reduce the subsidy and the 1982 subsidy is expected to be $1.4 billion. But the GOI realizes the heavy burden such actions would place on the poor.

While the domestic demand will not deplete Indonesian oil and gas reserves, a decline in the exportable surplus appears certain in the short run. This does not bode well for the Indonesian public and private sectors,

particularly when Indonesia's oil earnings account for approximately 25% of the GDP, 70% of the budget revenues and over 70% of export earnings.

Domestic consumption of wood as a fuel is another facet of the strategy problem facing the GOI in assuring a dependable supply of energy. While the estimates of per capita consumption of wood as a fuel for cooking vary significantly between and within locations, the net effect is a significant contribution to deforestation and soil erosion problems. Without any substitution, Indonesian households will increase their use of wood by about threefold by 2000.

The role of energy in the Indonesian economy is paradoxical. An energy rich country, Indonesia is characterized by a very meager per capita energy consumption. In terms of commercial energy consumption (per capita), Indonesia rates below the average for lower income countries (see Table II, page 11). The average Indonesian uses the same amount of commercial energy as his counterparts in India and Pakistan, less than those in Thailand and Philippines, and much less than those in China. In general only the poorest countries of Africa have a lower per capita commercial energy consumption than Indonesia. The future economic development and social progress of Indonesia, the fifth most populous country, will demand significant increases in per capita energy consumption.

Several analyses, one funded by AID/W, have examined the future compatibility and economic effects of an Indonesian economy relying on petroleum as the major commercial energy source and wood as the principal household fuel; that is, they analyzed extensions of the current trend in domestic energy use. All of them (Energy Development International, World Bank, Bechtel and Advanced Italian Nuclear Reactor, Inc.) show domestic consumption of petroleum lowering the amount available for export and thus seriously affecting Indonesia's economy. In fact, in some cases these studies show Indonesia becoming an oil importer by the mid-1990's. Also, all of them indicate that an exportable surplus can be maintained if a program or strategy is followed to conserve and substitute alternative energy resources for the domestic use of petroleum.

The GOI is cognizant of the requirements necessary to meet the country's energy demands while maximizing petroleum export earnings. It has planned three activities as a result: accelerate exploration for conventional energy sources; enhance conservation of oil resources by substituting other energy sources; and intensify research, development and use of renewable and nonconventional energy sources.

The acceleration of petroleum exploration has already begun. During 1980 the oil companies invested more than $1 billion in drilling and testing. This investment should increase oil production by over 30,000 barrels per day.

TABLE II

ENERGY CONSUMPTION OF SELECTED COUNTRIES

Country	GDP ($) Capita 1979	Commercial Energy Per capita (KCE) 1960	1979
ASIA			
India	190	111	242
Sri Lanka	230	114	140
Pakistan	260	136	218
Indonesia	370	130	237
Thailand	590	63	376
Philippines	600	159	356
China	260	650	835
AFRICA			
Upper Volta	180	5	23
Senegal	430	110	266
Kenya	380	150	180
Zimbabwe	470	1346	791
LATIN AMERICA			
Haiti	260	36	66
Honduras	530	157	248
Peru	730	436	737
Jamaica	1260	446	1390
NEAR EAST			
Morocco	740	169	315
Egypt	480	299	565
Jordan	1180	197	552
OTHER			
Japan	8810	1333	4260
United States	10630	8228	12350
Switzerland	13920	2762	5138
USSR	4110	2866	6122

Even in the unlikely event that this pace of investment and increased production could be maintained for as long as 10 years, it still would not produce all the additional oil needed to meet the growth in domestic demand. Indonesia's difficult geology and typical small fields require continual exploration to find enough reserves just to replace current production. Many of Indonesia's unexplored basins are in deep water or difficult terrain and will be expensive to explore and develop. Thus, Indonesia can push for increased oil production to help sustain its development but cannot solely rely upon it. It must diversify its energy sources to meet the domestic demand and to do so will require applied energy research.

2. Opportunities for Diversification and Applied Energy Research

Fortunately, Indonesia has several potential alternate energy resources available, namely coal, peat, geothermal, hydropower, biomass, solar and nuclear.

Coal is Indonesia's most abundant fuel. In barrels of oil equivalent, total coal reserves are estimated to be four times as great as the petroleum reserves and seven times as great as the equivalent of the natural gas reserves. Recent estimates of hard black and lignite coal for Kalimantan alone are 100 million tons with likely reserves in excess of 500 million tons. The largest deposits, found in Kalimantan and Sumatra, are generally of a low quality, making further testing, characterization and product research necessary. Coal is a complex substance whose composition varies within mines and along seams. Because of this, analysis and information storage capability is essential in order to make most effective use of the various qualities of coal. Some of the potential uses are direct combustion for industry; coal gasification for refinery needs and combined-cycle power plants; coal/oil and coal/water mixtures for thermal power generation; carbonization to improve coking properties and to prepare a smokeless, clean burning fuel for domestic use; and even liquefaction of coal as a transportation fuel or as a substitute for kerosene.

In addition to coal, peat is found over wide areas of Sumatra and Kalimantan. The extent and quality of this resource, though, is unknown. Before Indonesia can use peat for power production, industrial heat and domestic use, it must evaluate the resource.

For electricity generation, geothermal has good potential. The total exploitable geothermal potential is estimated at 8,000-10,000 MW with half of that on Java, the country's most populated island. The Ministry of Mines and Energy has already designated several areas on Java as ready for exploitation. The first geothermal electric power plant, a 30 megawatt (MW) facility, is under construction with financial assistance from the Government of New Zealand. The GOI has invited proposals for the exploration

and exploitation of seven other identified fields on Java in an effort to reach a target of 2,000 MW capacity from geothermal sources by 2000. Still, if Indonesia is to meet this target, it has to step up its selection of sites, analysis of the power potential, determination of the physical characteristics of the steam, and design and purchases of generation equipment.

Even though the potential for hydro power is not as large on Java as it is on the other large islands (Irian Jaya, Kalimantan, Sumatra and Sulawesi), it is still estimated at 2,500 MW and is not being fully used. Indeed, the installed hydro capacity on Java is 460 MW, on Sulawesi it is 174 MW, on Sumatra 288 MW and on Kalimantan 20 MW. To take advantage of the hydro potential, the rate of investigation of soils and related hydrological studies must be increased.

Another potentially significant energy resource is biomass used for direct combustion, gasification, pyrolysis, or the production of alcohol and methane. Of Indonesia's 190 million hectares, 122 million are covered in forest. In East Kalimantan alone, unused forest waste from concessionaires, transmigration projects and agricultural expansion amounts to four million cubic meters each year. Some 17 million hectares are used for agriculture, producing almost 61,000 tons of major crops. About 45 percent of the actual energy consumption nationwide is in the form of fuelwood with agricultural wastes accounting for an additional 15 percent. The forest products industry could become energy self-sufficient by using the wastes available from the mills. Advances with fast growing trees, charcoal production and charcoal stove design open an alternative to meet the energy needs of households. The production of ethanol, about five million litres per day, has already gotten a start in south Sumatra through Japanese financing. Yet a large-scale program could still be developed to substitute up to 10 million barrels of oil equivalent per year by 1990.

The potential of solar energy is, of course, large because of the intense periods of sunlight almost every day. Since the sunlight in most of the population centers of Java is diffuse, flat arrays are more promising than focusing collectors and simpler to maintain as well. Solar hot water heating for the textile and food industries is one example of an opportunity for petroleum substitution. Because of their current high costs, photovoltaics will in the near term be appropriate primarily for specialized applications such as the extension programs in public health and education, and in communications networks to some of the remote parts of the country. However, in the long term, photovoltaic applications may assume greater importance as the cost of the devices comes down. Already their use is attracting interest as field demonstrations show their operational reliability and more cost-effective applications are pursued.

Finally, Indonesia has some uranium resources and has considered purchasing a nuclear reactor sometime near the year 2000.

3. Role of PUSPIPTEK and the National Energy Research Laboratory

In its effort to enhance and develop national capabilities in the field of research, science and technology to support the national economic development in the various sectors, e.g., industry, transportation, energy, etc., the GOI established PUSPIPTEK, the National Center for Research, Science and Technology, at Serpong near Jakarta. The PUSPIPTEK project was started in 1976 and is expected to be completed in 1986.

It is planned to consist of eleven laboratories, a Science Center, the head offices of the various national research institutes, a housing complex for the research and scientific staff, and other necessary supporting facilities.

The eleven laboratories to be established at PUSPIPTEK are:

- Strength of Materials, Components and Structures
- Aerodynamics, Gasdynamics and Vibration
- Thermodynamics, Engines and Propulsion
- Energy Research
- Technology Processes
- Multi-Purpose Nuclear Research Reactor and Relevant Laboratories
- Calibration, Instrumentation and Metrology
- Electrotechnique
- Applied Physics
- Applied Chemistry
- Metallurgy

The first five laboratories are essentially technology development and engineering facilities; these will be managed and operated by the Agency for the Development and Application of Technology (BPPT). The sixth laboratory will be the nuclear research center under the direction of the Atomic Energy Agency (BATAN). The last five are applied research facilities managed and operated by the Indonesian Institute for Science (LIPI).

The PUSPIPTEK project is analagous to the Tsukuba Science City of Japan. This municipal complex of research laboratories and educational facilities is the site of about 30 percent of the nation's government research laboratories and more than 40 percent of its government research manpower. The first institute moved to Tsukuba in 1972 and the last (43rd) in 1980.

The PUSPIPTEK Energy Research Laboratory (PERL) was established for the purpose of supporting an energy diversification program by developing to the maximum extent the use of Indonesia's alternative energy resources.

The basic policy of the PERL as set forth by the Chairman of BPPT is that its programs are to be structured to

produce processes or products which are of great benefit to Indonesia and which support the development of national industry as rapidly as possible. With this policy as its guiding principle, the Laboratory will carry out broad-based research and development programs designed to obtain the necessary information on which selection of suitable applications of each resource can be based, develop specific processes and equipment for these applications and reduce them to industrial practice. The Laboratory will be the national center in Indonesia on which the future successful diversification of energy sources depends and thus will be of great importance to the economy of the country.

The Laboratory staff will consist initially of approximately 70 scientists and engineers currently in BPPT and is expected to grow to a professional staff of over 200 by 1990, by which time the total Laboratory personnel should number over 450.

PERL will consist of eight buildings, each with a basic modular area of approximately 500 m^2 per floor. In this group of buildings, BPPT will locate its four modular laboratories (chemical, solar, physics and biology), one workshop/mechanical laboratory, one pilot plant facility and one administrative office. Construction is expected to be completed by 1985.

Although not consciously modeled on the Korea Institute of Science and Technology (KIST), an institution whose development was supported by AID funds, it is anticipated that the PERL will develop along roughly similar lines. KIST was set up by the Republic of Korea to fill the perceived need for an organization capable of solving, under contract, scientific and technical problems arising in Korean industry. The intent was that the bulk of its support would come from its contract work done for industry, with some financial support provided by the Government for long-term research and development of importance to the country as a whole. The support provided by AID to KIST at its inception has indeed lead to an institution which has realized its original intent so that now approximately 2/3 of its support comes from industrial contracts and 1/3 from government support. Among other things, KIST has performed work in support of Korea's aluminum, glass and metals industries, as well as initiated and developed a solar R&D program.

As a result of this project, it is expected that the PERL will also develop a staff trained and experienced in a multidisciplinary approach to energy research and development projects within its scope of responsibilities. Because of the Laboratory's close association with universities, through research grants, temporary appointments of faculty and graduate students to its staff, graduate thesis opportunities, use of university consultants, etc., and because of its orientation to practical applications, the Laboratory can serve as a very effective catalyst for acquainting both staff and students with the practical side of academic training, as well as increasing the number of personnel trained to enter various energy fields.

Also, because of its close ties to industry (transferring its technical developments to industry practice, training industrial personnel in new or improved processes, providing consulting advice to industry, etc.), the Laboratory can serve as an effective bridge between the academic community and industry. Experience in the developed countries has shown that this linkage leads to innovative solutions to problems which ultimately contribute significantly to upgrading the nation's standard of living and the quality of life.

PERL is established in the sense that it has been given funding for new construction. (Tenders have already been let for construction of one building and funding has been provided for the construction of another.) In addition, another building is already constructed and in use at PUSPIPTEK for ongoing energy research activities being carried out by BPPT personnel. These activities and the majority of the personnel (Annex II E(2)) will be transferred to PERL in accordance with this project.

4. Relationship to AID and Other Donor Activities

A number of other donor agencies provide technical assistance to Indonesia in energy. The activities emphasize studies, assessments and planning; the energy resources stressed are oil and gas, hydropower and coal. There is very little support given for technology development and the necessary institution building.

The World Bank, Japan, France and Canada support broad energy sector analyses. The World Bank and Japan assist in oil and gas planning. Planning in the power sector is provided by the World Bank, Australia, Canada, Japan and France. Energy resource assessment is supported by the World Bank (coal), France (oil and geothermal), New Zealand (geothermal) and Australia (coal and oil). Technical assistance in the coal sector is provided by Australia (coal port studies), Japan (coal production) and the World Bank (review of coal production prospects). Renewable energy assessments and technology development are supported by the Asian Development Bank (rural supply/demand analysis), France (demand survey), and Germany (experimental solar and biomass applications in rural areas). The Netherlands is developing a project to assist in establishing village wood lots.

Capital assistance is provided by a number of donors with the World Bank as the largest contributor. Assistance emphasizes the electric power sector and coal production.

The USAID energy program focusses on planning, manpower development and technology development and dissemination.

Energy Planning for Development I was recently completed. It provided a national overview of energy supply and demand, a survey of rural energy consumption and assessments of

selected technologies. Energy Planning for Development II (497-0318) will continue this effort with a study of regional energy supplies and demands, analyses of urban household energy consumption and an analysis of productive uses of electricity. The work will be conducted by the Energy Planning Unit of the Ministry of Mines and Energy, the operations unit of the Technical Committee of Energy Resources (PTE) of the BAKOREN.

Energy Training and Manpower Development (497-0300) supports the establishment of an interdisciplinary graduate level program in technical and economic aspects of energy development at the Institute of Technology at Bandung. Graduate level education in the U.S. is provided for members of the faculty of this new program and for other Indonesians nominated by the PTE.

Under the Science and Technology Project (497-0266) research into small scale alternative energy technologies is being conducted by BPPT.

Some of the technologies to be developed by PERL would find application in various activities of the USAID rural development program. These would include technologies for household use such as coal burning stoves, small power systems such as wood gasifiers linked to electricity generators, and solar powered applications such as remote communication systems.

B. Detailed Description

1. Goal

The goal of this project is to assure the continued economic growth of Indonesia through the development of the needed scientific and technical institutions and manpower. The role of energy is crucial to Indonesia's future: the export of oil and gas provides the bulk of governmental revenues, increased internal consumption of energy will be required for the basic needs of the growing population and for industrialization and modernization of the economy. Indonesia recognizes the need for trained manpower and strengthened institutions necessary to assure the availability of energy and its effective use.

2. Purpose

The purpose of the project is to assist the GOI in establishing a viable, professional energy research and development center, the PUSPIPTEK Energy Research Laboratory (PERL). PERL will have three objectives:

1. To conduct applied research and technology development in the field of energy.

2. To provide support to Indonesian energy-related industries.

3. To undertake technical and economic feasibility analyses on potential energy programs, projects and products.

PERL will serve as the national focal point for energy R&D. As befits its role of applied research, it will work in close cooperation with other government agencies, industry and universities -- the ultimate users of the technology produced, the suppliers of trained manpower and the researchers on basic scientific and technological principles. PERL will play a principle role in the transfer of energy technology, both into Indonesia from other countries and within Indonesia from the laboratories to the industries and ultimately to the users. Technology selection, adaption and evaluation will be required activities of PERL.

Because of the importance and complexity of its assignment, PERL will need to have a well trained staff and a program marked by a clear focus and competent management, in addition to needed equipment and facilities.

An objective of the project (and the second objective of PERL) is to support the creation of private sector energy industries in Indonesia. The project will establish a cadre of technical experts trained in the design, operation and maintenance of technologies developed by PERL. This cadre will then provide industrial support needed by fledgling assembling and manufacturing firms. These firms will frequently be joint ventures with U.S. companies interested in operations in Indonesia. The selection of technologies to be tested, demonstrated and adapted by PERL will be governed by the potential interest in the private sector in marketing and manufacturing technolgoies proven by the PERL effort.

PERL will be one of the eleven laboratories to be located in Serpong, a suburb of Jakarta, at the National Center for Research, Science and Technology (PUSPIPTEK). The PUSPIPTEK project was started in 1976. A descrete budget item of the Ministry of Research and Technology, the PUSPIPTEK Project provides the physical plant and infrastructure of the National Center. The construction of the Center is scheduled for completion in 1986. The PUSPIPTEK Project also provides general administration of the National Center. Each of the several laboratories will be equipped and operated as separate organizations under the management of the appropriate governmental agency responsible for the laboratory. Three separate agencies are involved -- the Indonesian Institute of Sciences (LIPI), the National Atomic Energy Agency (BATAN), and the Agency for the Development and Application of Technology (BPPT). (Annex II E(2)).

BPPT will be the operator of PERL and will provide overall direction and management.

3. Outputs/Inputs

USAID funds will be used for (1) institutional development, (2) technology development, (3) assessment and evaluation studies, and (4) project management and administration.

1.0 INSTITUTIONAL DEVELOPMENT

Support for the development of PERL into a professional institution stresses technical advisory services, training needs (both long-term academic and nonacademic) of the PERL personnel and seminars, exchange visits and limited short-term training. This component also includes a fund for research grants to be awarded by PERL to university researchers for studies necessary for PERL programs. The life of the project will be seven years in recognition of the time needed to develop an institution like PERL.

1.1 Technical Advisory Services

In addition to general project management, administration and support (see item 4.1), the project will require extensive in-country advisory service, especially during the initial stages of the project.. Because of the diverse requirements anticipated, it is felt that this service can best be provided by several advisors, each of whom would spend considerable time in-country, rather than a single resident advisor. This 'team' of advisors will assist in determining the operational organization of PERL, the development of its program plans, in the purchase of equipment, identification of training candidates, and the initiation of PERL operations. A total of 2 person years of effort is budgeted for this work; 50% of this will occur in-country ($200,000).

1.2 Academic Training

An essential feature of the project is long-term training of PERL personnel, both academic and on-the-job nonacademic training. For the academic training component, both MS and Ph.D. training will be provided.

PH.D. training will be provided in the U.S. for five people who will be expected to become senior scientists and research program leaders when they return to PERL. Assuming that each candidate has already attained an MS degree, the Ph.D. training is planned to require four years for each candidate and a total of 20 person years in all. The fields of study might include biology, solid state physics, chemical, electrical and mechanical engineering.

MS training in the U.S. and a third country (e.g., Asian Institute of Technology in Thailand) will be provided for a total of 11 people (5 in the U.S. and 6 in third countries). These participants would be expected to assume positions as project leaders upon completion of their overseas training. Each MS program is expected to require two years of study; a total of 10 person

years of U.S.-based training will be provided and 12 person years of third country training. The fields of study might include chemistry, physics (two participants), biology (two), chemical engineering (two), mechanical engineering (three) and electrical engineering.

For planning purposes the cost for one year of U.S. academic training is assumed to be $20,000; the cost for a year of third country training is estimated at $8,000 (based on AIT costs). The total budget for academic training is then $700,000 as follows:

U.S. -	Ph.D.	(5 people x 4 years x $20,000	= $400,000)
	MS	(5 people x 2 years x $20,000	= $200,000)
3rd Country -	MS	(6 people x 2 x $8,000	= $ 96,000)
		Rounding	= $ 4,000

Of PERL's planned staff of 118, 14% will be provided long-term academic training.

1.3 Nonacademic Training

In addition to the long-term academic training, the project will also provide academic, on-the-job training. One year internships would be arranged for PERL personnel to work in U.S. Government and national laboratories, nonprofit and for profit research organizations and private companies. Twenty-five participants will receive this training in the following illustrative areas:

Chemistry	(2)	Physics	(3)
Chemical Engineering	(3)	Instrumentation	(3)
Mechanical Engineering	(2)	Systems Analysis	(2)
Electrical Engineering	(3)	Economics	(2)
Biology/Biochemistry	(3)	Management	(2)

Approximately 21% of PERL staff will participate in this program. The cost of one year of this training is expected to average $20,000 for a component budget of $500,000.

1.4 Seminars, Exchange Visits

In order to assure that the technical personnel of the laboratory are kept abreast of regional and world wide progress in relevant technical areas, personnel will be encouraged to attend international and regional conferences and to undertake scientific exchanges with co-workers in other countries and other forms of short-term training. The PERL itself will organize and host conferences on appropriate research and technology topics both for national and for regional participation. Technical exchanges with other ASEAN countries will be of particular interest due to

Indonesia's leading role in energy issues in the ASEAN community. A total of $300,000 has been budgeted for this component:

Attendance at int'l conferences (20 trips @ $5,000)	$100,000
PERL seminars (6 @ $25,000)	$150,000
Contingency	$ 50,000
	$300,000

1.5 Research Grants

While PERL will be the focal point of national energy R&D programs, the universities offer a significant pool of trained manpower and much related work will still be conducted on university campuses and by university faculties. It is not the intent that PERL would draw university researchers away from their research and teaching work.

In the operation of PUSPIPTEK, a synergism is desired in which university faculty members and students can use PUSPIPTEK facilities for their research and PUSPIPTEK laboratories can call upon universities to conduct directed research studies as part of national programs. This project will support this approach by providing loan funds for PERL to establish a research grant program.

Under this program, PERL will identify research areas that require special attention. Research proposals submitted by university personnel will be evaluated by a technical committee organized by PERL. Winning proposals will be awarded research grants which would include work to be done on university campuses or PERL. PERL would co-finance this grant program. In the initial years, the PERL contribution would be small but it would become the major portion in the later years of the project. This phasing in of the grant program will facilitate the ultimate incorporation of a continuing grant program in PERL's operating budget.

A nominal grant will be for $10,000 in AID funds; a total of 50 grants will be awarded. The total budget for this component is $500,000.

2.0 TECHNOLOGY DEVELOPMENT

The operations of PERL will stress investigation into selected energy products and processes that are important for Indonesia's development. The focus will be placed on the effective utilization of Indonesia's non-petroleum energy resources, in particular coal, biomass and solar energy. Conservation of energy will not be an explicit theme although attention will be given to efficienc of energy use in selecting various technologies for PERL program and research grants may be awarded for conservation studies and analyses.

Project loan funds will be used to purchase equipment and technical assistance for programs in coal, biomass and solar energy; for other technical programs such as corrosion of materials and heat exchange; for general workshop equipment; and for an analytical laboratory.

2.1 Coal Programs

The coal program R&D work will consist primarily of carrying out bench-scale studies and larger scale pilot-plant-type development and demonstration projects.

A process that would prove profitable would be the substitution of coal or coal-derived gas for meeting refinery fuel requirements now satisfied with oil. It has been roughly estimated that this requires as much as 15,000 barrels per day of oil. Releasing even a large fraction of this oil for export could add significantly to additional petroleum revenue.

Low and medium calorie gas derived from coal can also be used for local industrial heating for combined-cycle power plants. Medium calorie gas can be used as feedstock for methanol or ammonia plants or for making high calorie gas suitable for pipeline transmission. It can also furnish the synthesis gas for indirect coal liquefaction (for example, the SASOL process) and for the hydrogen required in direct coal liquefaction.

For these reasons it is anticipated that two coal gasification units (one small, one large) will be built to develop and demonstrate the various options. While it is too early to specify the systems precisely, in general they will contain equipment of the following kinds, some of which will obviously be shared. The facilities would include means for unloading coal by truck into a storage area, a crusher and ball mill grinding system including a cyclone separator and bag house filter, and a pulverized coal storage bin. Either of the units could have either a dry feed or slurry feed system. The former would require pressurized lock-hoppers while the latter would require slurry preparation tanks and slurry charge pumps with agitated holding tanks. Provision for using either pure oxygen or pressurized air in the gasifier with coal and steam would be needed. Downstream equipment would require a venturi or other particulate removal device, a gas cooler, high pressure knock-out pot, recycle water heater, flash tanks, etc., for the carbon removal system. Sulfur removal equipment or carbon dioxide removal equipment could be added in later stages if found to be necessary. The small unit is estimated to cost approximately $250,000, the larger about $450,000.

Both units would be procured from the U.S. in an arrangement with an equipment supplier under which Indonesian staff members would participate in the design and receive short-term training in the U.S. on the operation of the equipment. These costs would be included in the purchase cost of the equipment.

Coal is, of course, most efficiently used in direct combustion. Indonesian coals, being low in sulfur and ash content, can be burned directly in conventional furnaces without the costly sulfur and ash removal equipment needed to satisfy environmental regulations in the U.S. and other parts of the world.

Direct combustion of coal could make a significant reduction in the domestic use of petroleum products. In 1979, some 98 percent of Indonesia's domestic energy requirements were being supplied by oil and gas and less than one percent by coal even though the country has large coal resources available.

To promote the direct combustion of coal, equipment funds in the amount of $700,000 have been earmarked to buy equipment such as the boilers and ancillary equipment necessary to identify and solve the problems in converting from diesel or gas-fired operation to coal-fired operation, and also the possible use of coal/water and coal/oil slurries where these appear to have unique application. Attention will be given to coal systems for small industrial operators especially in rural areas; this use of coal could alleviate the demand for firewood and local deforestation. Arrangements will be made with the U.S. supplier for short-term training of PERL staff members in operation and maintenance of such equipment.

Another practical application which appears to have great promise in Indonesia is the potential substitution of coal (or wood-waste) briquettes for kerosene in domestic cooking. With this objective in mind, and following a suitable feasibility and systems study, it is intended to enter into a licensing arrangement with a U.S. supplier of briquetting equipment and processes to be adapted to raw materials available in Indonesia. This is estimated to cost approximately $100,000.

Among the important bench-scale studies will be those directed toward development of means of making metallurgical coke from Indonesian coal for both ferrous and non-ferrous metal production; continuation and extension of the work on calcium carbide manufacture; the production of smokeless fuels to replace wood and kerosene for domestic use; and the improvement of means of producing commercial activated carbon. Investigations into processes of coal liquefaction will also be conducted. These bench studies are estimated to cost $300,000.

2.2 Biomass Program

Indonesia is blessed with abundant renewable resources and there appears to be good potential to make a marked improvement in the fuelwood and biomass energy situation in Java and the outer islands without either harm to the environment or infringement upon production of valuable forest products. Fast-growing fuelwood species, fuelwood plantations and agricultural residue use can

improve the situation on the island of Java, while mill residues can be used by the forestry industry on the outer islands to make those industries energy self sufficient.

The recommended research and development projects in biomass production include field plot evaluations and comparison of promising fuelwood species, utilizing wood residues in the forest products industry on the outer islands, determining the suitability of using various agricultural wastes on Java, assessing energy farming pracices and potentials, and surveying peat resources and applicable conversion technologies for peat.

To achieve these R&D objectives the biomass laboratory should carry out specific projects in direct combustion technologies, gasification, pyrolysis, fermentation technology for alcohol production and methane fermentation.

Direct combustion of wood/biomass is a mature technology and no pilot development work should be needed at the Energy Laboratory. However, to enhance public confidence in the technology, small pilot demonstration projects are required in field locations. One of these could be a small (150 kwe) wood-fired electric power plant on either Sumatra or Kalimantan. It would consist of a wood chipper, fuel storage bins, boiler, turbine, generator and auxiliary equipment at a cost of approximately $200,000. A second plant is planned to be a wood-fired steam and/or electricity producing co-generation plant set up in an industrial setting on, for example, a saw or plywood mill in Kalimantan. The Energy Laboratory would, as in the first demonstration project, provide technical assistance and a project monitoring role. The project would be a 300 kwe - 7,000 kg/hr saturated steam plant consisting of equipment similar to the first and costing about $300,000.

In developing gasification technologies, the Energy Laboratory should be equipped to conduct bench-scale advanced batch and continuous gasification tests on different biomass feedstocks. The basic data developed in these studies would be used for designing pilot facilities of which the first would be an updraft design, the second a downdraft design. The gases produced from these gasifiers, using various biomass feedstocks, would be tested in internal combustion engines and small oil-fired boilers, respectively.

The downdraft gasifier, hooked up to an internal combustion engine, would have a capacity of about 100 kg/hr of bone-dry biomass with an output of about 100-150 kwe. Feed-
stock would be low moisture wood chips, agricultural waste and other biomass feedstocks. The equipment, consisting of a gasifier, internal combustion engine, fuel bin, fuel gas scrubber, etc., is estimated to cost about $200,000.

The updraft gasifier would consist of the gasifier with a close-coupled boiler on which fluid-bed gasification/pyrolysis tests and pyrolysis product utilization tests could be performed.

Capacity would be 200 kg/hr of bone dry wood chips, logging waste, saw and plywood mill waste and agricultural waste. The major equipment required would be the gasification/pyrolysis vessel, a small oil/gas-fired boiler, cyclone feed bins, producer storage tanks, etc., at an estimated cost of about $200,000. Provision will be made so that this unit could also operate in a pyrolysis mode, obviating the need for a separate pyrolysis unit.

Biomass ethanol is a major renewable energy source which offers immediate prospects of providing a premium liquid fuel based on available domestic biomass resources to partially replace petroleum product demand in Indonesia. Ethanol use as a substitute for the lighter petroleum products such as gasoline and naphtha would complement efforts to promote wood, hydroelectric, coal and solar energy as substitutes for heavier fuel oil petroleum products.

Indonesia has embarked on an ambitious plan aimed at the ultimate development of alcohol production capacity of about 20,000,000 kl/yr of power alcohol by the year 2000. The program, conceived to consist of as many as four thousand plants with an annual production of about 5000 kl each, is a key component of the new transmigration program developed by the government to redistribute the country's population more evenly among the land masses comprising the nation.

The Energy Laboratory pilot plant area would include a pilot demonstration plant to test and standardize new and improved alcohol technologies developed through bench-scale evaluations. The capacity of the unit would be approximately 500 kl/yr (or 57 liter/hour) and would be capable of accommodating sago, sweet potatoes, cassava or cellulose biomass as feedstocks. Major equipment for such a plant, estimated to cost about $200,000, would include a grinder/chipper, cooker/extruder, fermentation tanks, distillation columns and storage. The necessary equipment would vary according to the feedstock actually being utilized.

To support PERL's biomass program, studies of fermentation techniques and processes will be undertaken. These will assist in determining production parameters for various biomass systems -- both alcohol and methane systems ($100,000).

Small systems for charcoal manufacture will be examined. The use of charcoal can reduce the consumption of firewood because charcoal can be burnt in a more controlled way than can firewood. Although a portion of the energy content of firewood is lost when it is converted to charcoal, the greater efficiency of utilization can overcome this loss and result in greater system utilization. The charcoal program would purchase systems to be evaluated for Indonesia as well as construct systems from existing designs. This component has been estimated at $100,000.

2.3 Solar Program

Solar Energy Activities in Indonesia

A number of solar energy activities are currently underway in Indonesia. They range from research projects at universities to field demonstrations managed by BPPT. The projects emphasize specific applications of solar energy, in particular photovoltaics (PV) and solar thermal process heat. The projects stress applications rather than technology development or basic research. Examples are given in Table III.

The development of PERL and the output of this project provide significant opportunities for advancing the use of solar energy and the development of solar energy technology for Indonesia.

The Government of Indonesia is especially interested in the following applications that potentially can be met by solar energy:

- Electricity for rural villages
- Communication for remote areas
- New sources of fresh water including desalination of sea or brackish water
- Cold storage in remote regions to store perishable food
- Industrial process energy

Proposed Approach of the USAID Solar Program

The solar energy program consists of the following five major elements:

1. Expansion of the photovoltaic (PV) laboratory at PERL,
2. Establishment of a PV test facility at PERL,
3. PV field tests,
4. Solar thermal laboratory testing,
5. Radiation Measurements.

The scope of the solar program involves only photovoltaic and solar thermal energy technologies and related applications. Wind energy projects in Indonesia are under the jurisdiction of LAPAN and are not explicitly covered under this USAID loan.

Primarily, this program is structured to enable PERL to do the following:

- Make and test solar cells and modules (starting with silicon, single crystal wafers) and acquire needed skills to assess state-of-the-art and advanced PV technologies;

- Test and evaluate PV modules, subsystems (e.g., controls), and load devices (e.g., pumps, refrigerators) individually and as complete systems in a flexible test facility at PERL;

- Conduct field tests to assess the technical , economic and social feasibility of U.S.-manufactured PV systems and subsystems for a variety of applications and locations, primarily in rural areas of Indonesia;

- Design, test and evaluate solar thermal systems;

- Utilize Indonesian produced or assembled equipment where appropriate, e.g. lead acid storage batteries;

- Develop a trained cadre of personnel having expertise in PV and solar thermal technologies through direct involvement in all phases of design, development and deployment as well as long-term education and training at U.S. universities and/or laboratories in industry and government.

- Enlist the participation of appropriate ministries, institutes, and other implementing agencies within Indonesia and provide a mechanism for coordination and communication with interested parties.

The five program elements are to be implemented by PERL with USAID-funded equipment and technical assistance. Assistance will be in the form of training, site inspections, requirement definition studies, preparation of specifications and review of proposals. In certain cases provision may be made for direct project management by the USAID technical implementor in close coordination with BPPT. For all activities funded under this loan, mutual agreement shall be reached by USAID and the GOI regarding objectives and implementation procedures.

TABLE III: EXAMPLES OF SOLAR ENERGY ACTIVITIES

Technology	Project	Status	Management	Funding
PHOTOVOLTAICS	5.5 kw peak water pumping system at Picon	Operational	BPPT	Fed Rep of Germany
	Ice-making and water desalination system for Cituis fishing village	Planned	BPPT	FRG
	Water pumps for three sites in Eastern Islands	Planned		FRG
	700 watt array for residential use in Jakarta	Operational		Japan
	Water pumping and lighting systems for two sites	Planned	PLN	GOI
	Small laboratory facility to produce solar cells starting with single crystal silicon wafers	Operational	BPPT	
	Evaluation of modules and acquisition of meteorological data	Ongoing	Univ of Indonesia	GOI/DJK
	Research on application	Ongoing	LIPI	GOI
	Use of radio-telephones for remote applications	In-process	PERMUTEL	GOI
	Testing of two medical refrigerators in Western Java	In-process	Ministry of Health	AID/W

continued/

TABLE III: EXAMPLES OF SOLAR ENERGY ACTIVITIES

(CONTINUED)

Technology	Project	Status	Management	Funding
SOLAR THERMAL	Experimental 1 kw water pump, desalination unit and ice-making unit at PUSPIPTEK	Planned	BPPT	
	Evaluation of water heaters	On-going	U of Indon	GOI/DJK
	Research on solar refrigeration	On-going	IPB-Bogor Inst of Agr	GOI
	Research on solar dryers and ammonia systems	On-going	Gajah Mada Univ	GOI
	Research on solar water heaters	On-going	ITB-Bandung Inst of Tech	GOI
WIND	Generators for village electrical power	Planned	LAPAN	

Program Elements

TABLE IV

ILLUSTRATIVE BUDGET FOR PROGRAM ELEMENTS

Program Element	Budget
Expansion of Photovoltaic Laboratory	$ 292,000
Photovoltaic Test Facility	360,000
Field Tests of Photovoltaic Systems	225,000
Laboratory Tests of Thermal Systems	50,000
Radiation Measurement System	23,000
TOTAL	$ 950,000

2.3.1 Photovoltaic Laboratory

The PERL is currently installing equipment for small scale fabrication of solar cells. Depending on the need of this laboratory at the time of issuance of the subject loan, funds would be made available to augment and upgrade the capability to assure that solar cells can be processed to the module stage (that is, electrically connected and encapsulated). The purpose of this work would be to permit PERL to monitor the state of the art of solar cell development and fabrication. It is not expected that PERL would produce large numbers of modules; rather PERL's work would assure that the GOI had the capability to make the proper technology choice when considering purchases of PV system. This activity is budgeted at $292,000 (see Appendix II B(3)).

At a later stage it might be appropriate for PERL to begin to manufacture larger number of PV units. Firms in the U.S. are now planning to make a complete line of both cell and module manufacturing equipment, specifically aimed at developing countries. It is recognized that this equipment would have a larger capacity than would be currently utilized in Indonesia.

However, it may be possible to purchase scaled down versions in the next few years. The evaluation of progress in this field will be monitored during the project implementation.

2.3.2 Photovoltaic Test Facility

A facility of the solar energy section of PERL would be the Photovoltaic Test Facility (PTF). The purposes of this

facility are:

a. testing of system for field applications,
b. subsystem and system evaluation,
c. advanced systems research,
d. personnel training.

The facility would be composed of the following sections (Figure 2 in Annex II B(3)).

a. a photovoltaic array and patch board,
b. energy storage system,
c. power processing devices,
d. control devices,
e. load devices,
f. instrumentation,
g. data recording, and
h. power patch board.

System testing of field applications consists of checkout of initial operation by temporarily installing the field system in the PTF after system fabrication is completed. This provides an opportunity to confirm that all components, subsystems and the system as a whole operate properly before field installation. If there are problems with the system, this provides a controlled environment for fault diagnosis and repair.

Component, subsystem and system evaluation consists of monitoring the operation of a component, subsystem or system installed in the facility or configured from facility components. This allows an evaluation of the performance as compared to either the theoretical performance or a standard system's performance.

Advanced systems research can be conducted for analysis of new concepts and designs. Such projects may include power processing, photovoltaic power control, energy storage devices or new load devices.

Personnel training will vary from maintenance training for technicians to operation training for engineers and scientists. Since the PTF can be reconnected to simulate many different types of systems, this provides a powerful tool for "hands-on" training, both of BPPT personnel and of other implementing agencies.

The activities of the PTF are not limited to those specifically outlined here but can very according to the requirements of the users.

The PTF would be composed of sections that can be connected together in a flexible manner. This will allow a

large number of system configurations to be operated with a minimum of effort and time. These sections used by a system may be either the facility components or components that are temporarily installed for purposes of testing or evaluating that component. The different sections are briefly described in the following paragraphs.

The photovoltaic array would be composed of many low power subarrays, each subarray is approximtely 3-5% of the total array power. These subarrays can be interconnected in series and parallel by the array patch board to build an array of the required voltage and current.

The energy storage system would probably be lead acid batteries since they are readily available and their characteristics are fairly well known. Lead acid batteries are currently manufactured in Indonesia. Other types of energy storage may be installed in the facility for testing and evaluation. These systems might include advanced battery systems (e.g., zinc bromide) as their development progresses.

Power processing devices used in the facility would include DC to AC ivnerters and DC to DC converters.

The control devices would control various aspects of the system operation. Typical control devices would be battery charge controllers, photovoltaic maximum power tracking, and load management controls.

The load devices would be typical devices to be used in field applications, for example, water pumps and lights, or simulated loads such as a motor/dynamometer and resistive loads. The load device would include both AC and DC devices.

If it is desired that the facility would eventually test systems interfaced with the AC grid, then provisions should be included for AC grid power into the facility.

The instrumentation provides an instantaneous indication of the condition of the system under test. This may be either panel meters, a computerized system or a combination of both.

The data recording could be done with a small data logger or by a computerized data acquisition and decoding system.

The power patch board is the central part of the PTF. It is here that the interconnections are made to construct the system in the desired configuation. An important aspect of the power patch board is that it allows for two or more independent systems to be constructed and operated simultaneously.

2.3.3 Field Tests

The emphasis in the solar energy program is on testing -- in the laboratory and in the field -- existing and advanced photovoltaic system technologies for GOI-identified, high priority needs and applications.

This emphasis is based on BPPT's stated desire to develop in-country expertise and capability with these technologies through direct experience with practical systems and applications, and through the establishment of industrial linkages with appropriate U.S. firms.

Based on discussions with personnel from BPPT, PLN and the University of Indonesia, a number of applications were identified for possible field testing using photovoltaic energy systems. These applications are described in Appendix II B(3). A total of $225,000 has been budgeted for these applications which might include rural health clinics, education centers and fishing villages. These applications would emphasize systems that have been designed under other U.S. Government projects and consequently the cost per system would be considerably reduced.

Based on budget considerations and current priorities, it is recommended that three field tests be funded under this AID loan. It is understood that the final selection of applications and potential sites will be made by BPPT in consultation with USAID. For purposes of discussion the field tests given in Appendix II B(3) are given as illustrative at this time.

2.3.4 Solar Thermal Laboratory Testing

Direct conversion of solar radiation into heat is a well understood science and there are numerous commercially available solar hot water systems, solar dryers and passive solar heating systems. The emphasis of PERL in this area will be on assessing the performance of existing systems and designs.

The solar thermal program of this project will be limited to laboratory testing. The project will provide needed monitoring and measuring equipment and a limited number of available technologies to be evaluated. ($50,000)

Of particular interest will be work in food processing, crop and fish drying. These applications generally require air type solar collectors rather than collectors using water or other fluids as the heat collection medium.

PERL will work closely with food processing and agriculture specialists from other agencies to determine the practicality of solar drying for food preservation.

2.3.5 Radiation Measurement Systems

The measurement of meteorological information over an extended period of time is needed for the design and evaluation of solar thermal and photovoltaic energy systems. Regional data from a network of meteorological stations is of course necessary. But recognizing the large area of Indonesia and its diverse climactic regions, it will also be necessary for the PERL to have site-specific information for proper evaluation of prototype and demonstration systems for use in the field. Project funds will be used to purchase equipment needed to acquire this data. ($23,000)

2.4 Other Technology Programs

Under project funds, PERL will undertake limited investigations into other areas, especially corrosion of materials and heat transfer. These areas are of prime importance not only in combustion systems using coal or biomass but also in geothermal and ocean thermal conversion systems.

Corrosion is a pervasive and expensive problem for combustion systems. Utility boilers must be periodically shut down to correct corrosion problems. But these problems also severely and adversely affect geothermal and ocean thermal systems. High temperatures, highly reactive liquids and -- in some processes -- high pressure combine to produce severe corrosion conditions. Much work is being done in the U.S. and elsewhere on solving corrosion problems and on identifying and developing materials that will be resistant to these problems. PERL will monitor this work and perform bench-scale studies on corrosion processes. By strengthening its expertise in these areas, PERL staff will be better able to assist local industries to solve their corrosion problems.

Improvements in heat transfer and exchange are crucial for developing cost-effective solar thermal, ocean thermal and geothermal systems. PERL work will include design studies, bench-scale system studies and monitoring work done elsewhere.

A total of $400,000 is earmarked for this component.

2.5 Workshop Equipment

PERL, like any R&D facility, will need a well-equipped and staffed general workshop. This unit would provide metal-working and machinery, glass-blowing and carpentry support to PERL researchers. Included would be drill presses, lathes, band saws, milling machines, table saws, jig saws, various hand tools and supplies and material.

A total of $300,000 of loan funds is earmarked for outfitting and establishing the general support workshop.

2.6 Analytical Laboratory

To support these specific projects, basic laboratory equipment, apparatus and supplies will be needed for a central analytical laboratory and some of the bench-scale evaluations. This equipment will permit the chemical and thermal analyses necessary to determine the parameters of the combustion or other conversion process, its byproducts and its efficiency. These studies will be particularly important in order to assess the environmental consequences of a full utilization of the technology.

A complete list of equipment needed is given in the planning studies (see Annex II B, especially II B(2)). The major equipment items to be purchased would include: thermal analysis system with central programmer, recorder and differential scanning calorimeter ($40,000); research gas chromotograph with flame ionization detector and thermal conductivity detector ($43,000); atomic absorption spectrophotometer, both flame and flameless ($12,000); high pressure liquid chromatograph with variable u.v. and visible spectrophotometer ($30,000); auto analyzer with nitrate and nitrite cartridge ($14,000); sulfur analyzer ($12,000); gas chromatograph analyzer ($12,000); flame ionization gas chromatograph ($17,000); dionex ion chromatograph ($25,000); infrared spectrophotometer ($20,000); various analytical and top loading balances ($22,000) total); miscellaneous supplies and spare parts for the above equipment. In addition, a large amount of standard laboratory supplies such as conductivity meters, carbon-hydrogen analyzers, calorimeters, optical microscopes, centrifuges, various types of balances, etc., would be required.

In all, a total of $350,000 is budgeted for the analytical laboratory.

3.0 ASSESSMENT AND EVALUATION

3.1 Technology Assessment

PERL will conduct social, economic and technical feasibility analyses to determine national energy technology strategies and programs and to assess effectiveness of specific projects and products. These studies will assist in the formulation of national energy policies and plans and will enable PERL to meet its three objectives of applied R&D, industrial support and economic analysis. The project will provide loan funds for short-term advisory services and consultancies. These consultancies will be structured so that PERL staff are heavily involved in the studies and acquire operational experience in the conduct of such assessments. A total of $425,000 is budgeted for this component (approximately 43 person months).

3.2 Library Reference Materials

A technical library will be established at PERL and coordinated with PDIN (the National Scientific Documentation Center). Under project funds, PERL will acquire technical periodicals and reference material.

Equipment needed for on line bibliographic searches will be purchased for PDIN and a video terminal and printer hookup between PERL and PDIN will be established. The loan will also fund short-term technical assistance to install the equipment and train the operators. A total of $80,000 is budgeted for this.

3.3 Computer Support

In addition to technical assistance for studies, technical information and equipment, the project will support computer analyses at PERL. Loan funds will purchase a small computer system for PERL. This system will assist in the management and administration of the various components of the project -- tracking and scheduling training and technical advisory visits, monitoring progress towards project goals, controlling the finances, etc. It will also be used for mathematical analyses and word processing. A general purpose, small business computer system will be purchased from a U.S. supplier. (This system would not provide extensive mathematical calculations or processing of large amounts of data. These larger systems are available in other GOI agencies if needed on an exceptional basis by PERL.) The amount budgeted for this system is $50,000.

3.4 Coal Transportation Study

Under 498-0249 (Energy Planning for Development I), AID financed a workshop to synthesize four national energy demand and supply studies. Possibly one of the most significant outcomes of the workshop was the unanimous agreement among the studies and workshop participants on the importance of coal for Indonesia's future energy needs. Coal is by far the most underutilized energy resource in Indonesia, and yet it holds the greatest potential for meeting Indonesia's energy requirements. On an energy equivalent basis, coal reserves are equal to four times the oil reserves and five times the natural gas reserves of the country. Coal production, only 400,000 tons per year now, is projected to reach 17.5 million tons by 1990 to meet the demand. Thus, Indonesian energy planners are hoping for coal production to increase 40 times over the next eight years.

There are many problems to be resolved, though, if Indonesia is to increase coal production to the expected levels. Most of the Indonesian coal is not of high quality and none of it is located near its consumers. To take advantage of the coal, energy planners will have to consider various methods

of utilizing and transporting it, including mine-mouth power generation and high-voltage power transmission to Java, dewatering and marine transport, upgrading existing rail transport, gasification or liquefaction and pipelining it to consumers, and slurrying and transport by pipeline.

BPPT will conduct a technical study on the necessary infrastructure upgrading and technical processes required for the most efficient use of Indonesian coal. This study will be coordinated with the Ministry of Mines and Energy which, under USAID Project 497-0318 (Energy Planning for Development II), will undertake studies and analyses necessary to formulate national energy strategies and policies. This study will take approximately nine months and will be performed under a contract with a technical consulting firm ($250,000).

4.0 PROJECT MANAGEMENT AND ADMINISTRATION

4.1 Overall Management

The project will require a general contractor to coordinate the several activities and to provide overall assistance and guidance in the establishment of the laboratory. The contractor would assist PERL in:

- Establishing management policies and administrative procedures;
- training selected members of the staff in conducting directed research;
- inaugurating and conducting research programs;
- establishing good relations with private sector and educational institutions; and
- identifying training needs and appropriate training and educational programs for PERL staff.

To do this the contractor will provide technical and administrative advisory assistance, will procure selected equipment and identify suppliers for other equipment, will arrange for nonacademic training in the U.S., and will identify and make initial arrangements for academic training programs.

The contractor will also provide advice and consultation regarding seminars, exchange visits and research grants with arrangements for such being made directly by BPPT. The contractor will assist PERL and BPPT to identify suitable U.S. consultants or firms to undertake feasibility studies and, if appropriate, will be responsible for contracting for these studies. The contractor will provide advice and consultations on preparing specifications and the content of bid packages, assistance in reviewing bids and in selecting the successful bidder. The contractor will prepare regular progress reports to USAID on the progress of the project. These reports will

include a complete annual report for the yearly evaluation and management review.

The contract will include funding for the project administrator, secretary, travel, material and support service.. A total of $785,000 is budgeted for this component as indicated below:

Project Administrator	(3 person years)	$180,000
Secretarial Support	(3 person years)	70,000
Support Service	(1 person year)	42,500
Travel		50,000
Material, etc.		50,000
Overhead (100%)		392,500
	TOTAL	$785,000

The contractor will possess broad experience in energy R&D, its own research laboratory facilities and experience in managing contract research and technology development. It must have excellent working relations with the entire U.S. energy sector -- universities, national laboratories, private companies and research facilities. Its role will be to provide objective, professional advice and management services to PERL. Consequently, it must be free from any commercial interest that might conflict with PERL's linkages to the U.S. private sector. Also, its role will include assisting PERL staff members find training opportunities in U.S. universities and the private sector; to do this it must have acknowledged professional standing.

A DOE national laboratory with broad energy expertise would be the preferred candidate for the general contractor. Such a laboratory (e.g., Argonne) would have the needed professional standing, experience in conducting research and managing contracts for external research and development, facilities to make necessary procurements and existing linkages with universities and private companies.

A second type of contractor would be a large, not-for-profit contract research laboratory with relevant experience in energy research and international activities. Of special interest would be prior experience in institution building in developing countries.

4.2 Advisor/Liaison to BPPT

The project will provide grant funds to support a U.S. long-term advisor to BPPT. This advisor will assist BPPT and through it the Ministry of State for Research and Technology in identifying further opportunities for increased collaboration between the U.S. and Indonesia in scientific research and technology development. A principal emphasis of the advisor's

activities will be encouraging greater linkages between the U.S. private sector and Indonesia's scientific and technological development programs, including assembly and manufacture in Indonesia. Energy will be an important, but not exclusive, sector of interest. Employment generation through private sector activities will characterize the linkages sought.

The advisor would:

a) Serve as executive level advisor-consultant to the chairman of BPPT.

b) Identify and assess opportunities for potential U.S. involvement in plans and programs of the Ministry and BPPT.

c) Make direct contacts with the U.S. business and scientific community and, in conjunction with USAID, other USG agencies.

d) Provide information concerning U.S. private sector capabilities to the chairman and his senior staff in response to specific requests.

e) Arrange high level meetings between the chairman and his senior staff and representatives of the U.S. private sector and USG agencies.

f) Serve as liaison between the U.S. Mission and the Chairman of BPPT.

The advisor will monitor the progress of the PERL project although he will not have direct operational responsibility in the project.

The project grant funds will support four person years of long-term advisory service to BPPT. A total of $500,000 in grant funds is budgeted for this component.

4.3 Project Evaluation

The project will include three formal evaluations to be conducted by individuals and organizations not responsible for the project implementation. The first evaluation will occur two and one-half years after the project is approved. The second will take place five years after project is approved. The second will take place at the end of the project. A total of $60,000 is budgeted for this activity.

In addition to the above, yearly informal evaluations will be held to review the progress of the project. These management reviews will be co-chaired by the USAID project manager and the BPPT Project Office and will include

participation by GOI officials, PERL management and U.S. contractors. The annual progress report from the general project contractor will be the emphasis of this review.

4.4 English Language Training

The staff of PERL will need extensive English language training in order to satisfy AID requirements for overseas training. Project loan funds will be used to purchase language training materials (books, cassettes and films) and services. A total of $40,000 is budgeted for this component.

5.0 INFLATION AND CONTINGENCIES

Contingencies are budgeted for $460,000 (5% of budget items) and $1,800,000 is allowed for inflation (7.5% annual over the life of project with the planned expense schedule).

III. PROJECT ANALYSES

A. Policy Framework

This project supports five elements of Indonesian national development policy: to increase the use of non-oil energy sources; to promote the development of industries; to facilitate technology transfer; to create employment; and to augment the cadre of skilled technical personnel.

Internal use of non-oil energy sources will contribute to continuing the export of oil and gas on which the Indonesian economy is so heavily dependent. Although there is currently an abundance of oil available on global markets, this oil glut is expected to be short lived as global recession ends. Consequently, Indonesian oil should find a ready market for some time to come. The importance of oil alternatives for internal consumption remains great.

Indonesia desires to promote small and medium scale industry to complement its capital intensive petrochemical and extractive mineral investments. The energy industries to be supported by this project would primarily be labor intensive ones such as metal working and small appliance manufacture. In addition, the use of the energy conversion devices in rural areas would provide reliable power sources for various local industries.

In its technology development, the PERL will seek expatriate companies who wish to set up operations in Indonesia through licensing and joint venture arrangements. By working closely with the expatriate experts, the PERL staff will become thoroughly familiar with the technology and will be able to provide technical support to the subsequent industrial operations.

The training provided to the PERL staff -- both academic and in-service internships -- will assist in creating a technical staff qualified to define, conduct and support technology research and development programs. This skill can be transferred to other energy technologies and to other technical sectors.

The project supports five elements of AID development policy: to encourage the application of alternative energy; to develop institutions; to provide training; to promote the use of the private sector in development programs; and to support rural development.

The research and development will identify technologies appropriate for greater use and the results of the field demonstrations will increase confidence in the systems. Through reports, seminars and conferences these results will be spread to a wide national and regional audience.

The project will support the institutional development of PERL and, through PERL, universities undertaking technology R&D and socioeconomic feasibility studies for energy programs and technologies. Technical training and management assistance will be provided through the project.

While alternative energy R&D is carried out in a number of institutions throughout the world, the application of the results of this work and the utilization of new energy sources have been quite disappointing. A principal reason seems to be the failure to incorporate a delivery system into the research effort. This project emphasizes the private sector as the producer, marketer and deliverer of the technologies developed at PERL. The private sector will profit from promoting (selling) their technology. Their benefits from and impetus for promoting are direct and measurable. The technologists who developed the product in the laboratory would in general find more reward in product improvement rather than in selling the current generation product.

Reliable and affordable energy supplies are frequently lacking in rural areas. This hinders rural development because man and animal power must suffice for all tasks. The project will produce energy systems suitable for use in remote areas not served by conventional energy supplies; e.g., alcohol, biomass combustion and solar systems. The availability of appropriate systems can increase the quality of life and economic productivity in rural areas.

B. Technical Analysis

AID has had extensive experience with building and strengthening scientific and technological institutes of this

kind -- e.g. Korean Institute of Science and Technology (KIST), Central American Research Institute for Industry (ICAITI), Asian Institute of Technology (AIT), and Institute for Technological Research in Brazil (IPT). Evaluation of such institutions* point out their need to interact effectively with a range of users including government entities, public and private enterprises. To do this the institute should provide research and technological services to include but not be limited to: technical information services; techno-economic studies; pilot plant and semi-commercial development work; testing and quality control services in addition to laboratory applied research. In addition, formal linkages between advanced country and the developing country institutes, established around specific programs and training activities and designed to continue for a number of years, are most important aids to research institute improvement.

This project includes all of the above elements.

There are two elements of the project which deserve specific attention. First, a formal linkage will be created between the general contractor for the project and PERL under which the contractor will provide on-site and backstopping advisory services.

Long term resident advisors will not be included, however. Instead, a team of advisors will undertake TDY assignments of up to two-month duration per visit. This will permit monitoring the progress of the project, offering expert advice and identifying problems and their solutions. The actual day by day operation will, however, be in the hands of the PERL staff and management. In short, the advisors will advise only, not implement, which is the greatest advantage of the approach.

Secondly, extensive formal education and in-service training and internships are provided with 16 people to receive advanced degrees and 25 to be placed in one-year work assignments. The stress on internships reflects the desired pragmatic orientation of the laboratory -- not basic research but technology and product development. The mix would appear to offer an appropriate balance between education for the future leaders of the laboratory and job training for its operations personnel.

The level of experimental work to be done by PERL during the course of this project is within the technical grasp of the Indonesian personnel, her technical infrastructure and

* The Industrial Research Institute in a Developing Country: A Comparative Analysis, DRI for AID, Contract AID/csd-3316.

her current needs. The technologies are essentially mature -- direct combustion techniques, alcohol production, gasification, photovoltaic application and hydropower. More exotic technologies like ocean thermal energy conversion and coal liquefaction will be examined only in a laboratory setting in order to become more familiar with them. As technical breakthroughs are made in advanced countries, PERL will be able to assess the relevance to the Indonesian situation at that time.

The choice of technology to be investigated must be determined by economic and technical considerations. The project includes a component to finance these necessary analyses. In addition, the choice will be guided by the identification of a manufacturer to produce and market the equipment. This will permit the market forces to influence the final choice -- the private sector will not want to manufacture devices for which there is no market.

In summary, the project appears to be technically feasible.

C. Financial Plan and Analysis

The total project cost is approximately $29,000,000. Of this amount AID will finance $11,750,000 in the form of both a grant and a loan. The grant totals $500,000 and will be fully funded in FY 1982. The loan of $11,250,000 will be funded in three increments as follows:

FY 82	FY 83	FY 84	TOTAL
$2,700,000	$4,000,000	$4,550,000	$11,250,000

Budget

1. Cost Calculations:

The several preparatory studies presented cost data on laboratory equipment and technology systems.

Long term technical advisory services (not resident advisors) are estimated to cost $100,000/year (not counting overhead), salary ($60,000), fringe (23%) and travel (one-half time in Indonesian at $26,000). Overhead costs would be included in the contract for project administration and support services.

Seminars and exchange visits are calculated at $25,000 per seminar and $5,000 per exchange visit.

Research grants will average $20,000 with one half the funding to be supplied by the GOI.

Various studies and analyses to be conducted by outside consultants are costed on the basis of $110,000/person year of short term consultant services.

Inflation is assumed to be 7.5% throughout tne project.

2. Allocation of Grant Funds

The grant funds will be used for contracted consultant advisory services to BPPT. Two successive two-year personal services contracts are planned. Annual costs (not including inflation) are estimated at $114,500 as indicated below:

Compensation and Other Direct	$ 66,500
Shipment/Storage of Household Effects	7,000
Housing	24,000
Travel to/from Post and R&R	5,000
Business Related Travel	10,000
Other	2,000
TOTAL	114,500

The remaining grant funds ($42,000) is reserved for inflation and contingencies for these contracts.

3. Contracting and Financing Procedures

Several contracting procedures will be utilized. Direct AID personal services contracts will be used for the grant-funded advisor to BPPT. Technical services from USG agencies would be obtained through AID-negotiated Participating Agency Service Agreements (PASAs). For the bulk of project activities, host country contracts will be awarded.

Financing procedures would vary according to the contracting procedure. For the direct AID PSCs and PASAs, USAID or AID/W will make direct payments to the supplier/contractor. For host country contracts, Direct Reimbursement and Letter of Commitment/Credit procedures will most likely be used.

BPPT will establish a separate account for the PUSPIPTEK Energy Research Laboratory to facilitate auditing of the project.

The following tables present the total project cost by component (Table III C1) and the annual costs by component and input (Table III C2).

TABLE III C1

TOTAL PROJECT COST BY COMPONENT
($000)

	AID FX	AID LC	GOI LC	TOTAL
Institutional Development				
Continuing Technical Advisory Services	180	20	-	200
Academic Training	700	-	-	700
Non-Academic Training (Internships)	500	-	-	500
Seminars, Exchanges	150	150	40	340
Research Grants	300	200	10	510
Technology Development				
Coal Program	1600	200	250	2050
Biomass Program	1200	100	250	1550
Solar Program	900	50	250	1200
Other	380	20	100	500
Workshop Equipment	280	20	100	400
Analytical Laboratory	325	25	100	450
Building Construction	-	-	2600	2600
Assessment/Evaluation				
Technology Assessment	355	70	50	475
Library Reference Materials	75	5	40	120
Computer Support	40	10	50	100
Coal Transportation Study	200	50	50	300
Project Management and Administration				
Administration	750	35	10	795
Advisor to BPPT (grant funds)	300	200	-	500
Project Evaluation	40	20	50	110
English Language Training	20	20	-	40
Inflation and Contingencies				
Contingencies	400	60	50	510
Inflation	1600	200	-	1800
PROJECT TOTAL	10295	1455	4000	15750

TABLE III C2

SUMMARY AID COSTS BY INPUT AND YEAR
($000)

	AUG 82 (1)	AUG 83 (2)	AUG 84 (3)	AUG 85 (4)	AUG 86 (5)	AUG 87 (6)	AUG 88 (7)	AUG 89	TOTAL
Continuing Advisory Services	75	150	175	150	125	25	-		700
Short Term Advisors	-	50	50	40	30	20	10		200
Consultants	175	100	200	150	50	-	-		675
Long Term Training	-	85	130	180	170	85	50		700
Professional Internships	-	100	140	100	80	40	40		500
Short Term NonAcademic	-	50	50	50	50	50	50		300
Commodities:									
Technology Systems	500	1000	1500	700	500	250	-		4450
Equipment & Hardware	200	400	200	100	50	-	-		950
Reference Materials, etc.	30	50	50	-	-	-	-		130
Management, Support Services	95	170	175	160	115	90	80		885
SUBTOTAL	1075	2155	2670	1630	1170	560	230		9490
Contingencies	-	100	100	100	100	50	10		460
Inflation	-	169	446	410	406	244	125		1800
TOTAL	1075	2424	3216	2140	1676	854	365		11750

NOTE: Included in above are grant-funded expenses of $125,000 for the advisor to BPPT in years 2, 3, 4 and 5.

D. Economic Analysis

The economics of a project like this is difficult to quantify because of its character which emphasizes institution building and technology research and development. From the macro economic point of view, it is clear that Indonesia will gain significantly from a continuation of a high volume of petroleum exports. To do this will require several steps, one of which is the reduction of the growth of internal consumption. To achieve this, alternative energy resources and technologies must be employed. Technology tests, demonstration and adaptation are necessary steps. Yet they are not enough, the technology must be produced, marketed and serviced -- functions of the private sector.

The Indonesian economy is a highly state-driven one. Although free market elements are of growing importance, the state enterprises are seen as the keystone of economic development, spawning subsidiary private sector activities of support and services. Notwithstanding the time consuming and complex procedures that must be followed, Indonesia encourages private sector efforts -- within the setting of the mixed economy. Once established in-country, expatriate companies are able to operate profitably with their Indonesian partners in a relatively unfettered environment. The Indonesian private sector is the principal hope of employing the two million new entrants to the labor force each year.

The project will seek to enhance private sector efforts in the field of energy technology by cementing the linkage between the necessary research and development and the necessary production, marketing and dissemination.

One way to quantify the benefits of the project would have been to calculate the effects of resulting oil savings. The potential reduction of oil consumption (and increase in exports) would have been estimated and the economic equivalent of this calculated. This analysis would have been based on an a priori assumption, more conjectural than analytic, that was indeed above the analysis. Consequently, this approach was rejected.

Rather, we adopted the long-term view of technology development and utilization and the effect on economic development, which is seen as better befitting the institution building and R and D character of the project.

1. Technology and Economic Development

The two principal factors of economic growth are new capital formation and technological development. That is, increases in total production of goods and services come about either from increases in the amounts and quality of inputs

employed in production or because of higher productivity, the increase in output per unit of input. Economic research into the respective roles of these two factors as engines of economic growth has been conducted by two economists, Solow and Denison, for the U.S. economy.

The pioneering work of Robert M. Solow into the extent to which increases in the amount of capital employed were responsible for the rise of U.S. nonfarm output per manhour of work between 1909 and 1949 indicated that capital intensity accounted for 19% of the measured growth in output per manhour; the rest of the average annual productivity advance was due to advances in science and engineering, a better educated and better trained labor force and better management. Although Solow cited technology as the biggest contributor to increases in the U.S. output per capita ratio, he believed that the rate at which technological advances influenced economic progress was a function of continuing investment in capital goods that incorporated the latest technical knowledge in their design.

Edward Denison produced the second in-depth economic study into this area with an analysis of the factors causing the rise in output per worker between 1929 and 1957. His findings credited improved work force education with 42% of the rise, advance of scientific and technical knowledge with 36% and increased capital intensity with only 9%. Denison stressed the importance of research and development as almost sufficient for economic growth.

Both Solow's and Denison's work have led to almost unanimous agreement on the importance of research and development for economic growth. The differences between the two concerning the role of capital investment are not pertinent to whether the public sector should be involved in research and development projects such as the PERL project. The public sector has some control over the rate of technological growth through its expenditures on and policy for education and training, its grants to universities and research foundations, government procurement policies and government set quality standards.

While the research into the exact influence of technology on economic growth in developing countries is sketchy at best, it is impossible to deny a correlation. The need for government participation is also apparent. Dramatic breakthroughs in basic science may not be a part of a developing nation's research and development agenda, but refinement and continued progress of a development is. For example, Indonesian energy research will not produce a breakthrough in the production of solar cells. It may, however, contribute to national output by designing efficient ways to use solar cells for the Indonesian market in areas such

as rural health posts, isolated communication posts and village lighting.

In summary, public support for this type of research in a developing country is consistent with economic growth theory.

2. Economic Justification

This project builds and increases the Indonesian capacity to conduct energy research and development projects. It is of an institution building nature, strengthening BPPT, the universities and private sector which will use the PUSPIPTEK Energy Research Laboratory facilities. The laboratory will not only serve as a training ground, but will also increase the incidence of development of energy technologies and support some of the energy laboratory needs of industry. If these benefits could be measured, they could easily be compared to the costs. Unfortunately, the quantification of the economic benefits for this type of project is almost impossible given the state of the art in this field of economics.

The analysis will therefore examine what the level of benefits would have to be to attain a benefit/cost ratio of 1.00. Although this approach does not allow comparison of this project with others, it does provide an idea of how the minimum level of benefits in increased output necessary to justify the project compare to the findings of economists such as Solow and Denison.

This analysis assumes that: research and development in energy will increase the rate of growth in the GDP; training attained by Indonesians as a result of the project will increase the rate of growth in the GDP; benefits from the project will not begin until 1988 but will then contribute to an increased GDP for 10 years; the growth of the Indonesian GDP would be 7.5% without the project; the discount rate is 15%; and benefits or costs from a changed income distribution are not counted.

On the last assumption, it is important to be aware of the subsidiary effects of increases in productivity. The effects include: an alteration in the structure of labor demands; an impact on political and military power; a change in international trade flows.

With the above assumptions, Table III D1 presents a projection of the increase in output resulting from the application of energy research necessary for a benefit/cost ratio of 1.0. The average annual rate of GDP growth would have to increase by .00065% p.a. during 1988 - 1997. This would be an increase of .009 of 1% in the growth rate.

Thus, the benefits of improved use or application of technology do not have to be large to justify a research and development project. Further, this increase has to be considered in the context or the findings of Denison and Solow.

TABLE III D1

Increase in GDP Required
to make Benefit/Cost Ratio Equal to One
(U.S. Millions)

Year	(1) Project Costs	(2) P.V. of Project Costs	(3) Without Project GDP	(4) With Project GDP	(5) P.V. of GDP Increases
1982	--	--	77,774	--	
1983	.50	.435	83,607	--	
1984	3.5	2.647	89,877	--	
1985	4.0	2.630	96,618	--	
1986	4.0	2.287	103,864	--	
1987	4.0	1.989	111,654	--	
1988	1.0	.432	120,028.0	120,028.8	.314
1989	1.0	.376	129,030.1	129,031.7	.587
1990	1.0	.327	138,707.4	138,709.9	.823
1991	1.0	.284	149,110.5	149,114.1	1.025
1992	1.0	.274	160,293.8	160,298.6	1.198
1993	--	--	172,315.8	172,322.0	1.344
1994	--	--	185,239.5	185,247.3	1.465
1995	--	--	199,132.4	199,142.1	1.566
1996	--	--	214,067.3	214,079.0	1.646
1997	--	--	230,122.4	230,136.3	1.710
		11.654			11.678

Benefit/Cost ratio equals 1.002

(1) Project cost equals AID and GOI disbursements.

(3) 1980 GDP base year; projected at a 7.5% p.a.

(4) 1980 GDP base year; projected at a 7.50065% p.a. from 1988 when benefits of project begin to influence economy.

E. Social Analysis

The first and most direct beneficiaries of the project will be the personnel of PERL who will receive training and technical assistance under the project. In not quite so direct a fashion, the beneficiearies would include companies that manufacture and market PERL technologies with technical support given by PERL and workers filling jobs created in these energy product companies.

In another category would be hose people who apply the technologies developed in PERL. Rural industries can have more reliable supplies of energy, lower unit cost and greater amounts of energy available due to the use of local energy resources and easy to maintain equipment. The increased production, economic growth and employment generated through the greater use of energy would benefit the residents, workers and the entire community. Households which use PERL technologies to reduce the direct consumption of wood and other biomass for cooking would have more time for directly productive or educational activities since less time would be spent in collecting firewood. To the extent that this would result in fewer trees being cut for firewood in areas with a deforestation problem, environmental quality would be enhanced, soil erosion would be reduced and water quality improved to the advantage of all.

The project will have its greatest impact on another level. The significant internal use of non-petroleum resources would enhance the amount of petroleum available for export. Since petroleum export earnings account for 70% of the GOI budget revenues, any large reduction of these exports would have severe impact on government programs in areas including health, education, agricultural and rural development. This project will attack this problem in a straight-forward way -- the project will produce the technologies necessary to reduce internal petroleum consumption and increase exports; this will assure a steady supply of government revenues; these revenues will be used for programs essential for socio economic progress. In this way, the entire country will benefit from this project.

F. Institutional Analysis

The Ministry of State for Research and Technology (RISTEK) is responsible for coordinating all new technology development in Indonesia and for monitoring the impact of new technology on society (see Annex II E). In particular the Ministry (1) provides direct program and policy guidance to several agencies including the Agency for the Development and Application of Technology (BPPT) and (2) is directly responsible for the establishment of PUSPIPTEK (the Center for Science, Research and Technology). Within PUSPIPTEK, the

Energy Research Laboratory (PERL) will be managed and operated by BPPT.

The GOI will fund PERL through two separate avenues RISTEK will fund the construction of the building and the necessary infrastructure and BPPT will fund equipping the building and the operations and maintenance of the laboratory. Because of the joint funding and the policy and program oversight responsibility of RISTEK, it might be argued that RISTEK should implement this project. But since RISTEK is not an operatonal department and the objective of the project is the continuing operation of the laboratory, BPPT is the proper implementing agency.

The project will require close cooperation with the Ministry of Education and Culture (because of the university research grant program and other involvement of university personnel), the Ministry of Mines and Energy (because the State Electric Power Company will be an important user of PERL technologies), the Ministry of Industry (because of the objective to create new energy technology industries) and other ministries. This coordination will be effected through the oversight responsibility of RISTEK and its PEPUNAS structure (National Committees on Research and Technology Programs) which include representation from these relevant ministries. With one exception, it is not required that additional formal coordination mechanisms be created to assure project implementation.

The exception is the need to create a formal Review and Award Committee for the research grant program. This committee would be chaired by either a BPPT senior official or the Director of PERL and would include representatives from the Ministry of Education and Culture, the university community and other appropriate agencies.

G. Environmental Analysis

The project should have no significant direct adverse environmental impact. It is one of institution building, technical assistance and training. There will be no direct impact from developing conversion technologies using coal, biomass or solar sources. However, it is recognized that the extraction of the coal, the production of the biomass energy sources and the extensive use of the technologies developed under the project might have significant impacts. This project will provide support for measurements of pollutants from experimental combustion devices and for analysis of corrective steps to minimize pollution, thus permitting environmental problems to be reduced if and when the devices are employed in significant numbers. Before pilot scale demonstrations of the new technologies are undertaken, appropriate studies should be conducted to assure that any harmful local environmental impacts are minimized.

IV. IMPLEMENTATION ARRANGEMENTS

A. Implementation Plan

BPPT is already undertaking a set of individual energy projects (See Annex II E (2)). These projects will be transferred to PERL. At PUSPIPTEK, BPPT has completed and is using one building for energy research activities. Tenders have been let for construction of the second building and funds are available for the construction of the third. The project should get off to a fast start because of these on-going activities.

BPPT, upon the signature of the loan agreement, will designate the laboratory director and establish a project office. This office will have full implementation authority for the project and will include personnel in financial management, contracting and commodity import procedures.

BPPT will also establish a committee for reviewing grant research proposals from university personnel. This committee will include representatives from the Ministry of Education and Culture and from the university community. The Committee will adopt formal procedures for reviewing and approving these research proposals.

The selection of the general contractor will take place as soon as possible after the loan agreement is signed and CPs are met. The schedule that follows anticipates that 90 days will be required to meet CPs. During the negotiations on the loan agreement, a decision will be reached on whether a PASA with the U.S. Department of Energy will be negotiated. If so, this PASA should be completed by December 30, 1982. If a private sector organization is chosen as general contractor, a host country contract could be awarded by March 30, 1983.

Technical assistance in solar energy will be provided either as a supplement to AID/W's basic PASA with NASA or through a host country contract with a private firm. Discussions with NASA and AID/W will be necessary to decide this issue. If the PASA is agreed to, it should be finalized by December 15, 1982. If host country contracting is decided upon, the initiation of the contracting process would be postponed until after the general contractor is agreed to.

Host country contracts with various companies for the technical programs will be negotiated subsequent to the selection of the general contractor and agreement on the detailed implementation plan.

For USAID, the project will be managed by the Office of Science, Technology and Energy (STE). This office will have the responsibility of monitoring project progress, identifying

and resolving critical implementation problems and assuring compliance with AID policy and procedures. The GOI counterpart will be the project office established in BPPT.

STE and the BPPT project office will hold at least quarterly meetings to review the project. Semiannual progress reports will be prepared jointly by the STE office and the BPPT project office using inputs provided by the various project contractors.

The long-term training is planned so that the operations of the laboratory are not unnecessarily disrupted by departing participants, the returning participants can be easily incorporated into laboratory programs and there is maximum timely benefit to the laboratory from the training. As the figures that follow indicate, there is a steady stream of departing and returning participants and the returned participants have always accumulated the great portion of the total number of person years of overseas training.

Implementation Schedule

Three evaluations (discussed below) are scheduled: 30 months after project initiation (1 person month of effort); 60 months after initiation (2 person months); and 82 months after initiation (2 months prior to project termination) (3 person months).

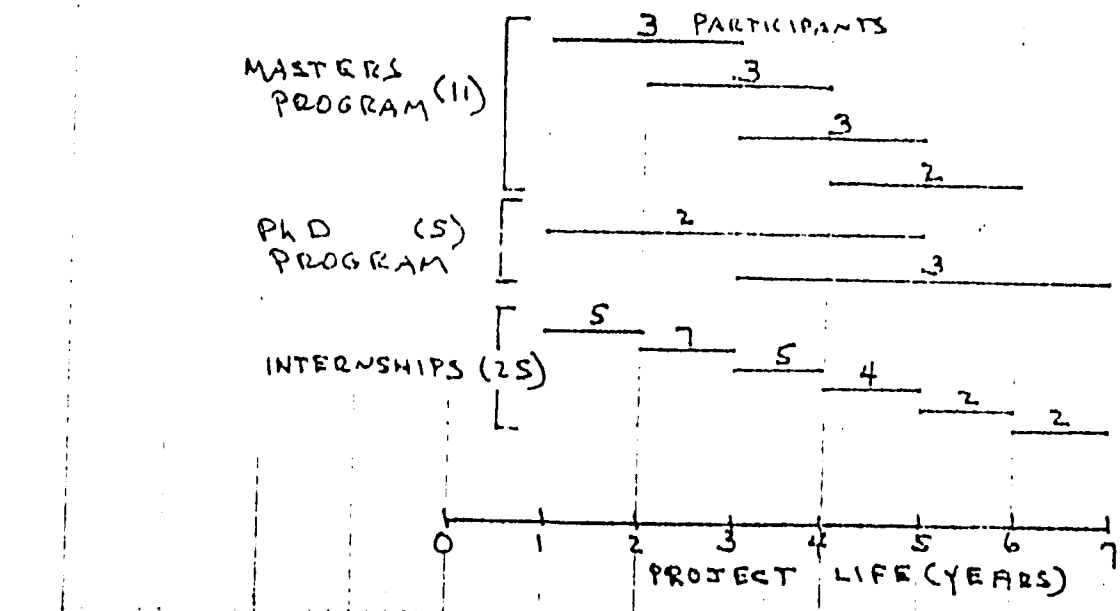
The project would be implemented according to the following schedule:

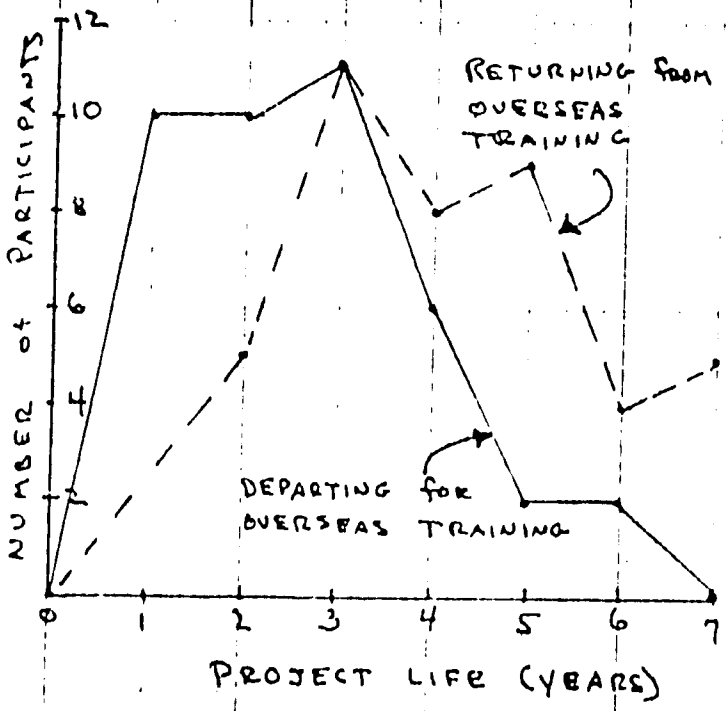
1.	Project approved by USAID	June 30, 1982
2.	Project authorized by USAID	July 15, 1982
3.	Project Grant Agreement signed	August 15, 1982
4.	Project Loan Agreement signed	August 30, 1982
5.	PIO/T prepared for general contractor (RFP)	September 30, 1982
6.	Solar advisory team defines lab specifications	October 15, 1982
7.	Prospective training participants (initial group) identified	October 15, 1982
8.	Second PERL building begins	October 1982
9.	Initial CPs met	November 30, 1982
10.	Language Training Program initiated	November 30, 1982

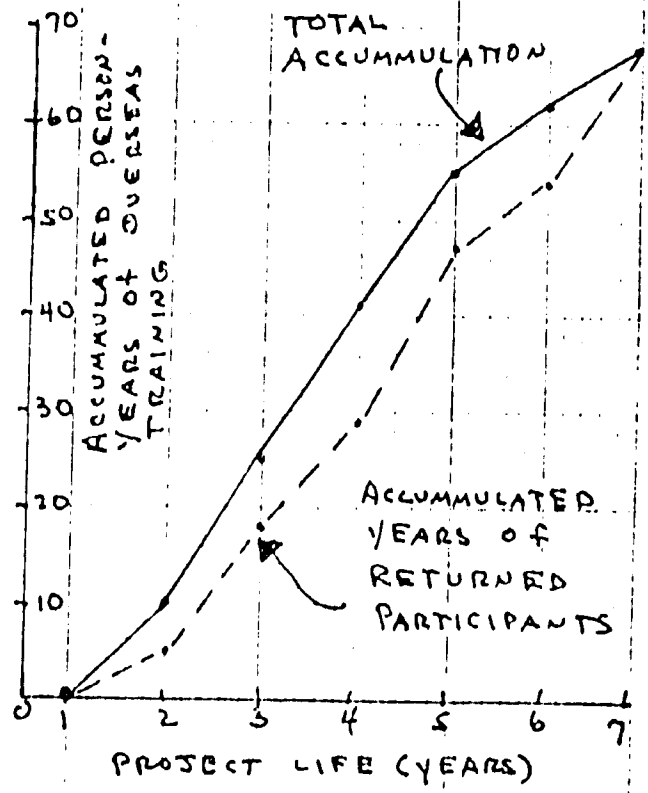
11.	Contract selection begins for Coal Transportation Study	November 30, 1982
12.	Solicitation of bids for solar equipment purchase begins	December 15, 1982
13.	Research Grant Review Committee established	January 15, 1983
14.	Contractor award for Coal Transportation Study	March 10, 1983
15.	Contract signed with general contractor	March 30, 1983
16.	Contractor selection begins for coal programs	March 30, 1983
17.	Detailed implementation plan finalized	April 10, 1983
18.	Contractor selection begins for biomass program	April 20, 1983
19.	First group of participants (10) confirmed and training program established	May 1983
20.	First Research Grant awarded	June 30, 1983
21.	Solar equipment installed	July 30, 1983
22.	Biomass program contract signed	August 30, 1983
23.	Coal Program contract signed	August 30, 1983
24.	Contract signed (2 years) for BPPT advisor (renewal)	August 1983
25.	Participants (10) depart for training	August 1983
26.	Annual Evaluation (Management Review)	September 1983
27.	Coal Transportation Study completed	October 1983
28.	Third PERL building begun	October 1983
29.	Equipment installed for coal research	December 1983

30. Equipment installed for biomass research	December 1983
31. Second PERL building completed	March 1984
32. Participants (10) program established	March 1984
33. Participants depart (10) and return (5)	August 1984
34. Formal External Evaluation	February 1985
35. Participants (11) program established	March 1985
36. Contract signed (2 years) for BPPT advisor	August 1985
37. Participants depart (11) and return (10)	August 1985
38. Third PERL building completed	March 1985
39. Participants (6) program established	March 1986
40. Participants depart (6) and return (6)	August 1986
41. Participants (2) program established	March 1987
42. Formal External Evaluation	August 1987
43. Participants depart (2) and return (9)	August 1987
44. Participants (2) program established	March 1988
45. Participants depart (2) and return (4)	August 1988
46. Final Evaluation	June 1989
47. Participants (5) return	September 1989
48. End of Project	September 1989

TRAINING SCHEDULE







B. Evaluation Plan

The project will be evaluated in two ways. Annual evaluation meetings will review project progress and identify implementation problems. These meetings will rely heavily on the annual project reports prepared by the general contractor. These meetings will be co-chaired by STE and the BPPT project office. These evaluations will be essentially management reviews to assure smooth implementation of the project. A total of six annual evaluations will be held.

In addition to the above, outside evaluations will be performed to assess objectively the effectiveness of the project in meeting its objectives. These evaluations would consider the following topics:

1) Has the laboratory generated products adopted by public sector and private sector users? Has the public sector R&D center produced technology that the private sector has commercialized?

2) What have been the commercial implications for the U.S.? Have U.S. private firms established joint venture arrangements in country due to the project?

3) Who are the beneficiaries of the project? Is the technology being used for small to mid-sized power and industry systems? By private power companies? By PLN?

4) To what extent is the technology being used in USAID projects or in other rural development activities?

5) Has there been effective collaboration between PERL and the university community? Have university personnel conducted research at PERL, at their universities using PERL research grants?

6) Has there been effective collaboration between PERL and other GOI ministries that are potential users of the technology -- e.g., Ministry of Mines and Energy, Ministry of Public Works, of Transmigration, etc.?

7) To what extent have jobs been created because of this project -- jobs in energy industries manufacturing products developed in PERL, jobs in other industries that utilize PERL technologies?

8) To what extent does PERL collaborate with foreign R&D institutions? Has PERL personnel published technical papers in appropriate journals?

9) Has PERL acquired private sector funding for industrial support provided by PERL? For contract research efforts?

C. Conditions Precedent, Covenants, Waivers and Negotiating Status

1. Conditions Precedent

As an integral component of the Project Agreements for the project, the GOI will agree to the following specific conditions precedent:

a. Prior to initial disbursement of funds under the loan, the Borrower will furnish to USAID satisfactory evidence that:

i. A director has been designated as head of the PUSPIPTEK Energy Research Laboratory with authority to establish training schedules for PERL personnel and enter into contracts for PERL.

ii. A PERL project office has been established in BPPT with personnel experienced in financial management, contracting and commodity import procedures.

iii. Arrangements have been made for permanent staffing and operation of PERL.

b. Prior to disbursement of funds for the research grant program, the Borrower will furnish satisfactory evidence that a peer review committee has been established with representation from the Ministry of Education and Culture and that formal review procedures have been established.

c. Prior to disbursement of funds for training activities, the Borrower will furnish satisfactory evidence that a training plan has been approved, candidates selected and GOI funding arrangements completed.

2. Covenants

The GOI will assure continuing adequate budgetary and staff support for the project which would include sufficient advance of funds to permit routine operations.

The GOI will consult with USAID semi-annually during the project for the purpose of bringing implementation and plans up to date.

The GOI will select training candidates on the basis of technical qualifications.

The GOI will take appropriate steps to preserve the proprietary rights of companies from the U.S. and other countries to technologies examined under funds of this project.

Since a prime objective of PERL is industrial support, the GOI will establish mechanisms to determine the interests of the Indonesian private sector in manufacturing and marketing energy technologies and to solicit the input of the Indonesian private sector on the plans and programs of PERL. These mechanisms will be reviewed during the annual project evaluations to determine how they might be improved in order to strengthen the linkages between PERL and the private sector.

3. Waivers

Given the range of technologies addressed in this project and the need for specialized equipment and services, it is probable that the U.S. will not in every case be able to supply the most appropriate material or technical assistance. It could be that sources in Japan or Western Europe are more appropriate sources in certain cases. Since the purpose of the project is to create a quality research and development laboratory, it would be inconsistent to deny expertise and equipment that is the most appropriate but not of U.S. origin.

Consequently, in order not to limit the ability to reach the project's objective, 935 waivers will be issued by USAID on a case-by-case basis where the facts indicate that the U.S. is not the appropriate source. The total amount involved would not exceed $500,000 over the life of the project. In each case when such non-U.S. procurement is approved, USAID will document the justification.

The project will include funding of certain costs in Code 941 countries, training and technical assistance. This category of expense is not expected to exceed $500,000 over the life of the project.

4. Negotiating Status

The project has been under intensive discussion with the GOI, in particular BPPT since the beginning of 1980. The themes of the project -- training, collaboration with U.S. companies, product development for Indonesian industrialization -- are the concerns of the Director of BPPT and the Minister of State for Research and Technology. The research grant program with universities supports the GOI desire to upgrade educational institutions and increase the outreach capability. The project paper has been reviewed by the GOI at various stages and there is agreement on all substantive elements of the project, including sharing of costs, the priorities identified in the project and the conditions and covenants. USAID does not see any obstacles to or expect any delays in execution of the Project Agreements.

ANNEX IA

REPUBLIC OF INDONESIA
NATIONAL DEVELOPMENT PLANNING AGENCY
JAKARTA, INDONESIA

No. : 1735/K.V./8/1982

Jakarta, August 13, 1982

Mr. William R. Fuller
Director
United States Agency for International Development
c/o American Embassy
Jakarta

Dear Mr. Fuller,

Subject : PUSPITEK Energy Research Laboratory

This is to request formally the AID for its assistance in the implementation of the above-mentioned project. The purpose of which is to assist in the establishment of a viable Professional Energy Research Laboratory and it will be carried out over a period of seven years.

As discussed with the USAID in planning the project, the requested assistance will take the form of an AID loan amounting to US$ 11,250,000 and a grant in the amount of US$ 500,000. These funds will be used chiefly to finance training of key individuals in various aspects of programme technical operations, management and analysis, purchase of commodity and equipment, personnel costs and other activities essential to reach the project purposes.

Your approval of this request will be appreciated.

Yours sincerely,

F.R. Almatsier
Head of Bureau for Foreign Economic Cooperation

Cc. : 1. PUSPITEK
up. Ir. Wardiman
2. Dep. Luar Negeri,
Ditjen HESBLN.

ANNEX I B

PUSPIPTEK ENERGY RESEARCH LABORATORY
(497-0333)

Certification Pursuant to Section 611(e)
of the
Foreign Assistance Act of 1961, As Amended

I, William P. Fuller, the principal officer of the Agency for International Development in Indonesia, am acquainted with and have taken into account, among other things, the performance, the development attitude and the budgetary planning of the Government of Indonesia and its implementing agencies in connection with prior AID financed projects. Based on these factors and observations, I consider that the Government of Indonesia has the capability to adequately use the AID assistance to be provided for the development of this Project.

Accordingly, I do hereby certify that in my judgement the Government of Indonesia, the Ministry of State for Research and Technology and the Agency for Development and Application of Technology have the financial and human resource capability to effectively utilize and maintain the facilities of the PUSPIPTEK Energy Research Laboratory Project.

William P. Fuller

August 26, 1982

Date

5C(2) PROJECT CHECKLIST

sted below are statutory
.iteria applicable generally to
projects under the FAA and
project criteria applicable to
individual funding sources:
Development Assistance (with a
subcategory for criteria
applicable only to loans); and
Economic Support Funds.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP TO DATE? HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT?

A. GENERAL CRITERIA FOR PROJECT

1. FY 1982 Appropriation Act Sec. 523; FAA Sec. 634A; Sec. 653(b).

   (a) Describe how authorizing and appropriations committees of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than $1 million over that amount)?

   1.(a) The authorizing and appropriations committees of Senate and House have been notified by a Congressional Notification, which expired on April 30, 1982.

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,00, will there be (a) engineering, financial or other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?

   2. Yes, to both parts.

3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?

3. No further legislation is required.

4. FAA Sec. 611(b); FY 1982 Appropriation Act Sec. 501. If for water or water-related land resource construction, has project met the standards and criteria as set forth in the Principles and Standards for Planning Water and Related Land Resources, dated October 25, 1973?

4. Not applicable

5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project?

5. Mission Director Certification is attached.

6. FAA Sec. 209. Is project susceptible to execution as part of regional or multilateral project? If so, why is project not so executed? Information and conclusion whether assistance will encourage regional development programs.

6. Project will include regional collaboration through training and research seminars.

7. FAA Sec. 601(a). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; and (c) encourage development and use of cooperatives, and credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.

7. Project has components for (a), (b) and (e). Components (c), (d), and (f) are not applicable.

8. FAA Sec. 601(b). Information and conclusions on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).

8. Project will emphasize collaboration with U.S. private firms and encourage private sector joint ventures.

9. FAA Sec. 612(b), 636(h); FY 1982 Appropriation Act Sec. 507. Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars.

9. GOI share of total project costs is 60 % in building and equipment. Terms of agreement will specify GOI contribution to project.

10. FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release?

10. No U.S.-owned excess foreign currency is available.

11. FAA Sec. 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise?

11. Yes

12. FY 1982 Appropriation Act Sec. 521. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity?

12. Not applicable

13. FAA 118(c) and (d). Does the project take into account the impact on the environment and natural resources? If the project or program will significantly affect the global commons or the U.S. environment, has an environmental impact statement been prepared? If the project or program will significantly affect the environment of a foreign country, has an environmental assessment been prepared? Does the

13. Yes to the first and the fourth parts. Not applicable to second and third parts.

project or program take into consideration the problem of the destruction of tropical forests?

14. FAA 121(d). If a Sahel project, has a determination been made that the host government has an adequate system for accounting for and controlling receipt and expenditure of project funds (dollars or local currency generated therefrom)?

14. Not applicable

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a. FAA Sec. 102(b), 111, 113, 281(a). Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward

1.a.(a) Project will produce technologies, some of which will be used directly by the poor. Jobs will be created in producing the technologies and in using them, increasing employment opportunities for poor.

1.a.(b) Not applicable

better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries?	1.a.(c) Project emphasizes collaboration between Indonesian institutions and researchers and U.S. organizations on problems of mutual interest. 1.a.(d) Not directly aimed at women, the project will include women researchers. 1.a.(e) Active information-sharing and regional training is a specific element of the project.
b. FAA Sec. 103, 103A, 104, 105, 106. Does the project fit the criteria for the type of funds (functional account) being used?	1.b. Yes
c. FAA Sec. 107. Is emphasis on use of appropriate technology (relatively smaller, cost-saving, labor-using technologies that are generally most appropriate for the small farms, small businesses, and small incomes of the poor)?	1.c. Project will emphasize small to mid-size energy systems.
d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activitiy with respect to which the assistance is to be furnished (or is the latter cost-sharing requirement being waived for a "relatively least developed" country)?	1.d. Yes

e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing, or is the recipient country "relatively least developed"?

1.e. Not applicable. Grant funds are being used for technical assistance only.

f. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase of productive capacities and self-sustaining economic growth?

1.f. Yes

g. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective particpation in governmental processes esential to self-government.

1.g. Project supports efforts of Indonesian organizations to increase their technical and scientific skills, develop their institutions, coordinate institutional activities and assess needs and capacities of local people for new technology.

2. Development Assistance Project Criteria (Loans Only)

a. FAA Sec. 122(b). Information and conclusion on capacity of

2.a. Prior loan experience indicates no problem with loan repayment.

the country to repay the loan, at a reasonable rate of interest.

b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete with U.S. enterprises, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?

2.b. Not applicable.

c. ISDCA of 1981, Sec. 724 (c) and (d). If for Nicaragua, does the loan agreement require that the funds be used to the maximum extent possible for the private sector? Does the project provide for monitoring under FAA Sec. 624(g)?

2.c. Not applicable.

3. Project Criteria Solely for Economic Support Fund

3. Not applicable

a. FAA Sec. 531(a). Will this assistance promote economic or political stability? To the extent possible, does it reflect the policy directions of FAA Section 102?

b. FAA Sec. 531(c). Will assistance under this chapter be used for military, or paramilitary activities?

c. FAA Sec. 534. Will ESF funds be used to finance the construction of the operation or maintenance

of, or the supplying of fuel for, a nuclear facility? If so, has the President certified that such use of funds is indispensable to nonproliferation objectives?

d. FAA Sec. 609. If commodities are to be granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart) arrangements been made?

UNITED STATES GOVERNMENT

memorandum

DATE: August 10, 1982

REPLY TO ATTN OF: Jerome J. Bosken, STE

SUBJECT: PUSPIPTEK Energy Research Laboratory (497-0333)

TO: Mr. William Fuller, Director

Attached for your review and approval is a copy of the Project Paper for the PUSPIPTEK Energy Research Laboratory (PERL). This project is for a loan of $11,250,000 and a grant of $500,000 and has a life-of-project of seven years.

A Mission committee has reviewed this project on several occasions. This PP reflects the results of these deliberations.

Throughout the project development process, the Office has met with and provided drafts to those Indonesian counterparts who will be responsible for implementing the project. This has assured agreement on the project at the project office/counterpart level.

Recommendation: that you approve this project by signing the PP face sheet and the Project Authorization.

Attachment

Clearances:
PRO:JSperling
ECON:JStepanek
FIN:RClark
LA:LChiles

JJB/am

OPTIONAL FORM NO. 10
(REV. 1-80)
GSA FPMR (41 CFR) 101-11.6
5010-114

GPO : 1981 O - 341-526 (6134)

PROJECT AUTHORIZATION

PUSPITEK Energy Research
Laboratory, Project. No. 497-0333

1. Pursuant to Section 106 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Puspitek Energy Research Laboratory Project (the "Project) for the Government of the Republic of Indonesia (the "GOI") involving planned obligations of not to exceed eleven million seven hundred and fifty thousand United States Dollars ($11,750,000) of which eleven million two hundred and fifty thousand ($11,250,000) in Loan funds is authorized, and of which five hundred thousand ($500,000) in Grant funds is authorized, over a three-year period from date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB/allotment process, to help in financing foreign exchange and local currency costs of the Project.

2. The Project will assist the GOI in establishing a viable, professional energy research and development center, which will (a) conduct applied energy research and technology development, (b) provide support to Indonesian energy-related industries, and (c) undertake technical and economic feasibility analyses on potential energy programs, projects and products.

3. The Project agreement which may be negotiated and executed by the officer to whom such authority is delegated in accordance with A.I.D. regulations and delegations of authority, shall be subject to the following essential terms and covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

4. (a) Interest rate and terms of repayment. The cooperating country shall repay the Loan to A.I.D. in U.S. Dollars within forty (40) years from the date of first disbursement of the Loan, including a grace period not to exceed ten (10) years. The cooperating country shall pay to A.I.D. in U.S. Dollars interest from the date of first disbursement of the Loan at the rate of (a) two percent (2%) per annum during the first ten (10) years, and (b) three percent (3%) per annum thereafter, on the outstanding disbursed balance of the Loan and on any due and unpaid interest accrued thereon.

   (b) Source and Origin of Goods and Services. Goods and services financed by A.I.D. under the project with Loan funds shall have their source and origin in the cooperating

country or in countries in A.I.D. Geographic Code 941, except as A.I.D. may otherwise agree in writing. Goods and services, except for ocean shipping, financed by A.I.D. under the project with Grant funds shall have their source and origin in the cooperating country or in the United States, except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the project with Grant funds, shall, except as A.I.D. may otherwise agree in writing, be financed only on flag vessels of the United States.

(c) Conditions Precedent to First Disbursement.

Prior to any disbursement under the Grant or Loan, or to the issuance by A.I.D. of any documentation pursuant to which disbursement will be made, the GOI will, except as A.I.D. otherwise agree in writing, furnish in form and substance agreeable to A.I.D.:

(1) evidence that a director has been designated as head of the PUSPITEK Energy Research Laboratory (PERL) with authority to establish training schedule for PERL personnel and enter into contracts for PERL.

(2) evidence that a PERL Project office has been established in BPPT with personnel experienced in financial management, contracting and commodity import procedures.

(3) evidence that arrangements have been made for permanent staffing and operation of PERL.

(d) Conditions Precedent to Additional Disbursment.

(1) Prior to any disbursement or to the issuance by A.I.D. of any documentation pursuant to which disbursement will be made for the research grant program, the GOI will, except as A.I.D. may otherwise agree in writing, furnish in form and substance satisfactory to A.I.D. evidence that a peer review committee has been established with representation from the Ministry of Education and Culture and that formal review procedures have been established.

(2) Prior to any disbursement or to the issuance by A.I.D. of any documentation pursuant to which disbursement will be made for training activities, the GOI will, except as A.I.D. may agree otherwise in writing, furnish in form and substance satisfactory to A.I.D. that the training has been approved, candidates selected and GOI funding arrangements completed.

(e) Covenants.

Except as otherwise agreed to by A.I.D. in writing, the GOI will (1) assure continuing adequate budgetary and staff support for the Project; (2) consult with A.I.D. semi-annually during the project for the purpose of bringing implementation and plans up to date; (3) select training candidates on the basis of technical qualifications, (4) take appropriate steps to preserve

the propriety rights of companies from the United States and other countries for technologies examined under funds of this Project, (5) establish appropriate mechanisms to elicit the interests and views of the Indonesian private sector in the plans and programs of PERL.

William P. Fuller
Director

Date: August 26, 1982

Drafted:LA:LChiles:05/03/82, mai

Project Title: PUSPIPTEK Energy Research Laboratory (497-0333)

LOGICAL FRAMEWORK

ANNEX II A

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Goal: To strengthen scientific and technological institutions and manpower needed for the continued economic growth of Indonesia.	-Scientifically and technically valid plans and programs for the optimum use of Indonesia's resources. -Improved technological products. -Increased number of industries based on science and technology. -Greater value added in industrial manufacturing. -Increased publications from research conducted by Indonesian S/T institutions. -Increased S/T collaboration between Indonesia and other countries, in particular U.S.	-Reports of various agencies such as UN and World Bank. -AID sector studies. -Quality standards. -National economic analyses and indicators. -National and international S/T journals.	1.Political stability is maintained. 2.Global energy prices continue to encourage selected alternatives to petroleum. 3.Private sector uses PERL technology. 4.Employment opportunities are created in private sector energy product companies. 5.At least moderate economic growth is maintained.
Purpose: To establish a national energy research and development laboratory.	-Sustained GOI budget support to PERL. -Maintenance of qualified staff at PERL. -Funding from industry for PERL contract research. -Industrial manufacture of PERL-developed technologies. -Increased collaboration between PERL and RI -Institutions and private sector.	-GOI budget plans. -PERL records. -Site visits. -USG records.	1.Continued GOI committment to PUSPIPTEK. 2.PERL research efforts and qualifications are needed by private sector. 3.PERL does not compete with private manufacturers. 4.PERL can transfer technology to private manufacturers. 5.Business and policy environment is conducive to industrial manufacture of PERL developed technologies.
Outputs: -Trained staff -Management structure -Equipment -Information and Reference Center -Field tests -Studies and technology assessments -Cooperative research with Indonesian universities	-Over 100 professionals on PERL staff; over 40 trained in U.S. for 1 year or more. -Functioning management and administration structure. -4 technology research programs underway, one analytical laboratory outfitted. -20 field tests completed. -10 assessments completed. -50 cooperative research projects underway.	-Site visits by USAID monitors. -Project evaluations. -AID records. -Contractor reports.	Trained personnel return to PERL. No changes in GOI energy policy hinder project implementation. Competent project management by USAID and GOI personnel.
Inputs: Technical Assistance: Long-term resident advisors.....4 py.....$500 Long-term continuing advisory services..2 py.....$200 Short-term advisors.....2 py.....$200 Consultants.....6 py.....$675 Training: Long-term academic.....11MS, 5PhD.....$700 Professional internships.....25 py.....$500 Short-term nonacademic.....15 py.....$300 Commodities: Technology systems.....20.....$4450 Equipment and hardwars.....Misc.....$950 Reference Materials, Books, etc.....Misc.....$130 Management and Evaluation: Project Management, Etc.....10 py.....$885 Inflation and Contingencies:.....-.....$2260 TOTAL.....$11750		USAID records and reports.	Adequate USAID budget and staff. No change in GOI procedures that would inhibit provision of inputs.

PREPARATORY PROJECT DEVELOPMENT STUDIES AND ACTIVITIES

Development of this project began in March 1980. Three separate teams of experts visited Indonesia to assess specific aspects of the proposed assistance to PERL:

1. A U.S. Department of Energy team (March 1-21, 1980) prepared an overview of the PERL concept and recommendations for the coal, biomass and direct solar conversion programs, Preliminary Planning Study for PUSPIPTEK Energy Research Laboratory. The Executive Summary of this report is presented as ANNEX II B (1).

2. A U.S. Department of Agriculture team under the S&T/EY Biomass Energy Project (November 3-24, 1980) prepared a more complete assessment of a biomass energy program, PUSPIPTEK Energy Resources Laboratory - Assessment of Biomass Programs and Facilities. The Executive Summary of this report is presented as ANNEX II B (2).

3. A team from the National Aeronautics and Space Administration (September 26-October 14, 1981) under the S&T/EY Photovoltaic Project prepared a more complete assessment of a solar program. This report from this trip was used to prepare the Solar Energy Program, ANNEX II B (3).

In addition to the above reports, a team of Indonesian scientists, educators and administrators visited various energy R&D facilities in the U.S. in July, 1981. The report of this trip, not attached, was a very significant contribution to the development of the project.

PRELIMINARY PLANNING STUDY FOR PUSPIPTEK ENERGY RESEARCH LABORATORY

REPORT OF U.S. DEPARTMENT OF ENERGY TEAM

JULY, 1980

PREPARED FOR

ASIA BUREAU

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

WASHINGTON, D.C.

PRELIMINARY PLANNING STUDY FOR A PUSPITEK ENERGY RESEARCH LABORATORY

REPORT OF USDOE TEAM

Team Members:

Richard H. Adams
Argonne National Laboratory

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U.S. Department of Energy

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Lawrence Berkeley Laboratory

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Massachusetts Institute of Technology

George Warfield
Solar Energy Research Institute

DOE Coordinator:

Donald C. Foster
Office of International Affairs

July, 1980

ACKNOWLEDGMENT

In the course of a short three-week visit it was not possible to make an in-depth, detailed study of all aspects of the Indonesian energy problems and resources. However, our work was made easier by the excellent preparations which had been made for our visit and by the excellent briefings and discussions which had been arranged.

The staff of the AID mission in American Embassy in Jakarta was extremely helpful, and we are especially grateful to Mr. William Littlewood for his help, his advice and his patience.

While it is not possible to name all our Indonesian colleagues who contributed so much to making our visit pleasant and productive, we do wish to extend our thanks to Minister B. J. Habibie for his support, understanding and gracious acceptance of our draft report. Thanks also are due to Harsono Pusponegoro, Director of the Technology Development Department of BPPT, for putting at our disposal the resources of his department and for the many arrangements made on our behalf. And last we would like to extend our very special thanks to Dr. Soedjana Sapiie and his many colleagues who arranged and accompanied us on the visits and participated in the discussions. Their knowledge, enthusiasm and many kindnesses collectively, and Dr. Sapiie's personal contributions, were very sincerely appreciated.

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EXECUTIVE SUMMARY

The following recommendations are based on the goals and objectives given in Section I of the report:

Section II. Energy Planning Group

A. Establish an energy information system.

B. Assess the possibility for decreasing the level and changing the pattern of future fuel use in Indonesia by inter-fuel substitution, improved end-use efficiency in equipment and processes, and conservation.

C. Develop the capability for taking institutional, social and environmental factors into account in energy planning.

D. Resources.

1. Three-four senior people plus three-four junior people to start--eventually expand to 15-20 total.

2 As time permits, send all member abroad for training for periods of 3 months to 2 years.

Section III. Training and Education

A. Provide on-the-job training assignments abroad.

B. Provide post-graduate scholarships in-country.

C. Provide post-graduate scholarships abroad.

D. Provide opportunities to attend institutional meetings and conferences.

E. Institute series of seminars and lecture courses.

Section IV. Coal Research and Development

A. Coal gasification studies should be given high priority, leading to building a small versatile gasification "pilot plant" (process development unit) at PERL.

B. Second priority should be given to study of coal liquefaction leading ultimately to building a small, versatile liquefaction plant at PERL.

C. Emphasis should be given to developing means of making metallurgical coke from Indonesian coal, supporting the activity now in progress at Ombilin.

D. Other research and development activities should relate to the conversion of oil-fired power plants to coal or coal/oil mixtures, and to coal/water slurry transport.

E. Resources

1. These programs could be started with 8 scientists and engineers and 16 support personnel, and ultimately level off at 30 professionals and 70 support personnel.

2. Direct training experience abroad for at least four senior engineers in both gasification and liquefaction would be desirable before designing and building such facilities at PERL.

Section V. Biomass Energy Programs

A. An evaluation should be made of the agricultural and forest residues available.

B A complete study should be made of the problems and possibilities of developing energy farms.

C. A complete assessment should be made of energy forms and patterns of use to guide the selection of conversion technology.

D. An evaluation should be made of the various biomass use options such as the following:

1. Char production for cooking.
2. Methane from biomass fermentation.
3. Direct combustion for power or electricity generation.
4. Gasification of biomass.
5. Direct liquefaction of biomass
6. Production of alcohol from sugar or starch-bearing crops.
7. Multi-purpose or combinational approaches.
8. Direct combustion for household use.

E. Resources

1. In the first year it is recommended that 10 staff scientists/engineers and 4 technicians be made available to carry out the recommended research and development. In the second year 16 staff and 22 technicians should be added, and in the third year another 16 staff and 28 technicians.
2. The total cost of equipment over the three year period may be as much as $2.5 million.
3. Two standard laboratory areas about 25 x 42 ft in area, and one high bay laboratory area 40 x 50 x 25 ft high are recommended.

Section VI. Direct Solar Conversion Program

A. It is recommended that the solar program consist of four parts, some of which is now on-going:

1. The photovoltaic program should cover photovoltaic applications, panel assembly, cell fabrication and cell testing.

2. The thermal conversion program should consist of studies of crop and fish dryers, solar stills, dessicant cooling and solar ponds.

3. A biodigester program should be pursued. (This is also covered under item V D2).

4. A rural energy center program should be developed which concentrates on using photovoltaics, biodigester, wind or any combination of these, for rural use.

C. Resources

1. The recommended staff would consist of 30 professionals (6 seniors and 24 juniors).

2. A total of about 650 m^2 office and laboratory space is recommended.

3. The roof of the laboratory building should be designed to accommodate solar hardware and systems for testing purposes.

4. A fenced-in field of 20 x 20 meters is recommended for solar pond tests.

5. The above recommendations would entail a budget of about $120,000 per year.

General Observations

A. To implement all of the activities recommended above at the levels of support suggested would require that a staffing level of about 86 senior staff and about 156 junior support personnel should be reached in about 3-5 years.

B. Capital expenditures only for laboratories and supporting equipment for the recommendvd activities (exclusive of coal gasification or liquefaction "pilot plants") would amount to about $3,000,000 in the first 3-5 years.

C. It is assumed that the highest priority will be given to beginning to acquire the best possible energy library. This is considered crucial for the success of the Laboratory.

D. Experience in other countries indicates that the best and most rapid research progress is made by an organization where the highest possible percentage of senior personnel are full-time staff members, compensated at a level to attract and hold the most competent scientists and engineers.

ANNEX II B (2)

PUSPIPTEK ENERGY RESOURCES LABORATOR ASSESSMENT OF BIOMASS PROGRAM AND FACILITIES

REPORT OF USAID/USDA BIOMASS ENERGY TEAM

JANUARY, 1981

PREPARED FOR
OFFICE OF ENERGY
DEVELOPMENT AND SUPPORT BUREAU
U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C.

STUDY TEAM MEMBERS

Dr. Rolf T. Skrinde, P.E.	Executive Vice President Olympic Associates Company Seattle, Washington
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Mr. Abu Talib	Chemical Engineer Renewable and Advanced Energy Systems The Mitre Corporation McLean, Virginia
Mr. Kurt H. Vause	Civil and Environmental Engineer Olympic Associates Company Seattle, Washington

EXECUTIVE SUMMARY

1.0 Introduction

In March 1980 a U.S. Department of Energy team was requested by the U.S. Agency for International Development (USAID) to prepare a planning study for the PUSPIPTEK Energy Resource Laboratory. The report contained recommendations for various energy programs, including energy from biomass. Early attention to increasing energy available from biomass was recommended in the report because of the substantial amounts of such resources available in Indonesia. The possibility of USAID sending a biomass energy team to Indonesia was then presented by U.S. representatives, and was favorably received by representatives of Indonesia. A biomass team thus spent three weeks in Indonesia from November 3 to November 24, 1980.

The objectives of the biomass energy team were to formulate specific plans and projects to be carried out by the PUSPIPTEK Energy Resource Laboratory (PERL/LSDE), and subsequently develop the biomass energy laboratory layout and facility and equipment requirements. Included were technology and resource base assessments and identification of technical and economic problems in developing specific conversion technologies.

2.0 Biomass Production

Indonesia is blessed with abundant renewable resources. The question is whether these renewable resources can supply

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significantly more energy, commercial as well as non-commercial, without adverse effects on the food and fiber supply. Currently, 122 million hectares are in forest and are classified as 47 million hectares production forest, 40 million hectares protection forest, 10 million hectares conservation forest, and 25 million hectares reserved forest. Unproductive land in Indonesia amounts to 42 million hectares.

Current use of woody biomass for energy has increased by 2.2 percent per year during the period 1969-1976, with consumption exceeding recorded production by some 36 million tons in 1976 on Java alone. Although serious problems arise with such a disparity between production and consumption, there is good potential to make a marked improvement in the fuelwood and biomass energy situation on Java and the outer islands without either harm to the environment or infringement upon production of valuable forest products. Fast growing fuelwood species, fuelwood plantations, and agricultural residue use can improve the situation on the island of Java, while mill residues can be used by the forestry industry on the outer islands to make those industries energy self-sufficient.

Recommended research and development projects in biomass production include field plot evaluations and comparison of promising fuelwood species, utilizing wood residues in the forest products industry on the outer islands, determining the suitability of using various agricultural wastes on Java, assessing energy

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farming practices and potentials, and surveying available peat resources and applicable conversion technologies for peat. The role of PLPI/ISDI in such efforts should be that of catalyst and coordinator rather than the principal investigating institution, in that existing and experienced organizations in agronomy and agriculture are well suited for such tasks.

3.0 Biomass Conversion Technologies and Technical Prerequisites for Development in Indonesia

3.1 Direct Combustion of Biomass

Firewood and agricultural waste have historically been used for domestic energy purposes in Indonesia. In the absence of sufficient quantities of biomass fuels, however, it has been necessary to resort to kerosene use. Solar (diesel) fuel is most commonly used in industry also because of a price-advantage over biomass. The opportunities for expanding the current use of biomass then is good, particularly for household use and in the forest products industry, and should be encouraged by active support from the government. Examples of such support would include financial incentives, joint field demonstrations of combustion technologies with organizations such PLN (local state-run utility) and the forest products industry, and intensive planting of fast growing trees for rural household energy needs.

It is recommended that demonstration projects be established for small-scale wood-fired power plants to supply electrical

energy needs on the outer islands in an effort to replace solar and oil-fired plants. It is also suggested that the fuelwood supply be increased on Java by establishing fuelwood plantations, refining and improving charcoal production technology and developing highly efficient charcoal-fired stoves. Since direct combustion is a mature technology, technology development activities at PERL/LSDE would be minimal and consist of technical data dissemination, wood combustion pilot demonstration projects in the field, and commercialization of efficient charcoal stove designs.

3.2 Gasification

Gasification of biomass is another mature technology being refined and developed worldwide, as well as in Indonesia. At the present time, several small gasifier projects are underway in Indonesia, including one such USAID-sponsored assessing the potential of advanced-gasification technology for methanol production. Since gasification technologies are commercially available today, this technology can find immediate application in different energy-consuming sectors. In the forest products industry, gasification technologies can compete with direct combustion under certain circumstances. Gasification should also be considered for retrofitting of existing small PLN oil-fired electricity plants in Sumatra and Kalimantan. Small scale gasifiers can also supply energy for different agricultural operations, including irrigation pumps and rice mills.

PERL/LSDE should be equipped to conduct gasification research and development, including basic studies, bench and pilot scale

research. Descriptions of recommended projects and resources for gasification research and development are found in Sections 4.0 and 5.0.

3.3 Pyrolysis

Pyrolysis technology has been receiving much research and development effort in developed countries, and in Indonesia as well. Low temperature small-scale pyrolysis of agricultural wastes has been given high priority in Indonesia, particularly for use at rice mills in rural areas. Research done to date indicate that pyrolytic technologies may hold most promise at large scale (greater than 100 tonnes/day) applications, however, while other technologies are better suited for small scale biomass conversion systems.

It is recommended that PERL/LSDE initially conduct bench scale studies of fluidized-bed, low temperature pyrolysis of different feedstocks, during which time such data are collected as to develop design criteria for pilot scale systems. Pilot scale development of such technology should also be undertaken at PERL/LSDE, as well as basic studies of advanced pyrolytic conversion techniques in an effort to develop those technologies.

3.4 Alcohol Production

The technology of alcohol production from biomass is well developed and has been given high priority for development in Indonesia. An ambitious program of development of as much as twenty million kl/yr additional production capacity by the

year 2000 is planned, and plans have already been drawn up to begin pilot plant work in 1981. Conventional technologies developed elsewhere for production of ethanol from starch and sugar feedstocks are likely to be used, with sweet potatoes, cassava and Sago palm being the feedstocks considered.

Based upon such an ambitious program, it is recommended that considerable research and development effort be placed in fermentation technology, beginning with continuous bench scale research and continuing through pilot scale demonstration units as warranted. BPP Teknologi would take the lead role in initiating such efforts, and at PERI/LSDE would begin a coordinated development program of bench scale studies using feedstocks previously untried (such as Sago or cellulosic feedstocks), basic research on development of high temperature yeast strains, pilot plant demonstration of fermentation techniques and equipment for more conventional feedstock sources such as sweet potatoes, and waste treatment studies for process effluents from alcohol production facilities. Already, USAID monies have been allocated to the first of these four program phases, with additional technical and financial assistance being provided for pilot scale demonstration by West Germany.

3.5 Methane Fermentation

The production of fuel gas (biogas) from digestion of organic wastes to methane and carbon dioxide is widely practiced throughout the world, and has been utilized to some extent in Indonesia

separate pilot plant building. Under such a proposed design, it is recommended that there be five basic bench scale laboratories in the Energy complex consisting of a workshop/mechanical laboratory, a central chemical (analytical) laboratory, a biological, physics, and electronics laboratory, with the remainder being reserved for non-biomass related laboratory studies. The seven other similarly sized units can serve to house related technical support, software, and administrative facilities, the pilot plant area serving to house five or six pilot scale demonstrations.

Equipment needs and specifications for recommended biomass energy projects undertaken at PERL/LSDE were reviewed by the study team in an effort to identify proposed project costs and requirements. Analytical equipment needs and costs total just over US$300,000 (US$301,660) under the recommended analytical laboratory plan (see Table 4-1). Estimated equipment costs for each of the recommended bench and pilot scale efforts are summarized below.

Estimated Expenditures for Proposed Biomass Laboratories

	Equipment Item	Estimated Dollar Cost
1.	Fuel log extruder unit	US$ 30,000
2	Pelletizer	30,000
3.	Downdraft gasifier connected to internal combustion engine	200,000
4.	Gasification/pyrolysis equipment, including vessels, boiler, feed equipment, and storage tanks	500,000
5.	Oxygen blown gasifier	750,000

Estimated Expenditures for Proposed Biomass Laboratories (Cont'd)

	Equipment Item	Estimated Dollar Cost
6.	Bench scale ethanol production from Sago	US$ 110,000[1]
7.	Bench scale waste treatment of residuals from ethanol production	5,000[2]
8.	Pilot scale alcohol unit	200,000
9.	Pilot scale anaerobic digester for methane production from water hyacinth	225,000[1]
10.	Bench scale thermophilic anaerobic digestion unit	25,000
11.	Rice straw gasifier for D.C. electricity	49,600[1]
	TOTAL	US$2,124,600

[1]Monies previously allocated by USAID.

[2]Analytical laboratory equipment specified in Table 4-1 with minor additions and modifications shall suffice for majority of equipment costs.

Also recommended (see Section 3.1.3.2) are two additional pilot demonstration plants, so called dendrothermal plants. These projects would not be located at PERL/LSDE, but should be carried out in close cooperation between BPP Teknologi personnel, PLN (State Electricity Corporation) and the Department of Forestry. The projects are as follows:

	Item	Cost
1.	500 KWe wood fired electric power plant for rural area	US$ 660,000
2.	1,500 KWe wood fired cogeneration plant for a sawmill or plywood mill	1,400,000
		US$2,060,000

Funding for such projects would have less priority than providing analytical equipment and equipment for pilot and bench scale

projects listed above. Total estimated costs then for the proposed program of biomass research and development work undertaken by PERL/LSDE comes to $US2,426,260 (including US$301,660 for lab equipment).

5.0 Personnel and Training

Personnel requirements for the biomass energy laboratory have been estimated for the various biomass energy projects recommended in Table 3-4 and suggested in Section 2.0. The total personnel requirements have been divided into five categories, including: 1) support staff for the central analytical laboratory; 2) senior scientists and engineers; 3) junior scientists and engineers; 4) workshop and mechanical laboratory personnel; and 5) administrative personnel. Between 9-13 support staff are recommended to staff the central analytical laboratory, 33 senior scientists/engineers to provide project management and technical expertise, 49-61 junior scientists/engineers to provide technical support, 7-9 workshop/mechanical laboratory technicians, and 4 administrators to administrate the biomass energy facilities and projects for a total of 102-120 personnel. Approximately 25 of these positions are required for staffing the entire energy laboratory complex, however, not just the biomass part of the complex. (For training requirements and proposed programs for these personnel, see Table 5-3.)

as well. Research efforts are currently underway or have been completed to assess different design configurations, feedstocks, operational modes, and construction materials. Results have been mixed and suggest only limited success in promoting commercialization of the technology in the country. As such, only limited funding and research effort is recommended for development of this technology.

The recommended role of BPP Teknologi in promoting commercialization of this technology is that of coordinator of field projects and being the institution for continued research in the area of methane fermentation. Already several field projects have been initiated, including one project supported with funds from USAID. Refinement and optimization of these existing projects should be continued to more reliably assess performance of such technologies, while new projects should be limited to gas processing and equipment studies, and development of thermophilic anaerobic digestion technology.

4.0 Biomass Program at PEPI/LSDE: Equipment Needs and Specifications

The study team worked closely with members of BPP Teknologi on the actual physical layout of the energy laboratory buildings. The original concept of the Indonesian planners is to construct a total of eight two or three story buildings to serve as laboratory facilities shown in their architectural sheet no. 03, with each building having a basic modular area of 500 m^2 per floor. Also, a series of seven similarly sized buildings are to be built adjacent to the proposed laboratories, as well as a

SOLAR ENERGY PROGRAM

This section presents detailed descriptions of illustrative activities to be undertaken in the solar program. The actual progress of the program and the actual activities to be pursued will be determined by the state of the technology over the next five years. Solar energy is a fast-changing field; extensive research and development continues in both government and industrial laboratories throughout the world. Various AID projects are currently testing solar energy devices and program approaches; numerous U.S. companies are marketing new products. Within this project the consistent theme will be to provide the maximum amount of technology transfer to the PERL through extensive hands-on-training and active involvement in all phases of the work. The goal will be to strengthen PERL's ability: to assess the capabilities of various technologies to solve specific energy problems in Indonesia, to design and pursue laboratory research and development programs, to conduct field tests and demonstrations of the technology, to promote the wider use of proven technologies and to provide technical support to local industries to manufacture energy systems.

A. Photovoltaics

The photovoltaic program will be primarily an application program. It will develop expertise in system design, load matching, power conditioning and control and maintenance procedures. The photovoltaic array will be generally treated as just one of several components with known input and output characteristics. This will facilitate the introduction of advanced photovoltaic array technologies when these become commercially available.

1. Expansion of Photovoltaic Laboratory

BPPT currently is undertaking PV cell fabrication using single cell silicon wafers. The expansion of the PV laboratory will build upon this on-going work in order to create a stronger capacity to understand the basic processes involved in photovoltaic technology and to assess the current state and future trends of this rapidly evolving field.

Two options were considered for this program element: (1) to strengthen the investigative capability of BPPT to assess technical options in photovoltaics or (2) to create a small manufacturing facility to produce complete photovoltaic modules. The second option would employ a small turnkey system using single cell silicon technology.

The first option was chosen due to the evolving nature of photovoltaic technology at the moment. Extensive R&D is underway in the U.S. and elsewhere on various PV materials

(e.g., silicon, Cadmium-Sulfide, Gallium Arsenide), on the crystalline state of the materials (single cell, poly-crystalline, amorphous) and on several techniques to produce the material (ingots, continuous ribbon, thin films) Because of the quality and quantity of this work, the principal need for the PERL would be to assess the several technologies currently available and soon to be available in order to make informed purchasing decisions.

The following equipment will be required to upgrade the photovoltaic laboratory (from Preliminary Planning Study). Cell and module processing will be undertaken. It is assumed that the process will only be carried back to the junction diffusion stage, not to the materials preparation and wafer production. The process will start with the purchase of Boron doped wafers. At the same time, to enable the laboratory to carry on steps 2 and 3 in parallel with step 1, it is also recommended that wafers with the junctions already processed be purchased.

Step 1

Diffusion p-type -- by means of diffusion furnace, 3" wafers in $POCl_3$:

Equipment & Materials Needed	Possible Source	Est. Cost
1. Diffusion Furnace 4 Tubes 76 mm. (3") Capability	Tempress Thermco Corso-Gray	$ 60,000
2. Doped (Boron) Wafers (76 mm.) 1,000 @ $5 each	Applied Solar Energy Corp. Motorola Arco Solar Solarex	$ 5,000
3. Gases and Chemicals	(Assume Local supply)	$ 10,000
4. Characterization Equipment Resistivity 4 Point Probe	K&S Tencor	$ 15,000
Microscopes	Bausch & Lomb	$ 10,000
C-V System	Princeton Applied Research Hewlett-Packard	
P-N Meter	Solid State Measurement, Inc. Tencor Veeco Keithley	$ 3,000
SUBTOTAL:		$103,000

Step 2

Metallization:

Two methods are suggested: 1) Screen printed which has potential for low cost in manufacturing; and 2) evaporated thin film which is easy to achieve in a laboratory setting.

Equipment & Materials Needed	Possible Source	Est. Cost
1. Screen Printer	AMI-Pressco Welltek	$ 12,000
2. Inks and Supplies	AMI-Pressco DuPont	$ 5,000
3. Infrared Furnace	Radiant Technology, Inc.	$ 15,000
4. Thin Film Evaporator	Veeco Varian Edwards	$ 15,000
5. Supplies and Materials (Acids, chemicals, metals)	Local	$ 10,000
6. Thickness Probe	Dektak Sloan Tencor Alpha Step	$ 15,000
7. Solder Pots, Solder, Flux	Kester	$ 2,000
8. Doping, AR Spinner	Headway Research Inc.	$ 7,000
9. Junction Diffused Wafers 1000 @ $10 per wafer	See Step 1-2	$ 10,000
SUBTOTAL		$ 91,000

Step 3

Encapsulation and Testing:

Equipment and Materials Needed	Possible Source	Est. Cost
1. Solar Simulator	Oriel Xenon Corp. Spectrolab	$ 12,000
2. Electronic Load	Spectrolab	$ 5,000
3. X-Y Recorder	Hewlett-Packard	$ 3,000

4.	Materials (Wire, Encapsulant, Glass, Frames)	Local Dow Corning (for encapsulant)	$ 10,000
5.	Pottant Dispensers	Hull Corporation	$ 10,000
6.	Vacuum Equipment	Scientific Products Co.	$ 10,000
7.	Curing Oven	Scientific Products Co.	$ 10,000
	SUBTOTAL		$ 50,000
	EQUIPMENT TOTAL		$254,000
	SHIPPING, HANDLING INSURANCE		$ 38,000
	TOTAL		$292,000

2. Photovoltaic Test Facility (PTF)

The PTF will provide a vital support capability to PERL photovoltaic activities. As a "breadboard" system, it will allow preliminary investigation of components, subsystems and complete photovoltaic systems before installation in actual service settings. It will permit the assessment of candidate PV systems and design concepts and can be used to determine optimum system configurations and operating modes. It will allow professional testing of operational performance of commercial PV modules to determine that they meet performance specifications.

The PTF will be modeled after the NASA-operated, DOE-funded facility established at NASA's Lewis Research Center in the mid-1970's.

The elements of a PV power system are shown in Figure 1 (page 5). The PTF includes these elements as well as instrumentation and data acquisition systems. The block diagram of the PTF is given in Figure 2 (page 5).

Array

The array will consist of an expandable number of solar cell panels mounted on support frames whose tilt angle could be varied. Initially a total of 5 km (peak) will be provided. Each solar cell panel can be equipped with modules of nearly any design to permit testing of modules of almost all manufacturers.

The modules may be interconnected electrically in various configurations. The output voltage of the array can be changed by reconfiguring the array interconnection in the field or in the control room. The array can also be electrically split into several independent systems.

ELEMENTS OF PHOTOVOLTAIC POWER SYSTEM

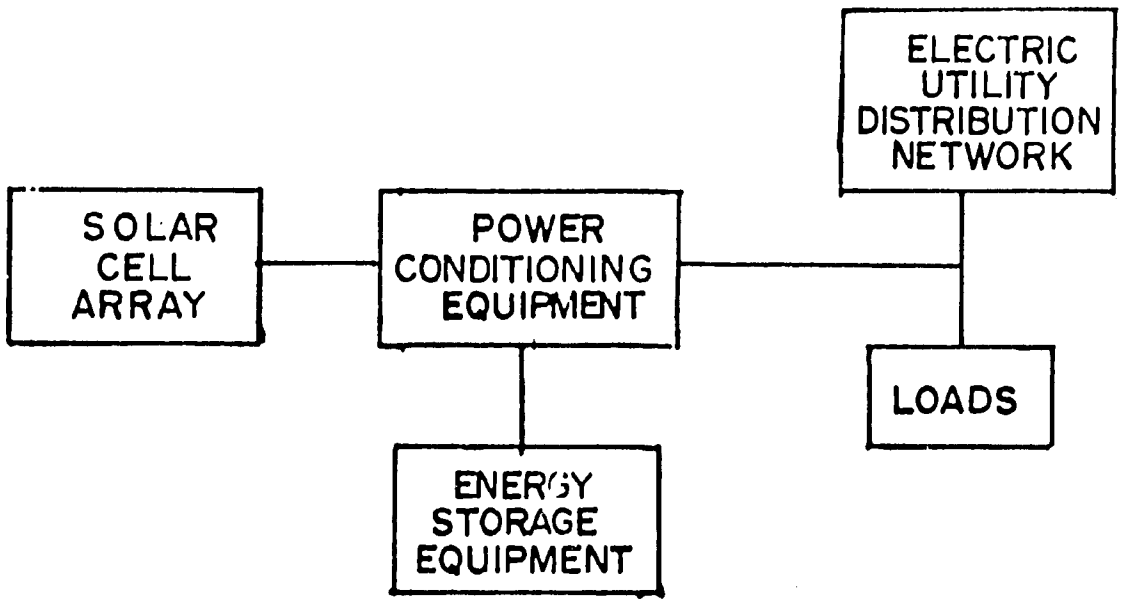


FIGURE 1. BLOCK DIAGRAM OF AN PV POWER SYSTEM

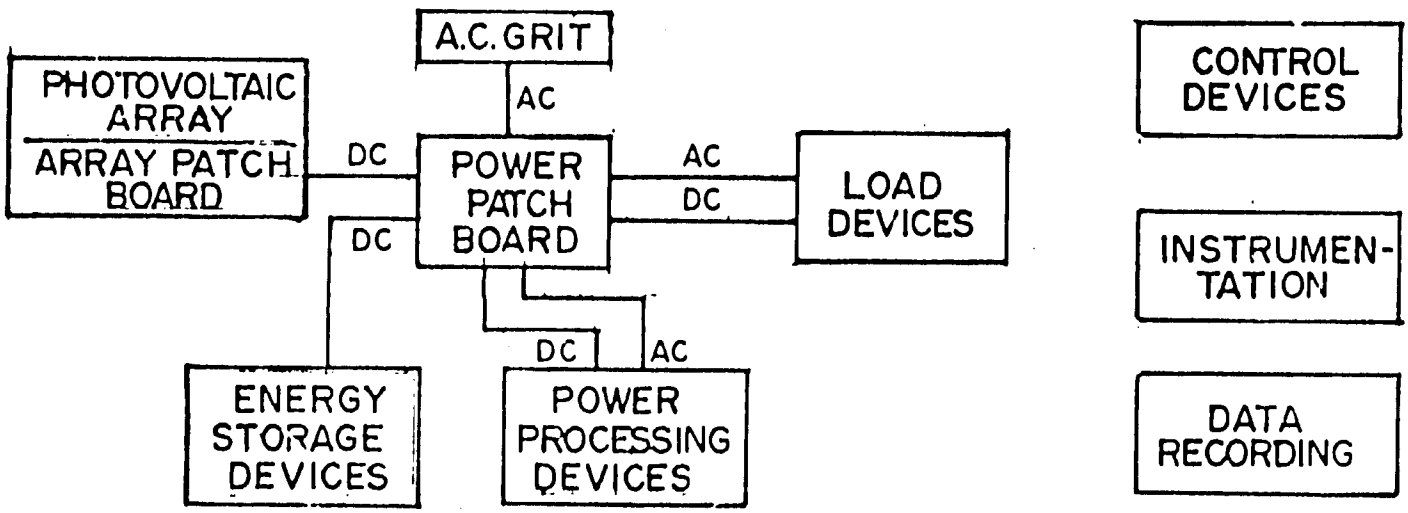


FIGURE 2. BLOCK DIAGRAM OF THE PHOTOVOLTAIC TEST FACILITY

Energy Storage Subsystem

Many photovoltaic power systems require on-site energy storage. The PTF will have 75 kw hr of lead-acid storage batteries initially with expansion later if the need arises. The batteries will be the type specifically designed for PV applications -- deep discharge, multiple cycle type. They will be housed in a building with sufficient ventilation to prevent build up of explosive or otherwise dangerous gases and with a safety alarm triggered by loss of ventilation.

The energy storage subsystem of the PTF can be used to test locally manufactured lead-acid batteries and to test new concepts of battery storage (e.g., zinc chloride or zinc bromide) as well as other energy storage concepts (e.g., Redox systems).

Power Conditioning Subsystem

The PTF would be a flexible power system and could be interfaced with virtually any type of AC or DC power conditioning equipment. Initially the emphasis would be on DC-to-AC inverter systems and on DC systems containing components such as battery charge regulators and DC-to-DC converters.

Instrumentation and Data Recording

The instrumentation and data recording subsystem would include equipment for measuring electrical parameters (voltage, current, power, reactive power, resistance), array temperatures, weather parameters, (wind speed and direction, air temperature), solar insolation, state of charge of the batteries and special user instrumentation.

Current-voltage traces of individual module strings and groupings of strings up to and including the total field could be made. Real time data acquisition equipment would include analog chart recorders, oscilloscopes, digital processors and recorders.

Illustrative Areas of Investigation

The PTF would be used for component testing, system development and fault identification and diagnosis. This work can be done much faster and more conveniently in a test facility than in the field. Areas to be studied might include:

- Operation of small motors with and without batteries.
- Lighting systems for public areas.
- Battery charge regulation using various control devices.
- Use of pilot cells to determine battery state of charge.
- Use of load shedding at high depth of discharge.
- Low power communication systems.

This program element will include equipment, installation and training of BPPT in the design, construction and operation of the PTF. The budget for this activity is presented below:

1.0 SYSTEM DESIGN

Engineering (800 hrs @ $20/hr)	$ 16,000	
Drawings ($1,000/DWG x 10 DWG)	10,000	
Failure Analysis (200/hrs @ $16/hr)	3,200	
Review (125/hrs @ $16/hr)	2,000	
Proof of Design Testing (160 hrs @ $10/hr)	1,600	
Operation/Maintenance & Training Manuals ($2,500/manual x 4)	10,000	
Contractor's Project Management (250 hrs @ $25/hr)	6,000	
Travel	5,000	
SUBTOTAL	53,800	
OVERHEAD (100%)	53,800	
TOTAL		$ 107,600

2.0 MATERIALS

Array Field:		
Modules ($11/wp x 5,000 wp)	$ 55,000	
Frame, Support, Wiring	12,000	
Battery Storage:		
Batteries ($150/kwh x 75 kwh)	11,250	
Racks	1,000	
Controls & Instrumentation	10,000	
Electrical Distribution	2,000	
SUBTOTAL	91,250	
OVERHEAD (25%)	22,810	
TOTAL		$ 114,060

3.0 ASSEMBLY, TESTING LABOR

Fabrication (600 hrs @ $10/hr)	$ 6,000
Assembly (factory)	1,500
Controls & Instrumentation (factory)	2,000
Acceptance Testing (factory-field) (150 hrs. @ $10/hr)	1,500
Packaging	1,000
Field Installation & Checkout	6,000
Site Survey	1,600
Training (40 hrs @ $16/hr)	600

	Contractor's Project Mgmt (200 hrs @ $25/hr)	5,000	
	SUBTOTAL	25,200	
	OVERHEAD (100%)	22,810	
	TOTAL		$ 50,400
4.0	SHIPPING		
	Array	$ 2,600	
	Battery	2,700	
	Auxiliary Hardware	1,900	
	SUBTOTAL	7,200	
	OVERHEAD (25%)	1,800	
	TOTAL		$ 9,000
5.0	INTERNATIONAL TRAVEL		
	Site Specific Survey (1 RT air fare, 6 days @ $80)		$ 3,500
	Field Installation, Training (2 RT air fare, 44 days @ $80)		9,500
	SUBTOTAL	13,000	
	OVERHEAD (25%)	3,250	
	TOTAL		$ 16,250
6.0	CONTINGENCY (10%)		29,700
7.0	PROFIT (10%)		32,700
	GRAND TOTAL		$360,000

3. Photovoltaic Field Tests

The objective of the field application tests is to demonstrate the feasibility of using stand-alone PV power systems and energy efficient loads to supply minimal basic services for small settlements in remote regions in Indonesia where alternative conventional power sources are not appropriate. Four illustrative field applications are presented here: Fisherman Shelter System, Community Service System, Rural Health Clinic and Rural Education Center. These applications would be based on prior U.S. experience with field applications of photovoltaic systems, in particular AID projects such as the centrally funded Photovoltaic Development and Support Program. These prior activities have proven the general system concept and produced system designs. These designs would then be modified as appropriate for the specific Indonesian applications.

The field application would be done in conjunction with the GOI line departments responsible for the specific sector (e.g., Agriculture, Education or Health).

These applications would not need on-site technical monitoring. The operational performance of the systems would be automatically recorded and the data forwarded to PERL for analysis and review. Periodically, BPPT personnel would visit the sites to provide system maintenance beyond the regular operation and maintenance performed by the local users.

In all applications, the following training would be provided:

- Train local users in system use and minor maintenance.
- Train technical personnel in data monitoring, maintenance and minor troubleshooting and repair.
- Train PERL staff (and relevant staff of other agencies) in major troubleshooting and repair.

The following items would be monitored and records kept for system and application evaluation:

- Photovoltaic system performance: generated energy.
- Load system performance: service provided.
- Social, health, economic benefits.
- Maintenance, problems, failure records.

A typical implementation schedule would be:

Preparation of Statement-of-Work	0 to 2 months
Procurement Cycle	2 to 9 months
Preliminary Design	9 to 11 months
CDR & Final Design	11 to 12 months
Procurement/Fabrication/Test	12 to 18 months
Ship (FOB-to-Site)	18 to 21 months
Install/Checkout/Accept. Test/Train	21 to 22 months

The definition of field applications will be made during project implementation. The planned budget for this program element is $225,000.

(a) Fisherman Shelter System

A Fisherman Shelter PV/Load System would consist of:

(1) A complete PV power system including the PV array, controls, instrumentation, and energy storage (680 watts).

(2) Water pump for potable water (5 litres/person/day), water for domestic uses (20 liters/day/person), and irrigation and water for irrigation ($10m^3$/day -- for a small garden).

(3) Three 20-watt fluorescent light for common areas in the shelter.

(4) One refrigerator/freezer designed specifically for the storage of medications and vaccines in high ambient temperature (43°C) environment.

(5) One water purifier to provide 5 litres/person/day of purified potable water.

The PV power system will be low voltage to enhance personnel safety and will be designed for unattended operation. The PV array and battery size will vary to meet the needs of each site. All loads will be DC-powered to reduce system cost and increase system reliability through the use of fewer components.

The pump would be designed to operate automatically whenever the PV array is generating sufficient power and may be located near the shelter or at the intake in the lake. The intake line will be designed to float on the surface of the lake or lay on the ground as the level of the lake varies with the time of year. The pump intake will be designed to take in water below the surface and above the bottom to avoid surface and bottom debris and contamination.

The pump will deliver all of its output to a water storage tank located above the level of the kitchen garden and the shelter. The tank would be designed such that a one to two day domestic water supply would constitute the lower volume of the tank and irrigation water would flow through the upper volume of the tank. Such an arrangement removes the need for practically all pump controls. Additionally, it provides an opportunity for the design and installation of a subsurface irrigation system that could operate unattended. Figure 3 (page 12) presents a schematic of the proposed PV system and associated loads.

The refrigerator/freezer (R/F) for medical supplies will be a chest-type unit and will have a usable interior volume of approximately 100 litres which will provide adequate space for medication storage. Such an R/F has been developed for the U.S. Center for Disease Control and the Department of Energy as a high performance unit.

Specifications

(1) Water Requirements:

Irrigation, @ 10m^3/acre/day x 1 acre	10.000 m^3/d
Potable, @ 5 litres/person/day x 25 people	.125 m^3/d
Domestic, @ 20 litres/person/day x 25 people (Bathing, kitchen, fishing gear cleanup)	.500 m^3/d
TOTAL	10.625 m^3/d

(2)	Pump Energy, @ 80 Whr/m^3	850 Whr/d
(3)	Lighting Requirements, 3 fixtures 1 hr/day x 2 lamp/fixture x 21 w/lamp	130 Whr/d
(4)	Refrigerator/freezer, @ 43°C ambient	735 Whr/d
(5)	Water Purifier, for 125 l/day	190 Whr/d
	Total daily energy requirements	1905 Whr/d

(6) PV Array Size and Battery Capacity
PV array: 680watts @ 28°C
Battery: 600 amp-hrs based on:
- 40 percent night R/F operation
- all lights at night
- 10 percent purifier at night
- 10 percent maximum daily depth-of-discharge (DOD) (This DOD yields a cycle life of 1400 cycles.

(7) Controls
Maximum voltage regulator (shunt or switching type)
Low voltage cutout
Pump controls for daytime only pumping

Insofar as possible, the shelter PV/loads systems will be composed of proven off-the-shelf hardware. Where possible, specific components of known design which have passed established qualification tests will be specified. Where additional testing of components is required, test requirements will be patterned after industry standards and to reflect the end-use conditions. The shelter system (separate systems for water pumping and the other appliances as appropriate) shall undergo a factory test of the complete system(s). Following installation and checkout, the system will be subjected to an acceptance test which will be designed to demonstrate operational status of the system.

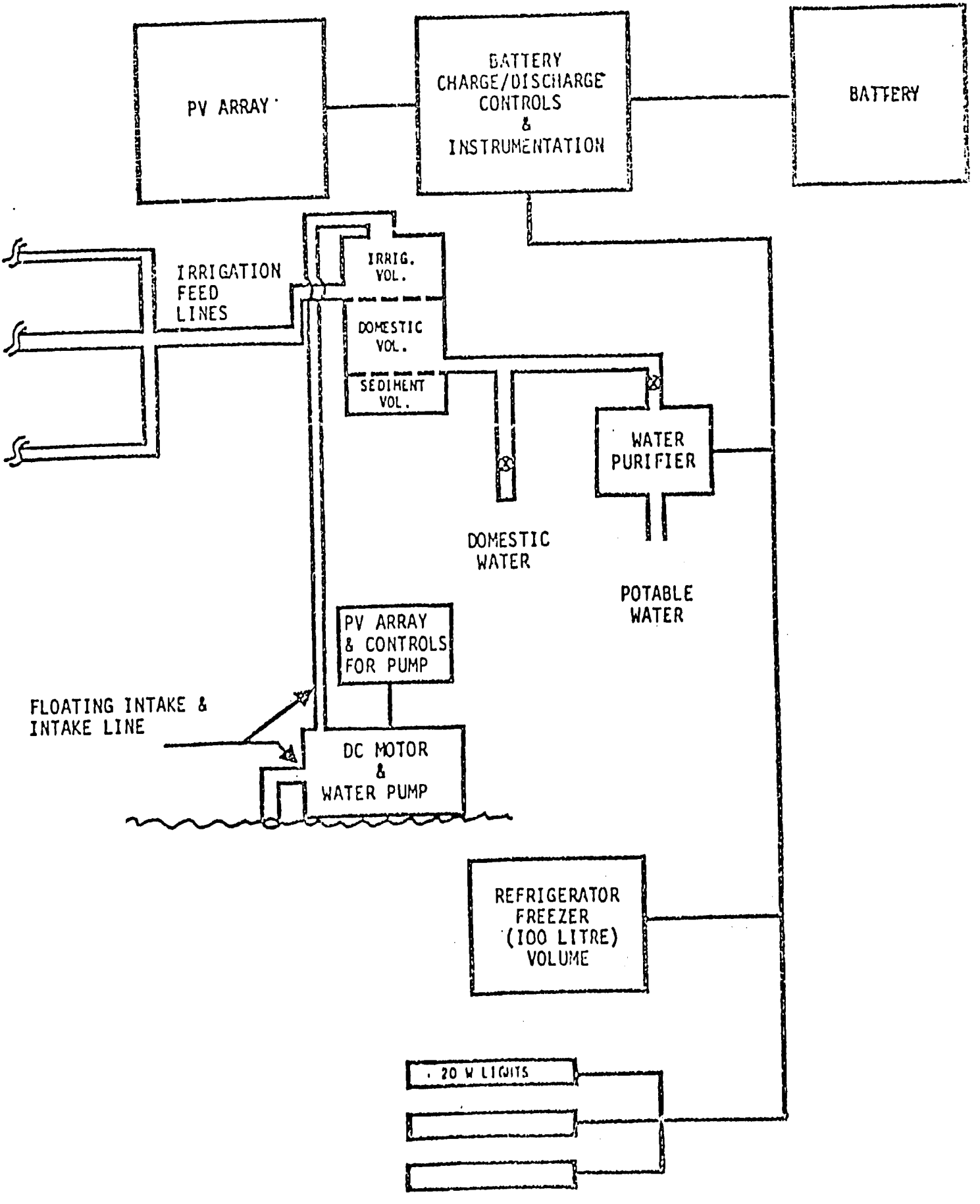
Cost Estimate

Equipment	$ 25,000
Shipping	3,000
Construction & Installation	10,000
Checkout/Startup	2,000
Operation Support (2 yrs)	10,000
TOTAL	$ 50,000

(b) Community Service System Rural Health Clinic and Rural Education Center

These would be similar systems (2.5 kw peak) that would provide essential electric power for needed service in remote areas.

FIGURE:
FISHERMAN SHELTER
PV/LOAD SYSTEM
DIAGRAM



The community service system would include general public lighting and lighting of individual homes, limited electric service to individual homes to power radios, battery chargers, other small appliances and possibly two-way radio communication for the village.

The rural health clinic system would provide refrigeration for medical vaccines, lighting for the clinic, radio communication and power for medical instruments.

The education center system would provide lighting for evening education and social activities, power for radio or television and for audio visual equipment

Direct current loads would be emphasized to save electrical energy. In some cases, however, DC to AC converters would be used to power AC loads. The exact details of each field application would need to be defined during project implementation

The typical costs for a 2.5 kw (peak) stand alone photvoltaic system would be:

PV Modules (2.5 kw, peak)	$ 25,000
Support/Foundation	4,000
Storage Battery	8,000
Wire, conduit, enclosure	4,500
Regulators	1,200
Instrumentation	5,700
System Protection Sensors	1,450
Data Acquisition System	5,000
Fence	1,000
Spares	4,200
Packaging, Shipping & Insurance	10,000
Installation, Check out and Training	10,000
TOTAL (estimate)	$ 80,000

4. Laboratory Testing of Solar Thermal Systems

The technology for direct conversion of solar radiation into heat is based on well understood sciences of thermodynamics, heat transfer and fluid flow. The PERL program will emphasize the development of optimized conversion devices and systems for specific applications in Indonesia. In this work both imported and locally produced equipment will be investigated.

The solar thermal program element will include both water and air systems. Hot air systems will receive more attention than hot water systems because of their application to crop and fish drying and reduction in post-harvest food losses.

The need for crop drying under controlled conditions is well recognized. This activity requires close collaboration between food processing specialists and solar engineers. The thermal group of PERL would work with the agriculture/food experts at IPB and elsewhere to study crop and fish characteristics and the dynamics of food drying in order to develop optimized dryers for the various foods. The solar thermal program element will purchase instruments and equipment needed to measure and monitor the performance of thermal systems. Laboratory measurements will be emphasized rather than pilot scale field demonstration. Existing systems will be purchased or systems will be built from local materials. The work will be limited to small systems or laboratory or bench scale systems to study concepts for larger units.

The following equipment will be needed to perform the required work:

Equipment & Materials Needed	Possible Source	Est. Cost
1. 24 Channel, 10" Strip Chart Recorder, 0-100°C	Leeds & Northrup	$ 2,400
2. Millivolt Recorder, 0-50 mV Range 15 Channel	Leeds & Northrup	$ 2,400
3. 5,000 ft, 24 gauge, type T copper constantan with nylon over nylon insulation	Leeds & Northrup	$ 600
4. Termocouple Junction Tool for use on 22-24-30 Gauge Wire	Leeds & Northrup	$ 200
5. Numatron for Thermocouple Output	Leeds & Northrup	$ 465
6. Pushbutton Selector Switch for Numatron	Leeds & Northrup	$ 190
7. Pyrometer, Eppley Model 848	Eppley Labs	$ 600
8. Pyrheliometer Model NIP	Eppley Labs	$ 900
9. Two Records for Eppley Instruments 6 1/2 Strip Chart @ $1,760	Leeds & Northrup	$ 3,520
10. Two Integrators for Eppley	Leeds & Northrup	$ 1,400
11. Event Recorder Model 292-4	Rustrak	$ 165
12. Air Flow Instruments 3 Model 2000, Range 0-.5" WC 3 Model 2000, Range 0-3.0" WC @ $30	Magnehelic	$ 180

13.	Two Manometer Air Units Range .1-1" WC @ $40		$ 80
14.	Four Flowmeters	Dwyer	$ 320
15.	Dry Bulb Thermometer		$ 600
16.	Moisture Tester		$ 300
17.	Fan (forced ventilation)	Various	$ 200
18.	Materials (construction) (Glass, support, tubing, etc.)		$ 5,000
	SHIPPING, INSURANCE (15%)		$ 2,200
	TOTAL		$ 22,000

In addition to the above, commercially available systems (such as hot water), food dessicators and crop dryers will be purchased to investigate their performances in Indonesia. The amount budgeted for these purchases is $15,000.

Initial investigation will be undertaken in the potential for the use of solar powered Sterling engines in Indonesia. This investigation will require the purchase of commercial units; the amount budgeted for this work is $13,000.

The total amount allocated to the solar thermal program is $50,000.

5. Radiation Measurement Systems

In addition to the above solar program elements, funds will be allocated to the purchase of measuring equipment to determine solar radiation data. These instruments would measure both direct and diffuse radiation, hours of sunlight and environmental factors. Measurements at PERL and at potential field sites would be included. Continuous and integral time measurements would be performed. A total of $23,000 has been budgeted for this equipment.

3 Eppley pyranometers, or equivalent	$ 3,000
3 Mechanical pyranometers, Weather Measure Corp. Model 402 or equivalent	$ 2,000
3 Eppley tracking pyrheliometers or equivalent	$ 7,500
2 Mechanical weather stations, MRI Model 1077 or Weather Measure Model WS 755	$ 7,000
2 Data recorder and integrator	$ 2,500
Chart paper, batteries, supplies, etc.	$ 1,000
TOTAL	$23,000

Budget Summary:

The total budget for the solar program is then:

	Program Element	Amount
1.	Expansion of Photvoltaic Laboratory	$292,000
2.	Photovoltaic Test Facility	$360,000
3.	Field Tests of Photovoltaic Systems	$225,000
4.	Laboratory Tests of Termal Systems	$ 50,000
5.	Radiaton Measurement Systems	$ 23,000
	TOTAL	$950,000

Education and training is included in the general budget items for Institutional Development.

INDONESIAN ENERGY POLICY

The official energy policy is stated in the Repelita III Five-Year Development Plan (1979-1983):

"a. To guarantee a continuous energy supply which meets national demands in both quality and quantity, at a reasonable price to generate a well-distributed increase in the standard of living of the Indonesian people and the achievement of a high economic growth rate.

b. To guarantee that, apart from fulfilling national needs, the energy supply also provides export commodities in order to support the balance of payments.

c. To guarantee that the development of energy resources is accompanied by an efficient and wise management of a life supporting environment structure in order to achieve a better quality of life for the Indonesian people

d. To make every effort to ensure that the overall supply and management of energy resources increases the capability and strnegth of the Indonesian people to face the future."

These objectives will be met through a program aimed at the following targets:

"(1) Increase and expansion in exploration and production of all energy resources, i.e., oil and natural gas, coal, water power, geothermal heat, and radioactive minerals;

(2) A reduction in the domestic utilization of crude oil and the promotion of crude oil as a prime export commodity through an extensive diversification program that increases the utilization of other energy resources;

(3) Conservation directed to a more efficient use of energy;

(4) Institutional development in order to be able to formulate a national energy policy and to guarantee its implementation and a review as and when necessary;

(5) Information and data development to complete the information and data on conventional and non-conventional energy resources and energy requirements;

(6) Information to promote understanding among the community of the energy policy undertaken by the Government.

(7) Monitoring and evaluation of the implementation and the laws and regulations stimulated in the framework of the national energy policy, in order to take measures for their improvement as required."

The program has three elements:

1. A short-term effort to intensify oil and gas exploration and development and to increase firewood production.

2. A medium-term effort:

   - to develop coal for domestic use in the electric power, industrial and household sectors

   - to utilize hydropower and geothermal energy

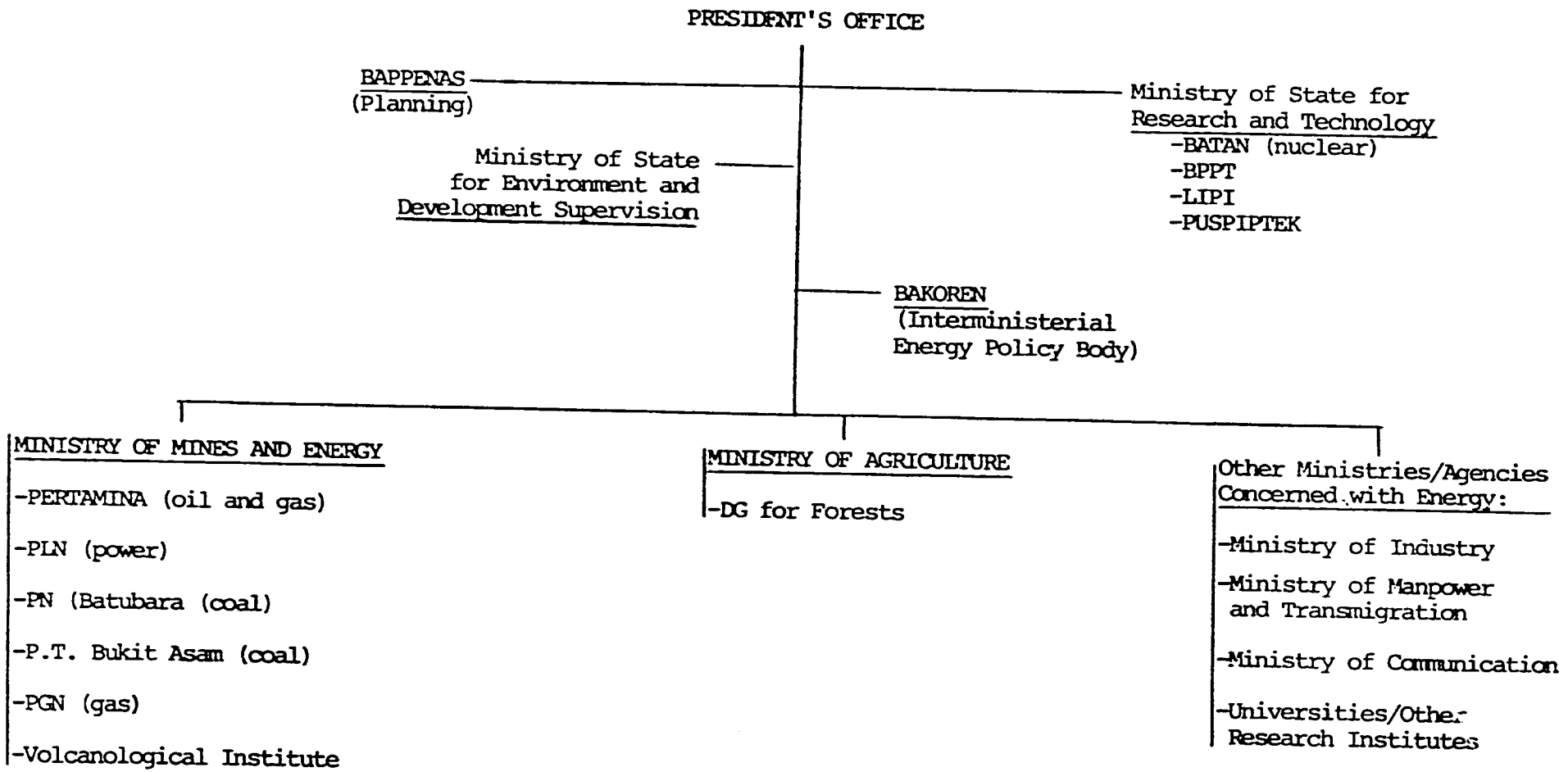
   - to encourage replanting of trees, wood plantations and more efficient wood usage

   - to encourage the use of biomass, solar power and nuclear power so long as it is techno-economically feasible

3. A long-term effort to achieve extensive and sustained energy conservation.

ORGANIZATION OF THE GOI

ENERGY PERSPECTIVE



ANNEX II D

THE ORGANIZATION OF RESEARCH AND TECHNOLOGY IN INDONESIA

(1) Overview of Policy, Organization and and Management of Research and Technology.

Country Paper Submitted to ASEAN, October 1980

(2) BPPT: Organization and Personnel Working In Energy

RESEARCH AND TECHNOLOGY IN INDONESIA

COUNTRY PAPER

Submitted to

THE FIRST MEETING OF ASEAN MINISTERS OF SCIENCE AND TECHNOLOGY

PATTAYA, OCTOBER 27 - 28, 1980

RESEARCH AND TECHNOLOGY IN INDONESIA

I. Introduction: The Need for a National Policy for Research and Technology.

II. Research Organizations in Indonesia.

III. Management of Research and Technology.

RESEARCH AND TECHNOLOGY IN INDONESIA

I. Introduction : The Need for a National Policy for Research and Technology

During the last decade, the government through the implementation of three Five Year Development Plans has achieved a remarkable success in controlling inflation, together with the rehabilitation and expansion of the economic infrastructure, as well as recovering political stability throughout Indonesia. Within the same period a steady annual gross rate of economic growth to the amount of around seven percent has been possible.

In the Third Five Year Plan, special emphasis will be given to the Triple Objectives or Trilogy of the Indonesian National Development : more social and economic equity for the whole Indonesian people, a sufficient high rate of growth, and a continued high degree of national stability.

The national resilience which is the dynamic condition of a nation which reflects the capability to cope with the challenges and threats from within the systems and the environment, is a prerequisite for national stability which provide the necessary conditions for national development. The national resilience can be obtained by enhancing the capabi-

lity of the people to manage and utilize the resources and environment to achieve the national objectives. The Indonesian government believes that with greater achievements in terms of the Trilogy Objectives, she will make a positive contribution to the stability and resilience of the region and indeed, to the stability of the world as a whole.

To achieve these goals, all available means and forces, including technological inputs should be utilized to secure maximum participation of the people in the development process. Starting with the Third Five Year Plan, increased emphasis will be given on the development of Indonesia's human resources. The Government believes that the energy and skills potential of the Indonesian people must be used as effectively as possible as the base of development. Investment must be made to study and activate the people's power for development. All aspects of human life must be taken into consideration and be developed.

Hence, strategies should be determined as to provide guidance for the selection and development of the required technologies, compatible to the socio-cultural pattern and dynamic condition of the Indonesian people which at the same time take account prevailing economic and financial constraints.

This challenging task was entrusted to the Minister of State for Research and Technology. It is his responsibility to formulate the national policy on Research and Technology, based on guidelines given by the People's Assembly and the President of the Republic of Indonesia.

Successful execution of this task is possible only if existing capabilities of research and technology in the different governmental agencies, universities and other autonomous research institutes could be invited to come to common terms of reference, without touching on their financial autonomy and other competencies. In July 1978, the National Workshop on Research and Technology was organized by the Minister for Research and Technology, out of which the general outline of a "National Policy for Research and Technology" was formulated.

The most important outcome of the workshop was the unanimous acceptance of the idea that coordination in research program

was necessary and that topics of research should directly or indirectly be in support of the current development programs of the government centered on the need to develop human resources. Based on this consensus the Minister for Research and Technology promulgated a National Program on Research and Technology.

The National Program on Research and Technology are based on the following basic ideas :

- To develop human resources we must first provide for their primary needs :

  food and nutrition; shelter and living space; clothing and bodily protection; education; and the preservation and strengthening of their health. This is an essential beginning.

- Second , we must equip people with other resources. Therefore, we must increase our efforts in the exploration and utilization of both renewable and depletable natural resources for conversion into energy, industrial raw materials and consumer goods.

- Third, we must create employment through the production of goods and services needed by the people themselves and by the peoples in the world. This process of adding value to raw materials may be called "industrialization" in the widest sense.

- Fourth, this process of production and the people that participate in it, as well as their families and their

social and physical environment, must be protected against natural and man-made disturbances and disorders.

- Fifth, but of equal importance, since people are not inanimate material but are living beings and possess feelings, ethics, culture, traditions, religion, science, technology, and philosophies of life, we must study, maintain and develop these features of human existence. as well.

We regard these five sphere of human existence as the central areas of attempt to view human being as resources. Therefore, they have been designated as the five priority areas for the conduct of scientific research and development, transfer and application of technology.

As applied to Indonesia's physical and social geography, each and every priority area has been further subdivided into the following four catagories : land; sea and marine; air and space; and environment.
Thus , we have for instance , in the priority area of Energy and Resources " : (a) Land Energy and Resources; (b) Marine Energy and Resources; (c) Utilization of Space Science and Technology for Energy and Resource Research and Technology; and (d) Environmental Aspects of Energy and Resources Development *)

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*) See also Appendix II

The National Program on Research and Technology was reviewed and improved in the National Workshop on Research and Technology held in Jakarta in June 1980.

II. Research Organization in Indonesia

Research Institutes in the Republic of Indonesia have a various organizational structures and responsibilities. There are research institutes under the Ministerial Departments, Non-Ministerial Government Agencies, Universities, State Companies and Private Research Institutes.

According to Presidential Decrees No. : 44 & 45 of the year 1974, each Ministry has Research and Development Agencies or Research Centers oriented to the service of their technical policy and operational needs.

There are Research and Development Agencies in the following 12 Ministries : the Department of Interior; Foreign Affairs ; Justice ; Information ; Trade ; Agriculture ; Communication ; Education & Culture ; Health ; Religion ; Social Welfare ; and Manpower & Transmigration. These agencies are subdivided into Research Centers. Other Ministries possess Research Centers which are not division of Agencies. There are four Research Centers in the Department of Industry, two Research Centers in the Department of Mining and Energy, one Research Center in the Department of Finance, Public Works and Defence & Security.

More than two thousand research workers are employed in these research establishment.

There are six Non Ministerial Government Agencies for research and technology established by presidential decree. These are : The Indonesian Institute of Sciences, The National Atomic Energy Agency, The National Aeronautics and Space Institute, The Central Agency of Statistics, and The Agency for The Development and Application of Technology.

The Indonesian Institute of Sciences covers research activities in social sciences and humanities engineering sciences and natural sciences and provides scientific services such as scientific documentation.

The National Atomic Energy Agency covers research on atomic energy the exploration of uranium, the production of isotops and their application.

The National Survey and Mapping Coordinating Agency has the task of producing base, topographical, oceanographical ; meteorological and other the matic maps and of surveying, inventorying and evaluing natural resources. The activities of the National Aeronautics and Space Institute are concentrated on the use of space technology for resource inventory, weather forecasting and communication.

The Central Agency of Statistics covers the collection and analysis of national statistics.

The Agency for the Development of Technology (BPPT) is a newly established agency which originates from the Advance Technology

Division of the state-owned Oil company PERTAMINA.

This Agency explores technologies compatible to the situation and conditions in Indonesia, and by special assignment is also responsible for their application in industries, on each own account or as a joint cooperation with other organization. In so doing, BPPT performs the function of technological enterpreneurship for the Government of Indonesia.

Another institute that will provide technical and laboratory services to science and research is PUSPIPTEK (the Center for Science, Research and Technology) in Serpong, near the capital city of Jakarta. It is planned as a science town, to be equipped with laboratories, a computer center and other facilities. As stipulated by Presidential Decree No. 43/1976, which establishes it, the main goal of PUSPIPTEK is :

(a). To develop infrastructure for research and technology needed for the acceleration of national development.;

(b). To provide facilities needed by the scientific community;

(c). To increase public awareness of the role of research, science and technology in development.

BPPT (Agency for the Development and Application of Technology) will supervise each of the ten laboratories to be installed in PUSPIPTEK. The first laboratory now under construction will have the facility for material and construction testing and will be ready for operation in about one year from now.

First priority has been given to these facilities, in consideration of their central role in the development of manufacturing industries in Indonesia by helping to secure the quality and performance of manufactured goods. A few of the state companies also have research institute of their own. These are mainly big state companies like PERTAMINA and other mining companies, the Agriculture Estate Companies and others.

The activities of these research institutes are limited to servicing and the operational needs of their mother companies. Besides the above mentioned research organizations, there are also private companies, such as Unilever Ltd., Good Year Ltd. which posses research units of their own. Private independent research and development organizations also exist, while universities also have research institutes attached to them.

III. Management of Research and Technology

A. Coordinating Mechanisms.

It is clear, that success and failure of the national programs of Research and Technology depends on their management, and the ability of the Minister for Research and Technology, to coordinate the various research institutes in Indonesia. A summary of the coordinating mechanism in research and technology by the Minister can be featured as follows :

1. The Ministry of State for Research and Technology *)

By Presidential Decree Number 59/M of 1978, the task of the Minister of State for Research and Technology is "to solve the research and technology issues and problems, such that their development and application will be more effective and integrated according to national development needs".

The Minister is assisted by five assistants. These are the Assistants for : General Planning; for Research and Technology Development; for Institutional and Manpower Development; for General Control and for Research and Technology Program Coordination.

*) For details of this Organization, see Appendix III.

Under the direct coordination of the Minister of State for Research and Technology are the following Institutes :

- L I P I (the Indonesian Institute of Sciences)
- BATAN (the National Atomic and Energy Agency)
- B P S (the Central Agency of Statistics)
- LAPAN (the National Aeronautics and Space Institute)
- BAKOSURTANAL (the National Survey and Mapping Coordinating Agency)

The Minister of State for Research and Technology is directly responsible for the evaluation, approval and control of the research programs of these institutes.

2. PEPUNAS (the National Committees on Research and Technology Programs).

The PEPUNAS, appointed by the Minister of State for Research and Technology, are Committees of scientists and science managers from Universities, Departmental R & D Agencies and others. Five of the Committees exist for each of the five main Research Priority Areas, as stated in the National Research Programs - Matrix, i.e. :

(1) Basic Human Needs, (2) Natural Resources and Energy, (3) Industrial Development, (4) Defence and Security and (5) Social Sciences and Philosophy.

Each PEPUNAS Committee is assigned to submit a list of recommended Research Programs in their respective Priority Area to the Minister for Research and Technology, from proposals submitted by research institutes which can be grouped into :

1. Departmental Research Institutes.
2. Non-departmental Research Institutes (directly coordinated by the Minister himself)
3. Universities (State and Private)
4. State Enterprise Research Divisions, and
5. Private Research Institutes.

The Minister for Research and Technology may recommend, modify or reject the Research Program proposals

3. <u>Badan Pengkajian dan Penerapan Teknologi (BPPT) The Agency for the Development and Application of Technology (ADAT).</u>

BPPT is the successor of the former A.T.P. (Advanced Technology Division of the State owned Oil-enterprise PERTAMINA) headed by Prof. Dr.-Ing. B.J. Habibie.

BPPT has six Directors, each supervising activities in the fields of : (1) Technological Facilities, (2) Natural Resources Development, (3) Basic and Applied Sciences Studies, (4) Technology Development, (5) Industrial Development, and (6) Systems Analysis.

The Minister for Research and Technology is concurrently also the Head of BPPT; therefore the strategies, policies and programs of BPPT are directly under the full control of the Minister. As an agency for technology application, BPPT through case-by-case assignment is also the coordinating office for specific development proyects. For example, under its former name ATP (Advanced Technology Pertamina) is established and developed the Indonesian aircraft manafacturing company P.T. Nurtanio in Bandung. Similarly a government owned shipyard in Surabaya is presently being developed by the BPPT.

4. PUSPIPTEK (the Center for Research, Science and Technology).

PUSPIPTEK is a center for research and scientific laboratories, workshops and experimental stations, located in Serpong (near Jakarta), presently under construction .

The following laboratories will be constructed a laboratory for material and construction tests (under construction), a laboratory for instrumentation, a nuclear research reactor, a laboratory for electronics, a laboratory for applied physics, a laboratory for engineering chemistry, a laboratory for energy resources, a laboratory for thermodynamics and engines, a laboratory for hydrodynamics, aero dynamics and vibration.

PUSPITEK is designed to provide research institutes as well as state owned and private enterprises with technical and laboratory services, by request. In specific fields, such as material tests, structural tests, etc., it will have a coordinating function among its users, to avoid duplication and to promote standardization simultaneously. PUSPITEK is also under the supervision of the Minister for Research and Technology.

B. Financial Resources

The main source of research-funds in Indonesia is the government budget. The government research budget is composed of the budget for Research and Development Sector and the research component included in the respective budget of the corresponding Ministeries (Defence, Public

works, Interior, etc.).

The departmental R & D budget is not mentioned in the overall annual State-Budget, and it is understandably only a relative small portion of the departmental budget itself.

State owned enterprises such as PERTAMINA (Oil), BANKA-TIN (Tin-Ores), several Plantation Estates (rubber, palm oil, coffee etc.) are providing limited amount of funds, for research activities of their corresponding R & D divisions.

BPPT has an unique budget-structure. Besides its routine and development budget, which is allocated out of the State-Budget special development budget may be extended by other organizations, such as the state owned oil company PERTAMINA.

This enable BPPT to act more flexible in its operations under the strict direction of its Head Prof. Dr.-Ing B.J Habibie, which is also Minister of State for Research and Technology.

C. Manpower Resources

At present there are no exact figures available on the amount of R & D personnel in Indonesia. In 1975, it was

estimated that 10.250 were working in various Research Institutes, while 331.650 persons were actually needed. According to the same estimates around, the year 2000 : 389.500 researchers will be required to satisfy the need of the country. Generally speaking manpower reqruitment for research activities has not been developed consistently so far, while the available scientists are mainly programmed for academic and lecturing professions. The problem of manpower resources for Research and Technology will be among the strategic goal of the Minister for Research and Technology, to deal with, so that short, medium and long term requirements could be met optimally.

D. International Cooperation

Industrial countries, are very advanced in Research and Technology. However, it should not be taken for granted that their capabilities in this field are straightly applicable to all conditions that prevailed in Indonesia. Joint studies between advanced countries and Indonesian R & D people should therefore come together, to find out the best technological solutions that are exactly needed by Indonesia.

Another fruitful joint - research between foreign and Indonesian research capabilities are in the areas of common

interest such as energy, marine sciences, space sciences for weather forecast and resources, remote sensing, etc. Joint research activities between Indonesia and foreign scientist should be of mutual interest to both countries, otherwise no serious result could be expected.

E. Cooperation between Member Countries of ASEAN

The Permanent Committee on Science and Technology of ASEAN was established in 1971 to promote cooperation in the development of science and technology among the member countries of ASEAN.

In 1978, this Committee was reorganized to become the ASEAN Committee on Science and Technology (COST).

Various research programs have been undertaken and managed by COST, i.e. :

1. Regional Climatic Atlas and Compendium Climatic Statistic
2. Soybean and Protein Rich Foods
3. Management of Food Waste Materials
4. Enviroment
5. Regional Standardization Cooperation (in preparation)
6. Marine Science (in preparation)
7. Non-Conventional Energy Research (in preparation)
8. Patent System (in preparation)
9. ASEAN Center for Appropriate Technology (in preparation)

10. ERTS DATA Processing Station in Southeast Asia (in exploration)
11. Water Management of Applied Hydraulic Research (in exploration)
12. Metal Corrosion (in exploration)

There are also other joint research programs being conducted in the areas of common interest in science and technology between individuals and institutions of Indonesia and the other member countries of ASEAN.

AGENCY FOR DEVELOPMENT AND APPLICATION OF TECHNOLOGY (BPPT)

The Borrower is the Agency for the Development and Application of Technology (Badan Pengkajian dan Penerapan Teknologi - BPPT) which was created on August 21, 1978. Its goals are to promote and coordinate the application of technology to economic development. It currently employs about 900 people, many of whom are scientists recruited from universities or other institutions to work part-time on special projects. It frequently funds and supports projects executed by other agencies such as LIPI, Ministry of the Environment and several universities.

A brief description of BPPT follows. A listing of BPPT personnel currently working on energy projects is given.

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". .. For that reason, we need to be prepared with the development and application of technology in order to be ready for the future. For this purpose, we need a vehicle to make thorough and integrated investigation of technological questions so that the presence and application of technology truly bring the greatest possible benefits in the interests of our nation, particularly in the context of developing industry and national production, which can strengthen our national resilience."

"..... It is in order to fulfil those requirements that I consider it necessary to set up this Agency for the Development and Application of Technology. In conformity with its basic duty, it is expected that this Agency will prepare formulations of general policy on programs for the development and application of technology, as material for consideration by the President in determining the essentials of national policy related to the growth and application of technology for development. Further, this Agency is also expected to coordinate the execution of programs for developing and applying technology as a whole and in an integrated way, and that it will provide services to both Government and private bodies with regard to the application of technology. In this context, I expect that Government Departments and agencies together with both Government and private industrial circles will gain benefit from the existence of this agency. And finally, the Agency is expected to be able to carry out activities for developing and applying technology that supports Government policies in the field of developing and applying technology for development....."

"..... I hope this body will be capable of making careful studies and choices of technology that will conform with our needs....."

Quoted from the Address
by the President of the Republic of Indonesia
at the Ceremony Installing the Head of the
Agency for the Development and Application of Technology
in Jakarta on 28 September 1978

BPP TEKNOLOGI

Under Presidential Decree Number 25 of 1978, on August 21, the Government of the Republic of Indonesia established an Agency for the Development and Application of Technology (BPP TEKNOLOGI). This agency is a Non-Departmental body responsible directly to the President. The President has appointed Prof. Dr.-Ing. B.J. Habibie to direct this agency.

GOALS

Considering that technology is an essential factor in promoting development, BPP TEKNOLOGI was established to:

- Augment the development and application of technology in all sectors by maximizing the utilization of all available technological capabilities, infrastructure and resources.
- Foster participation in and coordination of the development and application of technology in government and private activities.

OBJECTIVES

Specific objectives of BPP TEKNOLOGI include:

- Formulation of policies and programs for the development and application of technology to assist the President in establishing national policies for economic growth and development, as provided in the successive five-year development plans (REPELITA).
- Comprehensive and integrated coordination of the development and application of technology in all public and private agencies and institutions concerned.
- Provision of services to government agencies and the private sector in the application of technology.
- Conduct of activities in the development and application of technology in accordance with government policy for national development.

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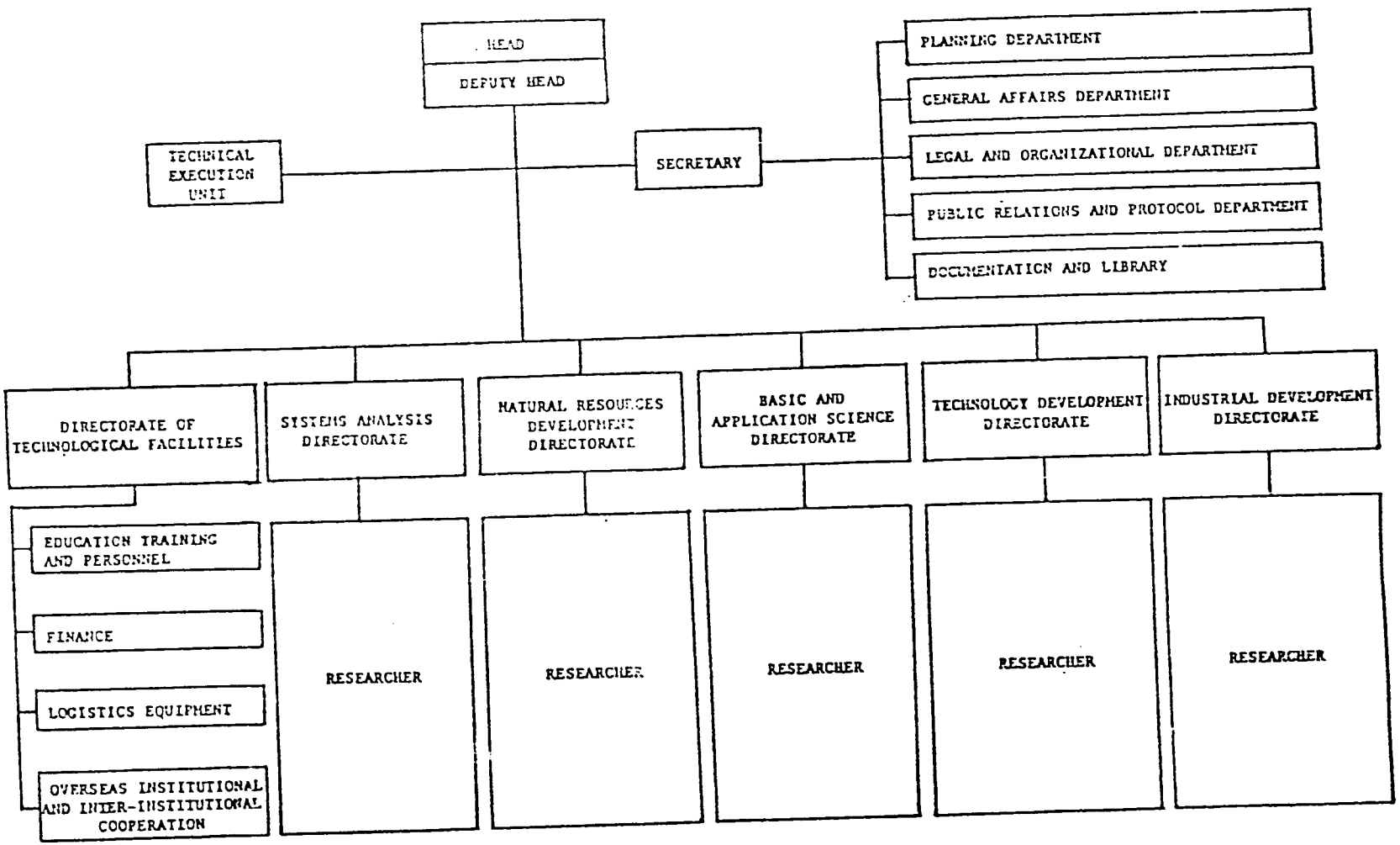
ORGANIZATION OF BPP TEKNOLOGI



TASKS

Tasks in the development and application of technology include:

- Policy and program formulation in support of national stability.
- Data collecting and processing.
- Management of technology transfer.
- Development of research and analytical skills.
- Coordinating, controlling and evaluating implementation of policies and programs.
- Management of cooperation with countries and international agencies.
- Provision of services and assistance to government agencies, to the public and private enterprise.

FUNCTIONS

The functions of this agency are to:

- Assist in the formulation of policies and programs for the development and application of technology;
- Acquire and analyze data relevant to the development and application of technology;
- Implement and guide the implementation of programs for the transfer of technology;
- Coordinate, direct and evaluate study programs for the application of technology;
- Develop and coordinate Indonesian cooperation with foreign and international agencies in the development and application of technology;
- Provide technological services to government agencies, develop the requisits plans and equipment.

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5.

1. Utilization & Development of Energy Project.

a. Utilization of Solar Energy & Village Energy Resources.

No.	Name	Field of Study	University	Graduation	Begin with BPPT	Ages
1.	Ir. Widyanarso D	Electronic	U I	Sept 1975	Nov 1975	32 year
2.	Ir. Iman Soedarwo	Electronic	U I	Jan 1976	Apr 1976	32
3.	Ir. Arsyad Ismail	Electronic	U I	1975	1976	32
4.	Drs. Abu Bakar Lubis	Phisics	U N P A D	Nov 1975	Jan 1976	35
5.	Ir. J.F. Sipasulta	Electrical - Power.	I T B	Mar 1977	Aug 1977	28
6.	Ir. A. Yusak Lubis	Industrial Technology	U S U	Oct 1976	Aug 1977	33
7.	Ir. Bambang Pamungkas	Electronic	I T S	1977	Nov 1977	31
8.	Ir. Aditya Kusuma	Electronic	I T S	1977	Dec 1977	31
9.	Ir. Martin Djamin	Electronic	U.I	Jan 1977	Feb 1978	32
10.	Ir. F.X. Soedarmono	Electronic	I T S	Sept 1977	Feb 1978	29
11.	Ir. Zhanggischan Udin	Electronic	I T B	Mar 1975	Jun 1978	31
12.	Ir. Christian Titaheleuw	Electrinic	I T S	1977	Jun 1978	31
13.	Ir. B. Witono	Electronic	I T S	Oct 1977	Jun 1978	30
14..	Ir. Chayum Budiono	Engineering Sciences	I T S	Feb 1978	Jun 1978	30
15.	Ir. Budiman Santoso	Mechanical	I T S	Sept 1978	Dec 1978	31
16.	Ir. Bambang Hapsariputro	Electronic	I T B	Oct 1978	Jan 1978	27
17.	Ir. Herliyani	Engineering Sciences	I T S	Oct 1978	May 1979	28
18.	Ir. Petrus Panaka	Engineering Sciences	I T S	Oct 1978	Jun 1979	29
19.	Ir. Abdul Kahar Kusno	Engineering Sciences	I T S	Oct 1979	Mar 1980	29
20.	Drs. Rachmat Mulyadi	Phisics	U N P A D	Dec 1979	Feb 1980	29

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No.	Name	Field of Study	University	Graduation	Begin with BPPT	Ages
21.	Ir. M. Dradjat Santoso	Chemical Engineering	I T S	Oct 1979	Apr 1980	32 year
22.	Ir. Bambang Prasetio	Chemical Engineering	I T B	Sept 1979	Apr 1980	26
23.	Ir. Nyoman Suharta	Engineering Sciences	I T S	Feb 1979	Apr 1980	31
24.	Ir. Kardono	Agricultural Technology	U G M	Dec 1978	Apr 1980	28
25.	Ir. Heru A. Witjaksono	Engineering Sciences	I T S	Oct 1979	Apr 1980	29
26.	Edi Santosa	Electrical	S.T.M	Dec 1977	Dec 1980	21
27.	Sofyan Agus Safari	Mechanical	S T M	Dec 1980	Dec 1980	19
28.	Drs. Agus Salim Dasuki	Phisics	U N P A D	Dec 1980	Mar 1981	26
29.	Ir. Herthalina Pakpahan	Electrical	I T B	Nov 1975	Mar 1981	30

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6.

b. Utilization & Aplication of Methanol.

No.	Name	Field of Study	University	Graduation	Begin with BPPT	Ages
1.	Dr. Suryo Harto	Chemistry	Hamburg	May 1974	May 1978	35 year
2.	Ir. Moekti Machfoed	Engineering Science	I T S	Apr 1977	Augt 1978	34
3.	Ir. Indyah Nurdyastuti	Chemical Engineering	I T S	Feb 1978	Augt 1978	34
4.	Ir. Muhsin Idrus	Chemical Engineering	I T S	Augt 1978	Nov 1978	23
5.	Ir. Hartiniati	Chemical Engineering	I T S	Augt 1978	Dec 1978	30
6.	Ir. Riyanto Marosin	Mechanical	U N I B R A	Dec 1978	Mar 1979	28
7.	Ir. Hermowo	Chemical Engineering	I T S	Feb 1980	Augt 1980	23
8.	Ir. Yusnitati	Agricultural Technology	I P B	Mar 1980	Feb 1981	25
9.	Ir. I. Made Sutama	Mechanical	I T S	Oct 1980	Mar 1981	27

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7.

c. Utilization of Agricultural Energy.

No.	Name	Field of Study	University	Graduation	Begin with BPPT	Ages
1.	Ir. Todo Tamburan	Chemical Engineering	Germany	Feb 1959	Augt 1978	45 years
2.	Ir. Sri Wahyuni	Animal Husbandry	I P B	Apr 1978	Dec 1978	27
3.	Ir. Indriyati	Agricultural Technology	I P B	Sept 1978	Dec 1978	26
4.	Ir. Prasetyo Sunaryo	Engineering Sciences	I T B	Oct 1978	Jan 1979	32
5.	Ir. Edwaruddin	Forestry	I P B	Apr 1978	Mar 1979	25
6.	Ir. Editha Sri Yulianti	Animal Husbandry	I P B	Apr 1979	Augt 1979	24
7.	Ir. Sudaryono	Agricultural Technology	U G M	Apr 1979	Spet 1979	27
8.	Ir. Fadlieh Salim	Agronomy	I P B	Mar 1980	Mar 1981	24
9.	Ir. Didiek Bayono	Mechanical	I T S	Oct 1980	Mar 1981	26
10.	Ir. Supriyanto	Chemical Engineering	U G M	Augt 1980	Augt 1981	27
11.	Drh. Yanuarso Eddy	Veterinary Medicine	I P B	Dec 1980	Feb 1981	23

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8.

1. The Team of Energy and Energy Source Laboratory Development.

No.	Name	Field of Study	University	Graduation	Begin with BPPT	Ages
1.	Dr. L.M. Panggabean	Nuclear Phisic	U S A	Aug 1972	Feb 1980	47 years
2.	Ir. Marsal Alimin	Mechanical Engineering	I T B	Nov 1978	Apr 1979	28
3.	Ir. Djoko Susanto	Electrical - Power	I T B	Mar 1979	Jul 1979	25
4.	Ir. Pather Radiman	Electrical - Power	I T B	Mar 1979	Sept 1979	27
5.	Ir. Budiadi	Electrical - Power	Trisakti	Feb 1979	Sept 1979	30
6.	Ir. Yulianto	Mechanical Engineering	I T B	Mar 1979	Oct 1979	28
7.	Ir. Djoko Pakrono	Engineering Sciences	I T B	Mar 1979	Apr 1980	29
8.	Ir. Krisna Simon	Engineering Sciences	I T S	Jul 1980	Apr 1980	26
9.	Ir. Bobby H. Sulistiono	Electrical - Power	U I			
10.	Ir. Radiman Goeming	Electrical - Power	U I			

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9.

3. Energy Geothermal.

No.	Name	Field of Study	University	Graduation	Begin with BPPT	Ages
1.	Ir. E.J. Lapian	Electrical	I T B	Oct 1970	Augt 1979	38 years
2.	Ir. Poeslan Sadhana	Geology	U N P A D	Dec 1981	Apr 1981	28
3.	Ir. Baginda Patah Sitorus	Mechanical Engineering	U S U	May 1977	May 1981	32
4.	Ir. Slamet Sudarto	Electrical	U G M	Dec 1980	May 1981	28
5.	Dra. Mimin Karmini	Phisics	U G M	Dec 1980	May 1981	30

4. Utilization of Coal.

1.	Ir. Wahyono	Chemical Engineering	I T S	Aug 1978	Dec 1978	30
2.	Ir. Subagio Imam Bakri	Mining	I T B	Sept 1978	Feb 1979	29
3.	Drs. Hasnedi	Chemistry	U N A N D	Augt 1980	May 1981	28
4.	Ir. Anny Kustantiny	Industrial Technology	I T B	Oct 1980	Jun 1981	25
5.	Ir. Bambang Suwondo R.	Chemical Engineering	U N D I P	1980	Jul 1981	29
6.	Dr. Ing. Mulyo Harsono	Chemical Engineering	T H Aaden			64

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5. Ethanol from Casava.

No.	Name	Field of Study	University	Graduation	Begin with BPPT	Ages
1.	Ir. Wardiman					
2.	Ir. Huswandi					
3.	Ir. Sofyan Rasyad	Agricultural	U N A N D	Jun 1978	Dec 1978	31
4.	Drs. Trisetyabudi	Biochemistry	U G M	Augt 1978	Feb 1979	29
5.	Ir. Trihono	Mechanical Enginering	I T B	Mar 1980	Augt 1980	24
6.	Ir. Didi	Architectur	U G M	Augt 1980		29
7.	Dra. Sri Susanti	Economy	U N S	Jan 1980		26
8.	Dra. Netty Widiastuti	Biology	UNSOED	Jan 1981		27

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11.

6. Energy Planning Group.

No.	Name	Field of Study	University	Graduation	Begin with BPPT	Ages
1.	Ir. Frits Sipasulta	Electrical	I T B	Mar 1977	Augt 1977	29
2.	Ir. Fathor Rachman	Electrical	I T B	Apr 1979	Sept 1979	27
3.	Ir. Sidik Budoyo	Mechanical Engineering	I T S	Oct 1979	Feb 1980	29
4.	Ir. Hari Suharyono	Chemical Engineering	I T B	Sept 1979	Mar 1980	25
5.	Ir. Ibrahim	Chemical Engineering	I T S	Feb 1977	Dec 1978	33
6.	Ir. Endang Suarna	Agricultural	I P B	Apr1979	Jan 1980	27
7.	Ir. Moh Rasyid	Agricultural	I P B	Apr 1979	Jan 1980	27
8.	Ir. Caecilia Malik	Agricultural Statistic	I P B	Sept 1979		24
9.	Dra. Ina Miryanti	Phychology	U I	May 1979	Jan 1980	34
10.	Ir. Djoko Prihiastoto					

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12.

6. Energy Planning Group.

No.	Name	Field of Study	University	Graduation	Begin with BPPT	Ages
1.	Ir. Frits Sipasulta	Electrical	I T B	Mar 1977	Augt 1977	29
2.	Ir. Fathor Rachman	Electrical	I T B	Apr 1979	Sept 1979	27
3.	Ir. Sidik Budoyo	Mechanical Engineering	I T S	Oct 1979	Feb 1980	29
4.	Ir. Hari Suharyono	Chemical Engineering	I T B	Sept 1979	Mar 1980	25
5.	Ir. Ibrahim	Chemical Engineering	I T S	Feb 1977	Dec 1978	33
6.	Ir. Endang Suarna	Agricultural	I P B	Apr1979	Jan 1980	27
7.	Ir. Moh Rasyid	Agricultural	I P B	Apr 1979	Jan 1980	27
8.	Ir. Caecilia Malik	Agricultural Statistic	I P B	Sept 1979		24
9.	Dra. Ina Miryanti	Phychology	U I	May 1979	Jan 1980	34
10.	Ir. Djoko Prihiastoto					

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13.

7. Utilization of Goethermal low Enthalphy.

No.	Name	Field of Study	University	Graduation	Begin with BPPT	Ages
1.	Ir. Rully Rulyadi	Mining	I T B	Jan 1979	Jan 1980	[illegible]
2.	Ir. Abdul Aziz	Chemical Engineering	I T S	Apr 1978	Dec 1978	[illegible]
3.	Ir. Idwan Soehardi	Geology	I T B	Oct 1979	Jun 1980	
4.	Ir. Sjaffriadi	Engineering Sciences	I T S	Mar 1981	Sept 1981	

COMPOSITION OF THE PROJECT COMMITTEE

DESIGN

PUSPIPTEK/BPPT

Ir. Harsono Pusponegoro
Dr. Sudjana Sapiie
Dr. Lolo M. Panggabean
Ir. Benito Kodijat

USAID

Dr. Jerome J. Bosken, Chairman
Mr. Richard Silc, RD
Dr. Joseph Stepanek, ECON
Mr. Rudolphe Ellert-Beck, PRO
Mr. Raymond Dropik, OMF
Mr. Thomas Ward, EHR
Ms. Lisa Chiles, RLA

USAID REVIEW AND APPROVAL

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Mr. Robert C. Simpson, Deputy Director