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USAID/GOP Assisted Project

CENTER FOR NONCONVENTIONAL ENERGY DEVELOPMENT
Don Mariano Mariano Avenue, Diliman, Quezon City, Philippines

DR. ROBERT ICHORD
USAID / Washington

[1982]

INTRODUCTION/BACKGROUND

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To: Dr. Robert Ichord

It is a great pleasure to welcome you to the Energy Research and Development Center (ERDC), formerly known as the Center for Nonconventional Energy Development. ERDC is a newly formed division of the Philippine National Oil Company (PNOC). Also located here are the offices for the Nonconventional Resources Division (NCRD), which is a component of the Bureau of Energy Development under the Ministry of Energy. To help acquaint you with the activities of ERDC and NCRD in general, and the AID supported projects in particular, we have prepared this package of information for you. It is designed to provide briefly some background and current information on the ongoing projects as well as an orientation to the numerous pending projects which may be financed under the Joint AID-GOP Program. Other materials are also included that we think may be useful.

We are pleased to inform you that five projects will be implemented by January 1982. These include the following:

	Project	Approximate USAID Amount	Status
1.	Waste-Fired Thermal Plant	$556,480	Waiting BED/AID approval of Memo of Agreement with implementor
2.	Promotional Program	114,000	AID preparing project implementation letter
3.	Energy Survey	144,000	Prepared for submission to BED Review Panel by 11/20/81
4.	IVES (Integrated Village Energy System)	318,000	Phase I GOP Counterpart resubmitted to BED by 11/20/81 for approval
5.	Adaptation of Engines for Fuel Interchangeability	594,000	Submitted to BED Review Panel for review by 11/27/81

Background

USAID Project

In May 1978, the Philippine and U.S. Governments signed an agree-

ment providing for $7.1 million in loan and $1.55 million in grant funds for determining the technical and economic feasibility of exploiting nonconventional renewable energy resources in the Philippines as an alternative to foreign-procured fossil fuels. The Government of the Philippines has committed itself to supplying an equivalent of approximately $3 million in counterpart funding.

The program consists of individual demonstration projects designed to utilize renewable energy resources through direct and indirect solar conversion. Training of Philippine Ministry of Energy personnel, technical assistance and support for collection of basic energy data, and promotion of renewable energy are also included. The program is an applied research activity since the technologies to be utilized are relatively well-established, currently available and were judged to have relevance to the rural areas of the Philippines.

In the area of direct solar conversion, two projects are underway; they involve the testing of solar drying units for both grain and lumber drying. A third, entitled the Solar Powered Ice Plant, was discontinued as a result of an internal evaluation of the project's progress, costs, and relevance to rural needs. Currently ERDC is reviewing a new refrigeration project targetted toward rural areas and oriented toward the preservation of perishable foodstuffs, particularly meat and fish. The thrust of this subproject is to modify existing refrigeration systems to operate on renewable fuels. The approximate budget set aside for the original three projects is $.942 million for the U.S. and ₱1.8 million in Philippine counterpart.

In the area of bioconversion, two major activities were planned: the construction of a rice hull-fuelled power plant and a research effort in silvicultural management of fuelwood plantations. These two projects originally constituted approximately $3.09 million from the U.S. and ₱12 million in Philippine counterpart.

The rice hull-fuelled project which has received the approval of AID and the Philippine Government will be implemented shortly. However, the silvicultural project was discarded as a result of a decision to shift jurisdiction of dendrothermal activities to the National Electrification Authority (NEA). For similar reasons, the small-scale hydro component, which was also originally included in the AID-GOP Program, was removed since it now falls under the perview of NEA, as well. Approximately $1.0- million from the U.S. and ₱2.6 million in Philippine counterpart was budgeted for small-scale hydro.

Several new proposals are currently under review as substitutes

for the small-hydro and dendrothermal projects. They include:

1. Adaptation of engines for fuel interchangeability
2. Medium-sized wind pumping systems
3. External combustion engines (Stirling and Ormat Systems)
4. PV Village Water Supply System
5. Dispersal of Cooking Stoves
6. Research Capability Upgrading
7. Development of Post-Graduate Energy Program

The wind research project is focusing on two general areas including the dispersal of wind-driven water pumps for agricultural and domestic use and the demonstration of wind-driven electrical generators for remote rural electrification. The project has an approximate budget of $280,000 from the U.S. and ₱677,000 from the Philippine government. The project is 30% completed.

Finally, an Integrated Village Energy System (IVES) project for utilization of renewable indigenous resources, is scheduled for implementation in early November 1981. Approximately $318,000 and ₱905,200 are budgeted for this project, in which an integrated energy system is to be installed in a rural village.

In addition to the above technology projects, the program also includes:

1. A national energy survey, the details of which are now incorporated into a proposal. Implementation is scheduled for January, 1982.
2. Short and long term training of Ministry of Energy personnel to improve Philippine institutional capability to conduct independent research and development activities in nonconventional energy. This is an ongoing activity.
3. A program to inform the public and promote the use of renewable energy scheduled for implementation in November, 1981.
4. Procurement of equipment to improve the capability of the Philippine Atmospheric and Geophysical and Astrono-

mical Service Administration (PAGASA) to monitor solar radiation and wind characteristics. This activity is ongoing.

5. Procurement of research equipment and technical literature to enable the Ministry to establish a renewable energy library and display center. This is an ongoing program.

6. Contracting with short-term consultants as needed.

These efforts will cost approximately $1.55 million from the U.S. and ₱3.3 million from Philippine counterpart funds.

As for the completion of the Joint AID-GOP Program, it is expected that all activities financed by AID will have been performed by April 30, 1983, or by another date agreed to by both AID and the Philippine Government.

We hope that this brief package of materials will prove helpful.

DAVID HIMELFARB
Project Coordinator
USAID-GOP Joint Project on
Nonconventional Energy
Development

DR. RUFINO H. IBARRA
Officer-in-Charge
Bureau of Energy Dev. -
Nonconventional Resources
Development

DR. IBARRA E. CRUZ
Manager
Philippine National Oil Company -
Energy Research Development Center

DAH/hbo

STATUS REPORT: USAID-GOP JOINT PROGRAM

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
GOVERNMENT OF THE PHILIPPINES
JOINT PROJECT
ON NONCONVENTIONAL ENERGY DEVELOPMENT

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COMBINED
ELEVENTH AND TWELFTH QUARTERLY REPORT
(Ending September 30, 1981)

INTRODUCTION

The Tenth Quarterly Report was submitted to USAID on June 4, 1981. That report described the progress of USAID subprojects for the period January 1 to March 1, 1981.

The Eleventh and Twelfth quarters of the project cover the various activities that occurred during the period from April 1 to September 30, 1981. Work accomplished during this period involved mainly the Center's evaluation of ongoing USAID assisted projects, the preparation of new subproject proposals, the processing of the amendment to the Loan and Grant Agreement to expedite the implementation of the Waste-Fired project and a review of the current fund transfer scheme for existing and proposed USAID assisted subprojects.

In addition, a three member consultancy team from Development Sciences Incorporated (DSI), under contract with USAID, began a three week evaluation of the Joint Nonconventional Energy Development program on September 7. As of this writing, the DSI evaluation report was not received by the Center. Nonetheless, prior to their departure, the team presented a draft Executive Summary to the Center and USAID.

NEW SUBPROJECTS

As a result of the transfer of the Dendro-thermal and Small Hydro subprojects to the National Electrification Administration, the Center has identified alternative subproject areas that support its policies for the development of nonconventional energy resources and technologies that help displace foreign procured fossil fuels. Of the $2.65 million programmed for the new subprojects, the major proportion of funds (80%) is directed toward the utilization of biomass fuels. The planned subprojects are shown below:

	USAID Funding U.S. $	Expected Starting Date
Adaptation of Engines for Fuel Interchangeability	600,000	January, 1982
External Combustion Engines (Ormat/Stirling Systems)	700,000	April, 1982
Rural Refrigeration Producer Gas Systems	640,000	April, 1982
PV Village Water Supply System	50,000	January, 1982
Dispersal of Cooking Stoves	140,000	April, 1982
Research Capability Upgrading	200,000	April, 1982
Medium-Sized Wind Pumping Systems	325,000	April, 1982
Development of Ph. D. Postgraduate Program		April, 1982

Buttressing this effort will be the implementation in January 1982 of an Energy Survey entitled, "The Potential Utilization of Biomass Fuels in the Philippines." The survey will be implemented by the Energy Research and Development Center, a newly created division of the Philippine National Oil Company (PNOC), at a cost to USAID of $160,000.

Because the implementation of the new subprojects will draw on the existing management and technical resources of the Center and because of the expanded workplan outlined for the AID program over the next two quarters and beyond, the Center has requested USAID to assist in the procurement of management and technical consultancy services. In addition to the development of training goals and programs for the Center's staff, experts would be provided in the areas of rural energy surveys, direct solar and wind applications, external combustion engines using various renewable energy fuels, and steam turbines and gasifiers for the conversion of rice hulls into energy.

ALTERNATIVE FUND TRANSFER SCHEME

Subproject evaluations have shown that a major obstacle to realizing project targets on schedule has been the delayed release of disbursements to implementors. During this reporting

period, the Center examined several alternative fund transfer procedures. As a result of this review, a decision was made to adopt a new process beginning January 1982 which will allow a timely release of funds and which is in accordance with the Budget Ministry's rules for foreign assisted projects, as stated in Budget Circular No. 278.

The selected scheme is commonly called the Reimbursement Method, whereby the GOP, after having advanced payments from its own resources for projects which are eligible for financing under the loan, submits to USAID an application for reimbursement. Upon approval of the application, USAID makes a reimbursement payment to the National Treasury. AID makes these reimbursements on the basis of quarterly reports which indicate implementor expenditures.

The major difference between this scheme and the previous one is that upon review of a work and financial plan (Special Budget Request), the Budget Ministry provides a Cash Disbursement Ceiling (CDC) for the whole year (rather than quarterly as in the past) and provides an advance to BED of 50% of the year's budget. With these funds, BED releases an initial quarterly advance to implementors. Upon review of corresponding quarterly financial and technical reports, BED processes checks

for subsequent releases to implementors. BED also claims quarterly reimbursements from AID, which upon AID approval are deposited to the National Treasury. In five months from the date of the initial Budget Ministry's 50% advance, BED submits a second Budget Request to the Ministry based upon an updated financial plan. This enables the Ministry to advance the balance of the years' budget to BED, and the process begins again.

LOAN ACTIVITIES

A. Solar Drying

1. UPLB Solar Crop Dryers

On September 7, 1981 the Project Management Group completed an internal evaluation of this subproject. The objectives of the project are to develop four types of solar crop dryers and to analyze their suitability for field applications. Scheduled for a two-year period, the project required a total funding of ₱1,734,696. Of this amount ₱1,283,116 is chargeable against the loan component of USAID funds, with the remaining ₱451,580 representing BED and UPLB counterpart.

The project began on November 23, 1979 upon the release of USAID's first cash advance to the implementor. After some

20 months of effort, two of the dryers are just short of completion while the remaining two models are behind schedule. Given that the planned project duration is 24 months, a request for an extension is under negotiation.

The reason for the slow pace of implementation is the lengthy period required each quarter to process disbursements and to resolve budget related issues that arise during the financial review process at BED and AID. The latter issue points to the need for improved communication between the project implementor and the Center to assure that budget realignment questions are dealt with more expeditiously. As for the delay in processing fund disbursements, the new fund transfer scheme adopted by the Center should assure that releases to the implementor are made in a significantly more timely manner.

The following chart reflects the target and actual percentage completion figures as of July 31, 1981 for the various activities corresponding to the four types of solar dryers:

	Dryer Type							
	Pangasinan		Isabela					
Activities	Batch		Batch		Continuous		Hot Water	
	Target	Actual	Target	Actual	Target	Actual	Target	Actual
a. Design	100%	100%	100%	100%	100%	100%	100%	100%
b. Fabrication	100%	100%	100%	100%	100%	60%	100%	80%
c. Construction	100%	100%	100%	90%	100%	40%	100%	0
d. Testing and Reports	67%	30%	67%	0	67%	0	67%	0

The chart shows that the two batch dryers, one located in Pangasinan and the other in Isabela are almost finished. The continuous flow and hot water dryers, however, are behind schedule. Weights given to the activities in the evaluation are based on the ratio between the equipment costs of each dryer and the total project equipment costs. Due to the relatively higher capital costs of the hot water and continuous flow dryers, these activities receive greater emphasis in a project performance assessment than the batch models. The overall weighted percentage completion of the project was 54% compared to the target figure of 95% as of July 31, 1981.

2. FORPRIDECOM Solar Lumber Dryer

This subproject is being implemented by the Forest Products Research and Industries Development Commission (FORPRIDECOM). Its main objectives are to : a) design and construct a 2000 bd. ft.-capacity solar lumber dryer with supplementary heating from a biomass-fired furnace and b) conduct comparative performance tests of the dryer with conventional drying methods. Designed for a period of 30 months, the project's total cost amounts to ₱255,792. Of this amount ₱220,652 is chargeable against the USAID loan fund with the balance representing BED counterpart funds.

Project implementation began in September 1979 with the

release of USAID's first cash advance. After twenty-three months of implementation, eighty-five percent (85%) of the dryer components have been fabricated and delivered to the field site. This figure corresponds to a project completion percentage figure of 50%, which closely parallels the percentage of funds that have actually been released to the implementor over the duration of the project, or 55% as of July 31, 1981.

As with the Solar Grain Dryer Project, the main factor impeding the scheduled performance of the project has been the processing time required for the acquisition of Cash Disbursement Ceilings (CDC) from the Ministry of Budget. For example, the 5th and 6th disbursements deposited by AID to the treasury on March 30, 1981 were received by the implementor almost six months later on September 25, 1981. Regarding the 7th quarterly disbursement deposited by AID on August 29, corresponding to the period March to May, 1980, a CDC was requested from the Budget Ministry by BED.

The new fund transfer scheme, scheduled for implementation in January 1982,will provide for GOP advances and thus eliminate a key constraint to the timely release of funds, namely, the quarterly request for a CDC from the Budget Ministry.

B. Windmill Dispersal Program

Progress has been satisfactory with 31% of the project completed. This completion rate corresponds to 12 months of project effort or 40% of the scheduled duration of the project as of August 31, 1981. To date five windmill projects have been implemented; four for irrigation and one for potable water. Their status is as follows:

Site	Status	Application
Negros Occidental	100% complete	irrigation
Cebu	90%	potable water
Negros Oriental	40%	irrigation
NPC Caliraya	95%	irrigation
Fernando Airbase	25%	irrigation

In addition, eight new sites have been identified as being technically feasible for windmill application. These include:

Location	Application
1. Bagumbang, Misamis Occ.	potable water
2. Punta, Zamboanga del Norte	potable water
3. Kabubuhan ISA, Zamboanga del Norte	irrigation
4. Batu-Punong ISA, Iloilo	electricity generation
5. Batanes	electricity generation
6. Talavera, Nueva Ecija	irrigation
7. Liwasan ISA, Pandi Bulacan	irrigation
8. Boy's Town Orphanage, Bacolod	potable water

The PSB Quarterly Report for the period-ending September 1981 was received. The key feature raised in the report was that given the low average wind-speed in the Philippines (12 kph), the project's aim of generating a total of 31 kilowatts is not attainable with the amount of funding alloted for electric power generation windmills. PSB argues that a more realistic option would be to use power generators of lower output (less than 3 kw) than was originally planned. The existing budget for electric windmills of about ₱800,000 would support approximately eight units of two kilowatt windmills.

The FSDC Quarterly Report for the same period also raised an important issue that concerned the limited capacity of the windmills currently supplied by PSB to provide adequate quantities of irrigation water. Several options are under consideration to increase the supply of delivered water, including larger capacity pumps and alternative windmill designs. Improvements in water distribution efficiency are also under consideration such as sprinkler, drip, and surge flow systems.

A meeting among PSB, FSDC and the Center staff was held on September 24 to discuss the issues raised above. During that meeting, other concerns were raised including the Center's role in implementation, the amount of funds allocated for transportation, and the contents of quarterly reports. More specifically:

a. The Center should participate more fully in project implementation to help identify and prevent technical problems, provide a more independent project assessment and benefit more completely from the lessons learned from the activities undertaken in the field.

b. The amount in the budget for travel and commodity trans-

port is not sufficient to adequately implement and monitor the project. For example, average unit transportation costs have increased from the ₱2,000 originally budgetted, to around ₱4,000. A budget realignment and/or increase is planned to provide adequate travel and transport funds for the project.

c. Quarterly reports should provide more information and insight into the social aspects of the dispersal program. For example, aside from technical considerations, it is useful to know how recipients are selected, what the role of the community is in the site selection process and in determining the distribution of benefits, and what kind of institutional arrangements are made for windmill maintenance.

In light of the experience gained from the first five windmill installations, FSDC and PSB have agreed to submit written recommendations for modifying the project. Meetings to discuss these recommendations are scheduled for October 14 and 20, 1981.

Also noteworthy during the reporting period was a four-day Windmill Dispersal Training Program conducted by FSDC involving sixteen participants from the Central and Field offices of FSDC.

C. NRMC Solar Ice Plant

On May 22, 1981, NRMC submitted their recommendation to CNED for the awarding of overseas bids to procure the solar collector, ice maker and boiler. Concurrently the Center embarked on a review of the status of the project, the bid costs and the work schedule. The following statements provide a summary of the project's status as of June 1981:

1. USAID commitment to the project amounts to $373,420;
2. Designed as an 18 month program scheduled for completion in February 1981, the project would require an indeterminate extension through 1982 and perhaps into 1983;
3. Project is 10% to 15% completed;
4. Unobligated balance of AID funds amounts to $317,450 or 85% of committed funds. Of the first disbursement ($106,220), approximately 50% is obligated.
5. Additional funds required for project completion amount to $386,000 or 103% of original AID commitment;
6. Total project costs, including $123,000 in GOP counterpart, will amount to approximately $883,000.

While these figures indicate that the cost of the project has escalated substantially from the original budget, NRMC did not request additional funds from CNED/AID. Rather, NRMC indicated that it would generate the required funds internally. CNED was requested to procure whatever materials could be financed with AID funds. The purchase of the remaining components would be

deferred until NRMC's funds were sufficient and available for the completion of the project.

In its assessment of the project, CNED considered the purpose of the Ice Plant as indicated in the project proposal. To quote, "The modest capacity of the ice plant will permit it to be deployed on a wide scale to hundreds of rural communities . . . " The proposal also states that the " . . . ice plant can save on the cost of imported equipment which will make up only 10% of the total installed cost of the plant." Regarding the former, the plant capacity was increased from 2.3 to 3.4 tons; and concerning the latter, foreign components now comprise well over 50% of total costs. The main point is that while the intent of the project was to produce a technology appropriate both financially and technically for the rural sector, the present design, with costs slightly less than $900,000, is well beyond the means of most if not all rural communities. This would be the case even if development costs were deducted.

Options Available

1. Approve NRMC's bid request which would obligate most of the remaining AID funds, but would result in partial project completion, an unknown completion date and no guarantee of sufficient GOP funds to complete the project.

2. Request NRMC to develop a new design or modify the

existing one to assure that the cost parameters of the Ice Plant are within the reach of rural communities.

3. Discontinue financial assistance to the project due to:

   a) NRMC's contention that it will continue the project with its own funds;
   b) The high cost of the design and well-founded questions of project relevance to target beneficiaries;
   c) Protracted implementation.

Action Taken

On June 17, 1981 a meeting was held with the project director to discuss these issues. BED was represented by Dr. Ibarra Cruz and Dr. Ernesto Terrado. In that discussion BED indicated that it was compelled to discontinue financial assistance to the project and to reprogram the remaining funds into areas of more immediate relevance to rural needs and resources that will yield results within a more clearly defined time period.

In arriving at this decision, BED was aware that (1) many factors that impeded the progress of the project and that escalated its costs were beyond the control of the implementor, and (2) the Ice Plant project antedates both BED and AID contributions and that NRMC is committed to proceed with the project without continued CNED/AID support.

On July 8, 1981 a letter was sent to the project director which summarized the problems encountered in the implementation of this subproject and which formally discontinued financial assistance to it. Another letter will be prepared to inform NRMC of the procedures that must be followed as a consequence of this decision, primarily the return to BED and AID of the unexpended balance from the first disbursement.

D. Waste-Fired Thermal Plant

The Amendment to the Loan and Grant Agreement required to get this subproject underway was endorsed by NEDA and approved by AID. The Center is waiting for formal notification from NEDA indicating that the Center can proceed with the project. Copies of the draft Memorandum of Agreement have been submitted to BED and AID for review.

E. IVES - Integrated Village Energy System

BED has approved the proposal for the Pinamuk-an Samahang Nayon (PSN), a major contractor in the IVES project. The Center is still waiting for BED's approval of the PSN Memorandum of Agreement. Activities to be implemented by the PSN will be financed with GOP counterpart funds.

The AID component of IVES will be finalized and submitted to BED for approval by November 1, 1981. It includes the following subcontractors:

a) University of Philippines Institute for Small Scale Industries (UPISSI) - to identify income generation activities and to train PSN staff in program and financial management;

b) U.P. Engineering Research and Development, Inc. (UPERDI)- to provide electrical power for household lighting and light industry through deployment of producer gas technology;

c) U.P. Institute of Agricultural Engineering - to develop and conduct field-based programs to increase coconut

production and identify improved processing opportunities;

d) U.P. Los Baños/Biotech - to develop and implement a field-based program for village level production of fuel alcohol from nipa sap.

GRANT ACTIVITIES

A. Project Coordinator

The activities of the Project Coordinator during the reporting period included: working with CNED staff in the identification of new subprojects and subsequent proposal preparation; coordinating staff meetings and discussions with project implementors regarding the status of ongoing projects; organizing the Development Sciences, Inc. team visit at the Center during the evaluation of the program; preparing documentation required to comply with the Center's requests for managerial and technial consultancy services; attending the conference on New and Renewable Sources of Energy in Nairobi; liaison with USAID; and assisting in the preparation and review of quarterly reports for submission to BED and USAID.

B. PAGASA Solar/Wind Mapping

The foreign procured wind measuring equipment from Weather-

tronics International arrived in Manila and is now in PAGASA's possession. The solar monitoring equipment ordered from Kahlsico, however, has been delayed. The company advanced several reasons for this which the proponent (PAGASA) and the Center believe to be valid. Correspondence regarding this matter has been forwarded to AID. The important factor to bear in mind is that the supplier has requested it be allowed to deliver the items it was contracted to supply on a modified delivery schedule. This will require that AID extends the validity of the Letter of Credit made in Kahlsico's favor to December 15, 1981.

While waiting for the delivery of solar equipment, PAGASA will begin to install the wind devices which have been delivered. It is expected that by November PAGASA will be ready to install the solar radiation equipment.

C. Promotion and Information Dissemination

1. Promotion Program

The project proposal for commitment of AID funds was revised to incorporate AID's suggestions and was resubmitted to AID.

It is expected that all outstanding questions have been

resolved and that AID is in possession of the documentation necessary to make an obligation decision.

2. Information Dissemination

The amount of ₱79,507.20 was obligated by BED for the purchase of the second batch of technical books and periodicals. Of this amount, only ₱4,209 was actually paid to PECO since the CDC for the funds had expired. With the recent revalidation of the CDC, processing of the remaining payment vouchers is being undertaken by the BED Accounting Division.

A claim for reimbursement of the purchase was sent to AID. The processing of the reimbursement, however, was held pending the amendment of AID's Implementation Letter No. 18 which authorized the purchase. The Implementation Letter earmarked $9,000 for the purchase which cannot cover the ₱79,507.20 ($10,600.96 at ₱7.5/$1.00) actually spent.

D. Energy Survey

A final proposal was finalized on October 15, 1981 which represented the efforts of several interagency meetings, the services of a DSI team member and the recommendations of an American consultant. It will be submitted to the BED review

panel before November 1, 1981.

Entitled "The Potential Utilization of Biomass Fuels in the Philippines," the survey, designed upon an interdisciplinary framework, will focus on the identification and matching of resource base characteristics with the characteristics of established technical options, that can be harnessed to utilize those resources. The purpose of the project is to establish a data base on the agricultural and forestry resources in the Philippines sufficient to provide a foundation for articulating policy directions for : 1) the applied research and technology dissemination efforts of ERDC and the Ministry of Energy; 2) the resource management activities of the Ministry of Natural Resources; and 3) the development of program by NEDA, private and voluntary organizations,and international assistance entities. Its specific objectives are as follows:

a) In selected geographical areas of the country, to provide baseline data on biomass resource availability and utilization in the agricultural, household, transport, cottage industry, light industry and heavy industry sectors.

b) To identify appropriate biomass-based technologies deserving of greater or lesser institutional support giving emphasis to resource availability (seasonal variations, ownership patterns, economic factors, etc.),

technology adaptability, dissemination potential, cost, complexity, and other pertinent criteria.

c) To develop a relatively site specific environmental, socio-economic, institutional impact analysis of identified technologies in the selected geographical locations of the survey.

d) To develop feasible intervention strategies for specific programs and technologies.

e) Determine the different characteristics (physical, chemical, and otherwise) of selected biomass resource fuels at both source and at end consumers.

f) Determine problems, obstacles, issues and other barriers involved in the procurement, processing and utilization of such resources.

g) Assess government policies that affect the use of renewable energy resources and technologies and to recommend policy modifications necessary to expand the use of these resources.

h) Identify specific areas in the country which can serve as pilot areas for agro-forestry energy development and utilization programs.

The scope of the survey will be limited to six specific biomass resources and nine specific technologies related to those resources:

Resources:

Coconut Trunks, Shells & Husks
Rice Hulls and Straw
Wood
Sugar Cane Residues
Bamboo
Animal Waste

Technologies:

Producer Gas
Alcohol
Biogas
Pyrolysis
Gasification
Charcoal Formation
External Combustion Engine (Stirling, Rankine and Ormat)
Direct Combustion Processes
Cooking Stoves

Scheduled over a period of approximately two years, the project's estimated total cost amounts to ₱1.7 million. It will be implemented by ERDC in cooperation with the Ministry of Natural Resources (MNR), Forest Research Institute (FORI), Presidential Committee on Wood Industries Development (PCWID), Forest Products Research and Industries Development Commission (FORPRIDECOM), and Philippine Coconut Research and Development Foundation (PCRDF).

FINANCIAL STATUS REPORT

USAID-GOP Assisted Projects
Financial Status
As of September 30, 1981
(in ₱)

Project Title	Project Code	Project Cost USAID	Project Cost BED	USAID Releases/ Committment**	BED Allotment	EXPENDITURES USAID Accounts Pay.	EXPENDITURES USAID Actual	EXPENDITURES BED Accounts Pay.	EXPENDITURES BED Actual	Balance USAID	Balance BED
LOAN											
1. Solar Dryer	AID 7801-L	4,433,000	1,350,000	791,337	112,540	139,355.26	523,679.58	-	53,360.06	128,302.16	54,179.94
2. Solar Refrigeration	7802-L	2,800,000	992,000	796,650	-	356,280.00	63,485.29	-		376,884.71	-
3. Waste-Fired Thermal	7803-L	4,173,600	1,269,300	-	24,000	-	-	-		-	24,000.00
4. Small Hydro*	7804-L	7,620,000	2,640,000	-	-	-	-	-		-	-
5. Wind Energy	7805-L	1,983,000	909,400	916,350	39,200	-	387,598.23	-		528,751.77	39,200.00
6. Dendrothermal*	7806-L	21,353,000	12,150,000	-	-	-	-	-		-	-
7. I V E S	7807-L	3,240,000	855,000	-	463,968	-	-	-	8,156.95	-	455,811.05
Total LOAN		46,602,600	20,165,700	2,504,337	639,708	495,635.26	974,763.10	-	66,517.01	1,033,938.64	573,190.99
GRANT											
1. Project Coordinator	AID 7811-G	1,515,000	300,000	** 986,346.60	253,954	-	** 460,169.10	-	26,049.54	525,177.50	227,904.46
2. Short-Term Consultant	7812-G	2,520,000	450,000	** 980,004.15	290,000	-	-	-	103,797.58	980,004.15	186,202.42
3. Participant Training	7813-G	2,093,000	630,000	** 2,100,661.42	332,000	-	** 374,506.80	-	65,747.42	1,726,154.62	266,252.58
4. Solar Wind Mapping	7815-G	1,152,000	1,225,975	-	115,000	-	** 449,550.00	-	-	(449,550.00)	115,000.00
5. Public Info/Seminar	7816-G	1,170,000	450,000	**359,962.50	385,000	-	**221,440.80	-	-	138,521.70	385,000.00
Total GRANT		8,450,000	3,055,975	4,426,974.67	1,375,954	495,635.26	1,505,666.70	-	95,594.54	2,921,307.97	1,180,359.46
GRAND TOTAL		54,052,600	23,221,695	6,931,311.67	2,015,662	495,635.26	2,480,429.80	-	62,111.55	3,955,246.61	1,753,550.45

* Funds to be reprogrammed

** Data taken from USAID Controllers Office.

Conversion Rate: $1.00 = ₱7.50

FINANCIAL SUMMARY: USAID-GOP JOINT PROGRAM

PROJECT FINANCING[1]

(000)

	Subproject	US	GOP	TOTAL
1.	Solar Dryers[3]	$ 591.00	$ 180.00	$ 771.00
2.	Solar Refrigeration[4]	351.00	67.00	418.00
3	Waste-Fired Thermal Plant	556.48	169.24	725.72
4	Integrated Village Energy Systems	318.00	124.00	442.00
5.	Wind Energy	280.00	93.00	373.00
		$2,096.48	$ 633.24	$2,729.72
	Other Subprojects[2]	3,550.52	1,882.76	5,433.28
		$5,647.00	$2,516.00	$8,163.00
	Contingencies (10%)	565.00	252.00	817.00
	Cost Escalation	888.00	378.00	1,266.00
		$7,100.00	$3,146.00	$10,246.00

NOTES:

1 - based on USAID-GOP Loan/Grant Agreement

2 - New subprojects in lieu of Dendrothermal and Small-Hydro

3 & 4 - Other sources of funds for reprogramming

3-a) Funds committed (based on MOA) for UPLB and FORPRIDECOM subprojects = $200,500

b) Excess AID funds available:

i) if UPLB request for additional funding (₱203,000) is granted ⇒ $362,500

ii) if request is not approved ⇒ $390,500

4-a) AID Funds Committed (based on MOA) for NRMC = $373,420

b) Funds released to NRMC = $109,130

c) With the termination of the project excess AID funds available:

i) if unobligated balance (approx. ₱354,000) is recovered ⇒ $290,870

ii) if unobligated balance is not recovered ⇒ $241,870

FINANCIAL STATUS

USAID-GOP Assisted Projects
Financial Status
As of August 31, 1981

Project Title	Project Code	Project Cost USAID	Project Cost BED	Allotment (Releases) USAID	Allotment (Releases) BED	Expenditures USAID	Expenditures BED
LOAN							
1. Solar Dryer	AID 7801-L	4,433,000	1,350,000	791,337	112,540	791,337	112,540.
2. Solar Refrigeration	7802-L	2,800,000	992,000	796,650	-	796,650	-
3. Waste-Fired Thermal	7803-L	4,173,600	1,269,300	-	24,000	-	24,000
4. Small Hydro*	7804-L	7,620,000	2,640,000	-	-	-	-
5. Wind Energy	7805-L	1,983,000	909,400	937,935.90	39,200	937,935.90	39,200
6. Dendrothermal*	7806-L	21,353,000	12,150,000	-	-	-	-
7. IVES	7807-L	3,240,000	855,000	-	463,968	-	8,156.95
GRANT							
1. Project Coordinator	AID 7811-G	1,515,000	300,000	986,346.60	253,954	986,346.60	26,049.54
2. Short-term Consultant	7812-G	2,520,000	450,000	980,004.15	290,000	980,004.15	103,797.58
3. Participant Training	7813-G	2,093,000	630,000	2,100,661.42	332,000	2,100,661.42	65,747.42
4. Solar Wind Mapping	7815-G	1,152,000	1,225,975	-	115,000	-	54,075.00
5. Public Info/Seminar	7816-G	1,170,000	450,000	359,962.50	385,000	359,962.50	383,721.60
Total		54,052,600	23,221,675	6,952,897.57	2,015,662	6,952,897.57	818,188.09

* Funds to be reprogrammed

PENDING NEW PROJECTS

SUBPROJECTS	USAID FUNDING U.S. $	EXPECTED STARTING DATE
Adaptation of Engines for Fuel Interchangeability	600,000	January, 1982
External Combustion Engines (Ormat/Stirling Systems)	700,000	April, 1982
Rural Refrigeration Producer Gas Systems	640,000	April, 1982
PV Village Water Supply System	50,000	January, 1982
Dispersal of Cooking Stoves	140,000	April, 1982
Research Capability Upgrading	200,000	April, 1982
Medium-Sized Wind Pumping Systems	325,000	April, 1982
Development of Ph. D. Energy Post-Graduate Program		April, 1982

PROPOSAL FOR FINANCIAL ASSISTANCE

PART I. PROPOSAL SUMMARY

1. PROJECT TITLE: (1) Photovoltaic Cells as Prime Mover of a Water System

2. PROPONENT: University of San Carlos - Water Resources Center

3. PROJECT COST: (2)

Total:	₱ 714,770
USAID Financing Requested:	₱ 327,280
GOP Counterpart:	
BED Counterpart:	₱ 315,740
USC-WRC Counterpart:	₱ 71,750

4. DURATION OF PROJECT: Two (2) Years

5. PROJECT SUMMARY:

It is proposed to install a small watersystem for about 2,000 people. The system consists of a well, a pump which is powered by photovoltaic cells and buffered by a groundlevel reservoir, a 3km gravity-fed transport pipeline and two or three public faucets. This pilot installation will provide the data which are necessary to optimize the array size, pump capacity and reservoir volume in terms of quantity and time-distribution of solar energy supply and water demand.

For this purpose the following quantities will be monitored: incoming solar energy, electric energy, pumped water, and consumed water. Periods of overflow and respective shortage will also be recorded. Eventually the reservoir volume will be enlarged. The collected information will be analyzed. Guidelines for an optimum design will be formulated. (3)

P.S.: Evaluator's comments attached. 10/28

PART II. TECHNICAL ASPECTS

6. SIGNIFICANCE OF THE PROJECT:

In the country there exists a need for small water supply systems for 250 - 2,500 people. This is proven by the numerous occasions where potable water is transported over distances of 2-3 km by hand, by tricycle, or by truck - actual solutions --, or by abandoned pumping installations with pipeline - attempted solutions--. (4)

The reasons of failure are often a combination of several factors: (a) poor design - small diesel engines are not available which results in high operational expenses; (b) lack of appropriate maintenance - a diesel mechanic finds a better job in the population centers; (c) weak community organization--collected funds are not available when needed; (d) too high operational expenses--nobody counted with the actual fuel price increases.

A nonconventional energy supply may be the solution since photovoltaic cells can be exactly dimensioned and require very little maintenance and operate without fuel expenses for 15-20 years. An optimum design is very important, however, because the system costs are essentially installation costs. Typical applications require a pumping head of 40 m and 1 liter per second discharge. With an average of six hours actual pumping per day, this arrangement provides about 16.5 m^3 water per day, enough for the water needs of 250 people or enough drinking water for 2,500 people. Such systems satisfy existing needs of localities where the good groundwater is some 40 m deep (so that headpumps are difficult to operate and maintain), or of localities where the groundwater is not potable (salty) and potable water has to be collected further inland. A system of this type consumes 400 hydraulic watts, which with pump efficiency of 40% and electric motor efficiency of 80% translates into 1250 electric watts. At photo cell prices of $30 per watt, the cost of the prime mover is ₱300,000. With a life span of 20 years and an average of six hours per day insolation this array produces 54750 kwh. The cost of kwh is ₱1.46 which is still high compared with the ₱0.85 per kwh in Cebu. (5) (6) (7)

The price of the photocell array is determined by the price of the photosensitive material, of the array materials (aluminum, glass, etc.), of the labor to produce photocell and of the labor to assemble the array. Polycrystalline material is essentially cheaper than monocrystals and will be used in the near future. The labor component can easily be local labor; compare the manufacturing of transistors, etc. Thus the photovoltaic array may well become a source of affordable energy. The price of the photovoltaic array is expected to go down to $4 watt in a few years. This does not take into account the possible price reduction through the cheaper local labor. Even if locally assembled cells and arrays would not be cheaper than $4 per watt, the labor

component would no longer be a dollar component but a peso component. However, at this moment, large (megawatts) arrays seem not to be in direction of development. Medium size (up to 50 kw resp. up to 500 m^2) arrays do not look so implausible in the future. And information about actual performance - e.g. the average 6 Wh per day per installed watt - can be gathered from still smaller installations of about 1 kW.

In conclusion, the proposed drinking water system is intended to provide essential data about performance and economics of a source of energy which is largely independent of oil.

The general data to be gathered are: (a) actual energy conversion under field conditions in the local climate: how much solar energy is converted in electric energy, in potential energy (40 meters head added to a measured number of cubic meters water); (b) the time distribution (day or season) of the energy conversion.

The more specific data to be gathered are the quantity and the time distribution of the water requirements of a rural community and about the time distribution of the supply. The general data are necessary for the design of photovoltaic systems where storage of electric energy can be avoided like water supply, mills, handicraft shops, etc. The specific data are necessary for the optimization of the design of water systems. Finally, the Project provides water where it is badly needed.

7. PRESENT STATUS OF THE PROJECT:

The USC-WRC has conducted surveys about water consumption: 0.11 m^3 per head per day when the residence is connected to a supply system, 0.06 m^3 per head per day when the water is fetched from a neighborhood handpump. Less reliable data from the proposed Project Area give 0.08 m^3 per household per day for drinking and cooking only, which is about 10 liters per head per day. These same data indicate that the average household in the Project Area spends ₱1.00 per day - ₱12.50 per m^3 - for its drinking water. The USC-ERC has undertaken a much more detailed survey through the USC-OPS. The data of this are being evaluated and are expected to give more accurate information about, among others, the quantity of water used, the time of fetching, the constraints of fetching-distance, carriers--, the influence of these constraints on the quantity of water. These data will help to determine the design parameters of the Project System. However, these data are collected during a socio-economic survey and thus may lack in quantitative definition.

The USC-WRC has intalled 60 handpumps in depressed areas. These pumps are turned over to the users for maintenance. All these pumps are still working, 15 of them for more than 2 years. The rest are more recently installed. Two-hundred forty pumps are scheduled to be installed in the coming two and a half years. The users are organized in a small Water Committees which take care of the sanitary, technical and financial aspects of the maintenance. One of the three areas of activities is adjacent to the Project Area.

The USC-WRC has undertaken a detailed study of microbial contamination of wells and groundwater through the USC-Water Laboratory. The result is that the WRC-improved wells are safe according to WHO standards.

The USC-WRC also operates a meteorological station in Cebu City, recording among others, the hours of sunshine and the net incoming energy. These data are correlated with PAGASA data and can thus be extrapolated over more than 25 years of the PAGASA series. Also, these data can help to determine how far the 18 months of observation deviate from the average.

A recent (1981) UNDP_World Bank study has shown the technical feasibility of low (5-10 m) lift water pumps which are powered by photovoltaic cells. Based on data from this study the following specifications are achievable:

head	40 m
discharge	1 l/sec
pump efficiency	40%
motor efficiency	80%
duration	6 hours per day, average

Such systems requires 1250 electric watts and produces 16.5 m^3 per day of six hours actual pumping. This is equivalent with 0.057 watt per liter per day, an improvement of some 25% over a figure 0.08 watt per liter per day as published in 1979.

Some companies have - and others expect to have - pumps on the market with the required specifications. The USC-WRC has sent out inquiries to determine if an additional specification - submersible, $\emptyset < 0.1$ m - can be complied with. If not, a wider than standard casing would be necessary. This will not only increase the system costs, but also the system quality as the specific draw down increases with increasing well diameter, and thus the operational head decreases.

The UNDP study indicates that tracking improves system efficiency (24%) especially if the tracking does not require energy. Thus with manual tracking (three changes per day), it is expected that any day provides at least two hours pumping. Nosufficient meteorological data are available for the area, but it is estimated that very seldom two such worst days follow each other. So it seems to be a safe bet that with a storage of 1.6 times the daily supply a constant 16.5 m^3 per day can be delivered. This reservoir size is, however, a point of study.

8. SPECIFIC OBJECTIVES/TARGETS:

1. To determine and assess the suitability of utilizing solar-powered pumpping systems in providing for the water needs of a rural community.

2. To install and monitor the performance of a water system using a solar-powered pump in a selected rural site.

3. To gather techno-economic data necessary to optimize the array size, pump capacity and reservoir volume in terms of quantity and time-distribution of solar energy supply and water demands.

9. METHODOLOGY:

The project proposes to install a water system with the following components:

a) a photocell array of about 1250 peak watts which can manually track the sun--three positions;

b) a pump with capacity of 1 liter per second against 40 m head which can bring water from about 30 m below the surface- a submersible pump;

c) a pyrheliometer with recorder to measure the incoming energy and its time distribution;

d) a storage reservoir of 32 m^3 - equivalent with 1.6 times the average daily production;

e) a recording ampere meter which serves as a D.C. wattmeter., because the voltage of the array is practically constant;

f) a wattmeter which measures the quantity of water produced. Four to six readings per day provide a sufficiently accurate time distribution of the production;

g) a level indicator on the water reservoir. Four to six readings per day give a sufficiently accurate time distribution of the consumption;

h) a water level indicator in the well to measure the static water level and the dynamic head;

i) a current limiter which cuts out some panels in case of dangerously high currents;

j) a 2" pipeline to two or three faucets--distribution points.

It is the intention to sell the water at two or three distribution points at ₱0.10 to ₱0.15 per 20 liters. The current price is ₱0.25 per 20 liters and reports have that actually ₱300.00 per day is spent on drinking water in the Project Area. It is not envisioned to reach all the people in the project area directly by the two to three distribution points. Thus the time it takes to reach a daily sales of 16.5 m^3 water is a measure of the acceptance of the sales - ₱106.50 or ₱162.00 per day - will be remitted back to the funding agency.

Since it is a research project, it is not proper to use the money it may generate for non-related topics. From the other side, it is not wise to give the water for free where the alternative - and the permanent - supply is so expensive.

The data will be collected in the field by a full-time operator who also serves as a 24-hour guard. The data will be evaluated and subjected to statistical analysis (Ripple analysis among others) by a MS Physics candidate. The same person also supervises the field installations. The reports are the responsibility of the Project Director.

PART III. WORK PLAN

10. SCHEDULE OF ACTIVITIES:

The proposed project will undertake the following activities:

a) Review and analysis of available data; survey of water needs of the selected site; redesign of water system, if necessary (Months 0-3)

b) Procurement of equipment and installation at site (Months 2-7)

c) Testing, monitoring and data gathering (Months 6-22)

d) Techno-economic evaluation and report preparation (Months 20-24)

11. FINANCIAL PLAN SUMMARY: (Refer to Annex I for the Line Item Budget)

	ITEM	TOTAL	USAID FUNDING	GOP COUNTERPART BED	GOP COUNTERPART USC-WRC
I.	Personnel Services	₱ 70,500	-	₱ 54,750	₱ 15,750
II.	Equipment & Accessories	31,630	₱ 27,280	2,850	1,500
III.	Maintenance & Other Operating Expenses	59,240	-	22,740	36,500
IV.	Capital Outlay	553,400	300,000	235,400	18,000
	TOTAL	₱714,770	₱327,280	₱315,740	₱ 71,750

11. PERSONNEL REQUIREMENTS:

No.	Position Title	Monthly Salary/Honoraria
1	Project Director	₱700/mo. honorarium
1	Research Assistant III	₱1,000/mo salary
1	Research Aide I after six months	₱680/mo salary ₱705/mo salary
3	Dispensors	₱350/mo honorarium

13. REFERENCES:

Mr. Lawrence Ervin
Energy Consultant
USAID
Ramon Magsaysay Center
1680 Roxas Boulevard
Manila Telephone No. 59-80-11

Engr. Edgar Sibonga
Provincial Development Coordinator
Provincial Development Staff
Capitol, Cebu City
Telephone No. 9-36-67

Mr. Rey Estanislao Crystal
Director
NEDA, Region VII
HGV Arcade, Subangdaku
Mandaue City
Telephone 8-47-55

14. RELATED ACTIVITIES OF PROPONENT:

The proponent is Project Director of the Cebu Water Resources Project, which is funded by the Asia Foundation. This project started in October 1980, will last three years and costs $250,000. The proponent was director-Philippine-side of a cooperation between USC-WRC and the Netherlands Foundation International Cooperation. The purpose of this project is the professional development of the USC-WRC. It started in January 1976 and will end July 1981.

The USC-WRC has wide experience in water resources exploration and evaluation. It conducts river basin evaluations, georesistivity exploration, pumptest analyses, waste-water disposal studies, etc.

ANNEX I

LINE-ITEM BUDGET

ITEM	TOTAL	USAID FUNDING	GOP COUNTERPART BED	GOP COUNTERPART USC-WRC
I. Personnel Services				
a) Project Director/ Research Associate IV at ₱700/mo. 1/3 time, 24 months	₱ 16,800	₱ -	₱ 16,800	₱ -
b) 1 Research Asst. III at ₱1000/mo., 24 months	24,000	-	24,000	-
c) 1 Research Aide I, at ₱680/mo for 6 mos. and ₱705 for 14 mos.	13,950	-	13,950	-
d) 3 Dispensors at ₱350, each for 15 mos.	15,750	-	-	15,750
Sub-Total	₱ 70,500	₱ -	₱ 54,750	₱15,750
II. Equipment & Accessories				
a) Integrating pyrheliometer (US$1650)	₱ 13,200	₱ 13,200	₱ -	₱ -
b) 2 voltage recorders (at US$880 each)	14,080	14,080	-	-
c) Battery for recorders	600	-	600	-
d) Housing for recorder & battery	400	-	400	-
e) Water meter, $5m^3$ per hour, Ø 1"	1,350	-	1,350	-
f) Current limiter, about 15 A, single phase	500	-	500	-
g) 3 Water meters, $3m^3$ per hour, Ø 1/2"	1,500	-		1,500
Sub-Total	₱ 31,630	₱ 27,280	₱ 2,850	₱ 1,500

III. Maintenance & Other Operating Expenses				
a) 36 rolls Recording Paper at ₱70 each	₱ 2,500	-	₱ 2,500	₱ -
b) Travel expenses				
i) 8 trips, Cebu Manila at ₱1000/ trip	8,000	-	8,000	-
ii) Per Diem, 2 days per trip, ₱45/day	720	-	720	-
iii) 100 trips, Cebu - Project site at ₱75/ trip	7,500	-	-	7,500
c) Service Vehicle	25,000	-	-	25,000
d) Computer use, 75 hours at ₱20/hour	1,500	-	1,500	-
e) Computer programming	1,000	-	-	1,000
f) Secretarial and drafting services	2,000	-	-	2,000
h) Office supplies	4,000	-	3,000	1,000
i) Documentation/reproduction	2,000	-	2,000	-
j) Sundry (handtools, lubricants, rustfpoofing, etc.)	5,000	-	5,000	-
	₱ 59,240	-	₱ 22,740	₱36,500
IV. Capital Outlay				
Complete PV-powered water system to include:				
a) photocell array, 1250W at $30/watt,	₱300,000	₱300,000	-	-
Freight and Insurance Charges (approximately 12%)	36,000	-	₱ 36,000	-

b)	Pump, submersible, 1 liter/second, 40 m, head	₱ 26,400	₱ -	₱ 26,400	₱ -
c)	Array support, 3 positions	3,000	-	3,000	-
d)	Well, 50 m deep, casing 6"	15,000	-	15,000	-
e)	Reservoir, 32 m^3, with mechanical level indicator	25,000	-	25,000	-
f)	3000 m pipeline, 2" GI or 2 1/2" PVC, with deaerors	130,000	-	130,000	-
g)	Installation of pipe-line, 1500 manhours at ₱12.00/man-hours	18,000	-		18,000
	Sub-Total	₱553,400	₱ -	₱135,000	₱18,000
	TOTAL	₱714,770	₱327,280	₱315,740	₱ 71,750

Oct. 28 1981

TO: D. Hamilfarb

CC: R. H. Ibarra

Z. Mondejar

Please find attached my own comments on the USC-WRC Project Proposal entitled "Photovoltaic Cells as Prime Mover of a Water System". Also included is the AID Team's draft evaluation on the same subject. It is proposed that these comments be studied carefully by everyone concerned, especially the project proponent, since they should greatly influence the form and substance of the final proposal. Particular attention is called to the social/cultural aspects of the project for which very little reference has been made in the proposal thus far

For your information.

Edalmiro I. Quibilan

Edalmiro I. Quibilan

USC-WRE Project Proposal "Photovoltaic Cells as Prime Mover of a Water System — Comments and Evaluation

I. CWSD's Comments/Evaluation

The following comments refer to numbered items or sections in the proponent's project proposal which we believe require further clarification or changes.

(1) We suggest project title be changed to "Solar (Photovoltaic)-Powered Pumping System for Village Water Supply"

(2) See Appendix I for proposed revision of project cost.

(3) The proposed 1500-peak-watt PV pumping system is estimated to have an average daily flow of about 16 m³ (rather than proponent's original estimate of about 22 m³) (pls. see calculations in ~~appendix~~ (6) —). For a population of 2000 people, this means that the daily per capita supply is only about 8 l/person-day which is less than the accepted minimum basic water need for drinking and personal hygiene of 10 l/person-day. I am inclined to believe that the actual daily consumption of the village far exceeds the estimated capacity of the proposed PV water system. Assuming that this is the case and that all of the delivered water is taken from the single well (3 km away), then the PV system is deemed inadequate and certain arrangements need to be considered in order to assure an adequate daily supply to the village. Such arrangements may consist of the following:

(a) Drawing of the required daily additional water supply by hand-pumps from the same well or from a separate nearby well.

(b) The additional water may be delivered by the usual existing method (use of tricycles) or via the piping system of the PV water system.

It is in fact advisable that this alternative way of delivering water be maintained and be made an integral part of the water system for the village. It might even prove the only practical way of delivery in the event of breakdown of the main PV system or during periods of low insolation which may persist for several days. I believe, it is important to stress in the project proposal that the PV water system (unless the project acquires a much larger PV pumping system than the 1000 watt proposed) is meant either as an auxiliary or a main system with auxiliary rather than a complete system. At today's cost and for this particular application, the best compromise for the pumping system's viability is for it to be used as part of a system rather than as a complete system by itself.

There's also a good chance that other institutional and sociological issues will arise in the implementation of the project and which may in fact pose some problems as they usually do whenever a new technology is introduced at village level. In this regard, mentions of these should be made in this part of the project proposal.

(4) I think the following points should be given more emphasis here:

(a) That the proposed PV water system can be economically viable for amortization periods of greater than 10 yrs. with water being sold at less than ₱12.50/m³ which is the present cost of delivered water (to the village by use of tricycles);

(b) That the fixed data, technical as well as sociological constitute a vitally important information in the evaluation of the technology's viability and acceptance at village level;

and in the transfer of the technology itself; and

(c) ~~Project~~ Experiences in the overall implementation of the project of this nature that can be learned and which could be used profitably in the future.

(5) mainly capital costs

(6) The estimated average daily output of the proposed 1500 p-watt PV pumping system should be 16.2 m³ instead of 21.6 m³ as calculated by project proponent earlier. See assumptions + calculations used below.

Proponents assumptions/calculations

Daily irradiation, I_o = 6 KWHR/m²-day (this is standard daily irradiation)

$$= 1000\,W \times \frac{6\,HR}{m^2 \cdot day}$$

Daily flow, Q_D = peak (l/sec) × no. of HR.

$$= 1\,\frac{l}{sec} \times 6 \times 3600 = 21.6\ m^3$$

In the above calculation, we should however use 4.5 KWHR/m²-day since this value is what is taken as the appropriate value for Philippine conditions. Then,

$$I_o = 4.5\ KWHR/m^2\text{-day}$$

$$= 1000\,\frac{watt}{m^2} \times 4.5\,\frac{hr}{day}$$

and corrected daily flow should be

$$Q_D = \text{peak flow}\ (l/sec) \times \text{no. of HR.}$$

$$= 1 \times 4.5 \times 3600 = 16.2\ m^3$$

Even 16.2 m³ may be over-estimated, since the assumption 5)

of a daily average of 1000 W/m² irradiance for 4.5 hours may be an over statement.

(7). I believe \$30/p-watt is our figure and was meant to be the cost (\$/p-watt) of an installed system (PV array and motor/pump set) and not the cost of solar cells. Thus the total cost of a 1250-p-watt PV system (PV array + motor/pump set, using \$1 = ₱8) is ₱300,000. This figure has actually been further modified. (See relevant section elsewhere in this report). At any rate in calculating for the cost (₱/KWHR) of the electricity generated in 20 years under Philippine conditions, daily irradiation of 4.5 KWHR/m²-day should be used rather than 6 KWHR/m²-day. Consequently, the cost per KW-HR is C, is

$$C = [1250 \times 4.5 \times 365 \times 20]^{-1} \times ₱300\,000$$

$$= ₱7.3/\text{KWHR}.$$

(8) The world's largest photovoltaic pumping installation is found in Mead Field Laboratory, Nebraska. It uses a 25-KW peak flat PV arrays which drive a 15 hp pump to irrigate 80 acres of corn. Several photovoltaic application experiments in the range of 20–500 peak. KW output are on-going in the U.S.

(9) May be discussed in greater detail under Methodology.

(10) There are generally two types of pumps which may be considered for this project (a) positive displacement and (b) Centrifugal pumps (surface-mounted motor and/or pump and submerged motor and/or pump assembly. If and when a surface-mounted motor/pump set is

considered for purchase, it is very important to specify the suction head

(11) pump may in fact operate for more than 6 hrs per day, pumping water at different flow rates.

(12) This paragraph should read - " A 1250 p-watt PV pumping system should pumps about 16.2 m^3 daily through 40 m head and based on the 4.5 kWh/m^2-day daily insolation for the Philippines."

(13) Regarding the reservoir, I would like to raise the following issues:

(a) Is a reservoir really necessary? - on the basis of the estimated daily output (16.2 of the proposed 1250 p-watt PV pumping system and the expected (or existing?) village daily consumption which exceeds the daily supply, a reservoir appears unnecessary. However, since it may be impractical to match the instantaneous supply to the consumption rates, a tank may be needed to store any temporary excess in the supply. When a tank is incorporated in the water system for such purpose, it need not be greater than, say, 50% of the daily supply.

(b) A reservoir to store a day's supply - If it is decided that a reservoir is needed to store a day's supply in anticipation of unfavorable weather conditions, e.g., prolonged periods of low insolation, again the reservoir need not be bigger that the estimated daily output of the solar pump. (16.2 m^3). Storing water without increasing the daily output of the system as with an auxiliary system such as hand pump or a small diesel or gasoline-powered pump would reduce the volume of water to be made available to the village. Thus if half of the daily output is delivered (8.1 m^3) and half is stored, an 8.1 m^3 tank is needed and again pointing to the fact that the reservoir need not be bigger than the pump's daily output.

In summary -

- a reservoir is generally unnecessary in a situation where the demand for water is greater than the supply (by the PV system)

- if a reservoir is to be used for the purposes mentioned earlier, it need not be bigger than the PV pumping system's daily output. A bigger reservoir (greater than 16.2 m³) may be justified, however, if additional water ~~impoundment~~ is made available by an alternative water lifting device.

- Storing water without augmenting the PV system's output by alternative pumping would require that the volume of delivered water be limited to a fraction of the pump's daily output, thereby reducing the battery's service/load ~~factor~~ factor

(c) Where should the reservoir be located? - There are two places in which the reservoir may be located. One place is the village site itself and the other is the pump site. These two possible locations are illustrated in Fig. 1 & 2 of Appendix. II.
A tank located in the village offers the following advantages:

- Because it need not be elevated, it can be ~~a~~ a concrete tank using in-situ blocks - representing savings in materials and labor.
- Its content is immediately known to the water dispenser who controls ~~the~~ its distribution
- Lower pump effective head which may result in increased daily pump output.
- more amenable to future changes in its dimension, e.g. increasing its height to increase its capacity.

(14) This section should contain a summary of the major outputs / objectives of the project and descriptions of the approaches to achieve these objectives. It might also be helpful to provide in a separate section (as in an appendix)

ops a more comprehensive plan regarding the technical aspects of the project which might include the following:

a) Various parameters to be monitored such as horizontal daily irradiation, instantaneous array irradiance as well as daily cumulative array irradiation, PV array electrical output, hydraulic power, daily pump flow, etc.

b) Calculated or measure system performance parameters such as overall system efficiency, sub-system (motor and/or pump) efficiency, PV array efficiency.

(c) A more detailed ~~fixed~~ ~~without~~ pump performance monitoring procedures

(d) Proposed graphical representation of results involving the ff:

- A plot between horizontal daily irradiation ~~and~~ time (days)
- A plot between array daily irradiation ~~and~~ time (days)
- A plot between PV array output + time (hours)
- Instantaneous flowrate w/ time
- System, subsystem + array efficiencies w/ time. (instantaneous)
-

I would also like the proponent to consider the following.

It has been our experience with our solar pump project that during periods of low insolation, and because of the pumping system's inherent design, the motor/pump set continue to consume energy without lifting water at the specified head. This "idling" period, during which the motor is turning without effectively transferring water can be avoided if special circuitry is incorporated in the system. The circuit's main function is to disengage the motor/pump set from the array whenever insufficient power is available from the array. Additionally,

the circuit may also be designed to be able divert this power (which is inadequate for the motor/pump set) to doing useful work, such as charging a number of storage batteries used to power some of the monitoring equipment. It should be interesting to know how much of the time the motor/pump set "idles" in a given day. I believe this idling period can be substantially, or that if such a circuit is present in the system, motor/pump life can be extended considerably. I suggest the proponent inquires from the prospective suppliers of the PV pumping system if the latter can built into their ~~[illegible]~~ system this particular circuit. The proponent may also design and built this circuit themselves.

(15). I suggest that the project gets a complete PV pumping system, ~~rather~~ that ~~[illegible]~~ one in which the problem of properly matching the motor/pump set with the PV array can be assumed to have been dealt with by the manufacturers.

(16) I suggest a pyranometer which measures both direct + diffuse components of solar radiation. This particular instrument together with an integrator should be used to measure the daily cumulative horizontal irradiation. In addition I would like to suggest the use of a solar sensor (Silicon element) ~~together~~ with a similar integrator to measure both instantaneous cumulat. array irradiation.

(17) See comments number ~~[illegible]~~ (13)

(18). I suggest the use of a dc wattmeter ~~with~~ similar to what we have which has the following outputs: (a) a digital readout of the ~~dc~~ dc electrical energy in KW-hrs. (b) analogue output for power.

(19). Suggest the use of the ff: (a) flow sensor with signal conditioner + batch accumulator to measure both instantaneous flow rates so

and cummulative flow. A water rate meter (the type normally used for homes which has digital output) may be added to the system as an additional device for calibration purposes or for replacement of the batch accumulator should the latter fail.

(20). Implicit method appears impractical in that in the tank depends on both the supply rate and the consumption rate. Why not just record the consumption (the amount of water withdrawn) with the use of a water meter and the corresponding time to have an idea about the time distribution of the consumption?

(21) Suggest that limiter isolates load (motor) from array completely when excessive current is present, as in shorts.

(22). Suggest the use of sch. schedule 200 or 40 since static pressures involved are rather small. In Hamilton the cost of a 2" sched. 40 x 20 ft is P180.

(23). See Appendix III regarding possible price schedule for R.V pumped water.

(24) Please see Appendix I for proposed changes

Ed Guibat
Oct. 28, 1981

AID's draft valuation

PHOTOVOLTAIC VILLAGE WATER SUPPLY SYSTEM

A community, presently without its own supply, will be used as the site for a Photovoltaic powered water supply system. The subproject will include system design, purchase, fabrication, installation and operations. The subproject will demonstrate the ability of Photovoltaic produced electricity to provide an acceptable water supply for small rural villages in the Philippines. The subproject will be implemented by the University of San Carlos Water Resources Center and will require approximately P700,000.00. The project will supply P330,000.00 and counterpart funding mostly from BED will provide the remaining.

The subproject key staff should be expanded to include a person familiar with PV systems and their design and performance. This will likely be someone from the ERDC. The proposal should be expanded through the use of a US Consultant (possibly the same person hired to assist in the Rural Refrigeration Proposal and subproject upgrading process). The cost estimate in the draft version reviewed by the team contained errors and key assumptions and sources of costs were not included. This proposal should be improved in this area before it is submitted to the Minister and AID for approval. A more thorough project work plan is required before the purchase of systems and work is initiated since system design and performance should be tailored to produce an economically viable system within the near term (five years). The teams rough calculations showed that even under favorable conditions, using the current design, a very low IRR was possible. The subproject approach and team should also be expanded to include social/cultural evaluation. Key decision milestones should be identified and the planned rural energy survey should be utilized to collect data on potential sites for end users of small water supply system (farms, isolated commercial ventures, mines,

APPENDIX I. Proposed revision to Project Cost.

II. Financial Plan Summary

	USAID	BED	USC-WRC	TOTAL.
I. Personnel Services	—	85,950	15,750	101,700
II Capital Outlay	360,000	130,000	18,000	508,000
III Equipment and Accessories	80,600	31,000	—	111,600 83,70
IV Maintenance + Other Op. Expenses	—	25,350	36,500	61,850
V Contingencies	—	50,000	—	50,000
Total	₱ 440,600	₱ 294,400	₱ 70,250	Grand Total ₱ 805,250

Line Item Budget

ITEM	USAID	BED	USC-WRC	Total
I. Personnel Services				
(a) Project Director (₱1000/mo - 24 mos)	—	24 000	—	
(b) 1 Consultant (₱1000/mo - 24 mos)	—	24,000	—	
(c) 1 Research Assistant (₱1000/mo - 24 mos)	—	24,000	—	
(d) 1 Research Aid I (₱650/mo - 6 mos) (₱705/mo - 14 mos)	—	13950	—	
(e) 2 Dispensers (₱ 350/mo - 15 mos)	—		15,750	
Sub-Total	—	₱85,950	₱15,750	
I CAPITAL OUTLAY				
(a) PV array, 1250-p.watt (w/ complete mounting structure ₱ 31,250) (₱ 25/installed peak watt)	₱ 281,250	—	—	
Freight and Insurance (approx. 12%), $ 3750	33,750	xxx	—	
(b) Submersible motor/pump set, 400 hydraulic watt, 40 m total head.	45,000	xxx	—	
(c) Reservoir, 25 m³	xxx	15,000	xxx	
(d) 3 Km pipeline, GI 2" x 20 sched. 40 w/ de-aerators	xxx	100,000	xxx	
(e) installation of pipeline.	xxx	xxx	18000	
(f) Well casing 4-6", 50m key.	—	15,000	—	
Subtotal	₱ 360,000	₱ 130000	₱ 18,000	

III Equipment and Accessories	USMP	BSD	USC-WRC
(a) 1 Pyranometer (US $1200)	₱ 10,800	—	—
(b) 1 solar sensor (US $600)	5400	—	—
(c) 2 millivolt integrators (US $450 ea)	8100	—	—
(d) 2, 2-channel chart recorders. (US $2300 ea)	41,400	—	—
(e) Flow meter, inclusive of sensor accumulator + converters ($700)	63,000	—	—
(f) 1 Hand held solar meter ($100)	900	—	—
(g) 1 Hand held multimeter, digital w/ millivolt scale ($300)	2700	—	—
(h) DC millivolt source ($150)	1350	—	—
(i) 1 Thermohygrograph ($200)	1800	—	—
(j) 1 Hygrometer twirle ($50)	450	—	—
(k) 3, 12V batteries for (d) + (e) above	900	—	—
(l) Current limiter about 15A, single phase	500	—	—
(m) 2 water meters, 3m³/hr Φ-½" (₱300 ea)	~~600~~	600	—
(n) 1 water meter 5m³/hr Φ-1" (₱500)	~~500~~	500	—
(o) Housing for instruments + batt.	—	2000	—
Sub-total	₱ 80 600	₱ 91000	—

III MAINTENANCE AND OTHER OPER. EXPENSES.

ITEM	USAID	PEO	USC-WAC.
(a) 36 rolls Recording Paper at ₱70 ea.	—	2,520.	—
(b) Travel expenses.	—	10,000	—
i) 10 trips, Cebu/Iloilo at ₱1000/trip	—		—
ii) per diem, 3 days per trip, ₱45/day.	—	1350	—
iii) 100 trips, Cebu Project site at ₱75/trip	—	—	7500
		—	—
(c) Service vehicle	—	—	25,000
(d) Computer use, 75 hours at ₱20/hr	—	1500	
(e) Computer programming	—	—	1000
(f) Secretarial + drafting services.	—	—	2000
(g) Office supplies.	—	3000	1000
(h) Documentation/ reproduction	—	2000	—
(i) Sundry (hand tools, lubricants etc)	—	5000	—
		₱25350	₱36500
V CONTINGENCIES	—	₱50,000	—

APPENDIX II

TWO POSSIBLE RESERVOIR LOCATIONS/ARRANGEMENTS

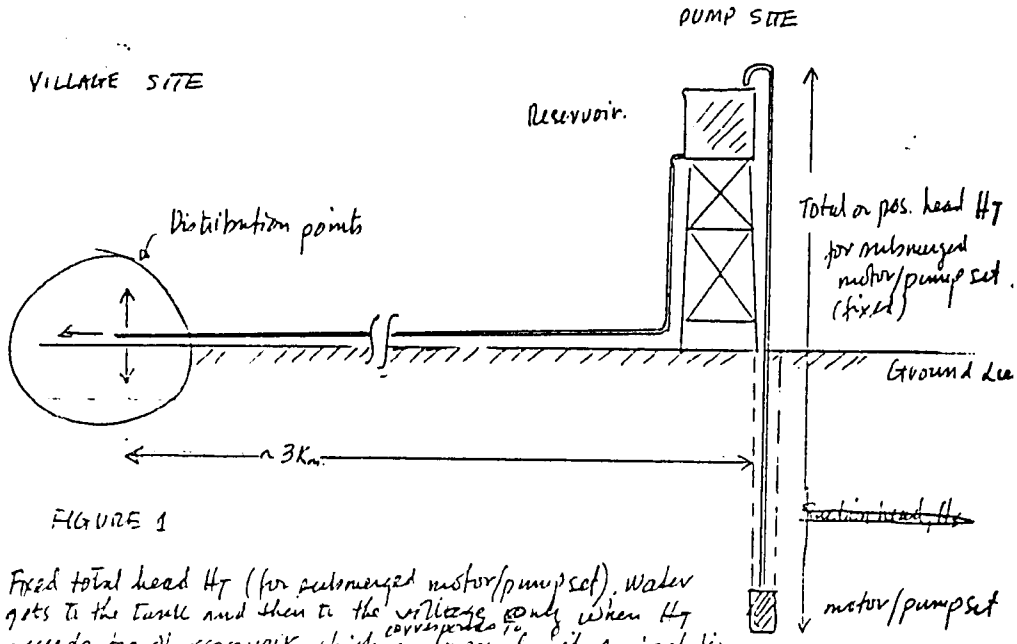

FIGURE 1

(a) Fixed total head H_T (for submerged motor/pumpset). Water gets to the tank and then to the village only when H_T exceeds top of reservoir which corresponds to a lower limit of insolation.

(b) Cost of steel tank and tower can be very high due to cost of materials & of transportation.

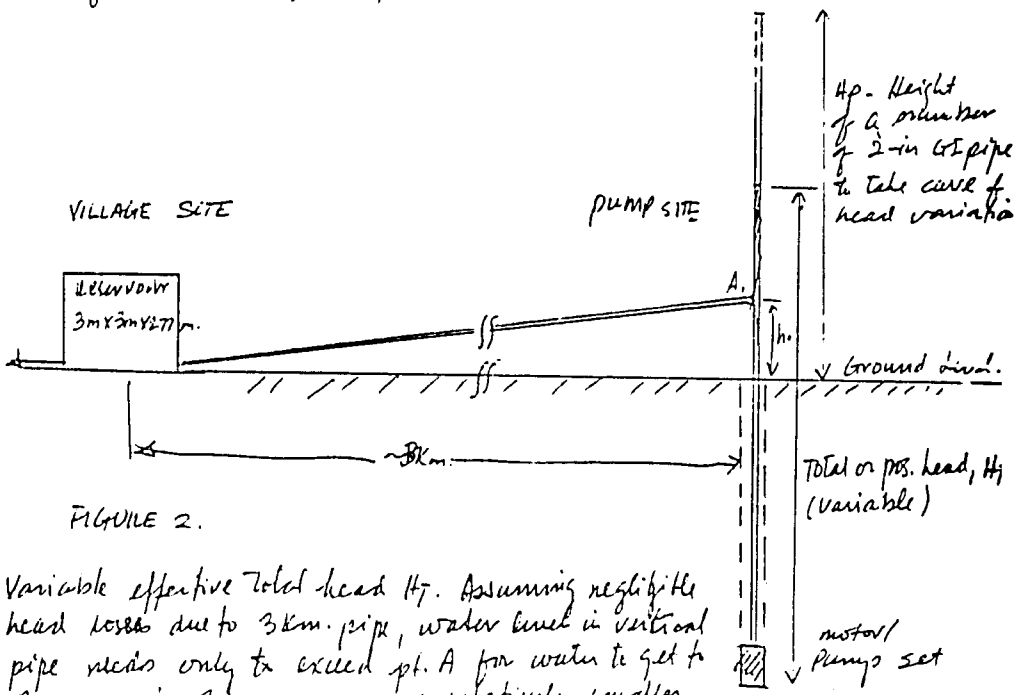

FIGURE 2.

(a) Variable effective Total head H_T. Assuming negligible head losses due to 3Km. pipe, water level in vertical pipe needs only to exceed pt. A for water to get to the reservoir. This may mean a relatively smaller power limit of insolation or a greater average daily output of the system.

(b) Reservoir can be made of concrete hollow blocks & water-proofing material. Since it requires no tower, it should be much cheaper than the tank in Fig. 1. When necessary, extension of the reservoir upward is easily achieved.

APPENDIX III

Given.

1. Capital cost: ₱ 476,000

(a)	PV array 1750 p.watt (8.25/installed p.watt ₱9 = $1)	₱ 281,250
(b)	Insurance + other charges.	33,750
(c)	motor/pump set 400 watts, hydraulic	36,000
(d)	3 Km pipeline, 7" x 20' sched. 40 (₱ 180 m)	90,000
(e)	pipe installation	5,000
(f)	well casing	15,000
(g)	reservoir.	15,000

2. Operating + maintenance cost: ₱9200/yr.

(a) Operator — ₱7200/yr.

(b) Replacements/supplies. 2000/yr.

3. Pump output daily — 16.2 m^3

yearly flow. 5913 m^3

4. Interest or discount rate (i). 14%.

5. Inflation rate (j) = 10%.

6. Amortization period (t) = 10, 15 + 20 yrs.

Calculation for the price of PV pumped water to be sold (₱/m^3) for 3 diff. amortization period of 10, 15 + 20 yrs. in order to achieve an acceptable return on the capital investment.

Procedure

(a) Calculate for the annual capital charge, Pann using.

$$P_{ann} = \frac{C i'}{[1-(1+i')^{-t}]}$$

where i' = effective interest rate

$$= \frac{i-j}{i+j} = 0.0363$$

C = ₱476,000.

p/2 Appendix —.

(b) Calculation for unit cost of H_2O (₱/m³), C_w

$$C_w = \frac{P_{ann} + \text{Annual operating + maintenance cost}}{\text{yearly flow } (= 5913\ m^3)}$$

Results.

Cost of water (₱/m³)

t (years)	Solar ₱/m³	Solar ₱/20 liter	Present method
20	7.45	0.15	↑
15	8.6	0.172	increasing?
10	11.30	0.226	
0 (1981)	—		12.50

PROJECT PROPOSAL

PART I. PROJECT SUMMARY

1.	PROJECT TITLE	: Rural Refrigeration Systems Using Renewable Energy Resources
2.	PROPONENTS	: 1) Department of Mechanical Engineering University of the Philippines 2) PNOC-ERDC
	IMPLEMENTING AGENCY	: U.P. Engineering Research and Development Foundation, Inc. (UPERDFI) U.P., Diliman Quezon City
3.	COOPERATING AGENCIES*	: 1. Food Terminal Incorporated 2. Bureau of Fisheries and Aquatic Resources 3. Rural Health Service 4. Peace Corps
4.	PROJECT COST	:
	Total	: ₱ 7,975,500
	a) USAID Financing Requested	: ₱ 4,990,500
	b) Proponent's Counterpart	₱ (360,000)
	c) Others (GOP)	: ₱ 2,985,000
5.	DURATION OF PROJECT	: Three (3) Years

*Tentative

6. PROJECT SUMMARY:

It is envisioned to initiate a rural refrigeration program wherein remote places that have no prospects of being serviced by the power grids in the near future will be provided with refrigeration systems using renewable energy resources for storing perishable foods and medicines.

Commercially available solar-operated refrigerators will be procured and field tested. At the same time investigation as to the possibility of assembling the PV components locally and the design, fabrication and field testing of prototype, than commercial, zeolite-water systems will be undertaken. Biomass-operated ice makers/cold storage will be designed and fabricated for field testing in pre-selected areas. Their performance characteristics and reliability will be monitored and the information gathered in the field tests will be used as basis for the design of commercial units which will be fabricated for dispersal in selected community organizations and government entities nationwide.

An Advisory Committee composed of a representative each from several government agencies such as the Rural Health Service, Bureau of Fisheries, etc. will advise the Project Director regarding refrigeration requirements, plant siting, etc.. Recommended plant sites will be surveyed to properly evaluate their suitability.

A very significant contribution of this project is towards self reliance, i.e., the project aims to develop local capability to fabricate and assemble the refrigeration units which utilize indigenous materials as energy sources for their operation.

PART II-TECHNICAL ASPECTS

7. SIGNIFICANCE OF THE PROJECT:

The Philippines is composed of a few large islands and thousands of small ones. Inspite of the on-going rural electrification program of the government, numerous small islands and remote rural areas have no prospect of being connected to the electrical grids in the near future.

Solar refrigerators and ice makers will be most useful to residents of remote rural areas and small islands where there is no or unreliable electricity but who nevertheless need to preserve food and heat sensitive medicines which are vital to their health and productivity.

The major problem that small-time fishermen and farmers usually encounter is the ability to preserve their products right after they are caught or harvested. Refrigeration is a widely accepted method of preservation and yet it is either not usually available or very costly in remote villages and farms.

This project addresses itself to this major problem that confronts the hundreds of thousands of fishermen and farmers in the several thousands of islands in the archipelago. These people are engaged in the gigantic task of food production and yet they are more or less forced to limit their production output due to the lack of or inadequate means of preservation to take care of the effects of its seasonal or intermittent nature.

This project aims to develop and disperse package type ice makers and cold storage units that will run on cheap renewable and locally available energy sources such as charcoal, wood chips or alcohol which the village or farm people themselves can supply. Self-reliance in terms of energy needed to operate these refrigeration units, cheap means of initial food preservation, and the resulting capability of the producers to have some means of control over the marketing schedule are some of the significant contributions of this project.

B. PRESENT STATUS OF THE PROJECT:

A. Sub-Project A (Biomass Ice Makers/Cold Storage

The proponent is not aware of any refrigeration unit in commercial use that uses charcoal, or wood chips or alcohol as its main source of energy. The proposed subproject will use existing technology in gasification of charcoal or wood chips and conventional refrigeration systems. The U.P. College of Engineering has done a great deal of research and development work on gas producer technology over the past decade. A minimal amount of research and developmental work is needed on the interfacing between the gasification process and the conventional refrigeration system.

A 1.5-ton ice maker powered by conventional diesel engine is presently available at an installed cost of around ₱174,000 with a unit production cost of around ₱0.30 per kilo of ice.

This subproject aims to design, develop, and disperse similar ice makers but utilizing charcoal or woodchips as fuel instead of diesel. Based on current prices of components, estimates show that the initial cost of these units are lower than the diesel-powered units. Calculations based on laboratory and field test data also show that a reduction in fuel cost by as much as 2 to 1 can be realized based on the current price of diesel fuel. This fuel cost reduction is expected to increase - with rising diesel fuel cost.

The other aspect of this subproject is to come up with locally designed and fabricated refrigeration systems (absorption type), utilizing mainly locally available materials, components and technical expertise. Alcohol, coconut oil, or biogas may be used as fuel, as well as wood chips and charcoal.

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B. Sub-Project B (Solar Refrigerators)

The conventional household refrigerators are mainly the electrically-driven motor compressor type using freon as refrigerant. "Electrolux" refrigerators, fueled by kerosene or liquified petroleum gas (LPG) and using the ammonia-water absorption system are in limited use.

In remote areas not connected to the power grid, electrically operated refrigerators are not applicable and the supply of kerosene or LPG can be very costly. In such places,therefore, solar refrigerators will be most useful for preservation of perishable foods and medicines.

Several solar refrigeration systems have been studied in the past, both here and abroad, but were found to be too complicated to operate for small capacity applications. Recently, however, two solar refrigeration systems have been shown to have potentials of widespread use. Since these systems utilize only solar energy for operation, these are very suitable even for remote rural areas.

One system is powered by an array of solar cells which convert sunlight directly to electricity (direct current). The generated electricity runs the d.c. motor-compressor combination to compress the freon refrigerant. Except for the power source and the d.c. motor, this refrigerator is the same as a conventional electric refrigerator. To ensure continuous refrigeration even during cloudy days, power generated by the photovoltaic array is also used to charge storage batteries.

The other system is the zeolite-water refrigerator. The system can produce two pounds of ice for every square foot of solar zeolite collector on a sunny day. In operation, portion of the refrigerant water in the evaporator vaporizes as it extracts heat from the refrigerator volume and is adsorbed by the zeolite in the solar zeolite collectors; the rest of the water turns into ice (refrigeration phase). During the regeneration phase, the water vapor earlier adsorbed by the zeolite is desorbed as the solar zeolite collector is heated up by sunlight, the water vapor is condensed in the air condenser where its heat of condensation is dissipated to the atmosphere and the liquid water flows back to the evaporator inside the refrigerator. The system has no moving parts to near off, hence long operating life can be expected.

Admittedly, both systems are prohibitive in cost at present. It is anticipated, however, that photovoltaics

will become competitive as small, self-contained power sources within the next five (5) years; moreover, it is intended to investigate the possibility of assembling the systems locally to further lower the cost and possibly make them competitive sooner. PV-powered systems can displace the conventional refrigerators in places outside the MERALCO franchise area where the power cost is high.

In the case of the zeolite-water system, its cost can be drastically lowered by designing and fabricating them locally, more so if zeolite deposits can be found in the country.

In view of their potentials of widespread use even in remote rural areas and possibility of local manufacture/assembly to thereby significantly lowering their cost, it is intended to test their performance now under different local weather conditions to determine their technical feasibility. Local design, fabrication and field testing of multi-sized prototypes and dispersal of commercial units will follow.

D. SPECIFIC OBJECTIVES/TARGETS:

A. Subproject A (Biomass Ice Makers/Cold Storage):

a. To identify candidate sites and select five (5) test sites.

b. To design and develop five (5) to six (6) units of charcoal/wood chips/alcohol operated refrigeration units and to install them in the selected sites.

c. To assess the performance and reliability of these units under the prevailing local conditions.

d. To determine social acceptance and economic feasibility of the test units.

e. To design and fabricate up to twenty (20) self-contained refrigeration units.

f. To disperse up to twenty (20) refrigeration units to pre-selected fishing villages and agricultural farms.

g. To conduct impact assessment studies on the dispersal program.

h. To develop, field test, evaluate, revise as necessary, and document a technology dispersal program for refrigeration and ice making technologies.

i. To develop a refrigeration technology program.

B. Subproject B (Solar Refrigeration):

a. To identify candidate sites and select four (4) test sites.

b. To procure 3 each of commercially-available photovoltaic-powered refrigerators and zeolite-water refrigerators and to install them in the selected sites.

c. To assess the performance characteristics and reliability of the refrigerators under the prevailing local conditions.

d. To design, fabricate and field test 4 different sizes of zeolite-water refrigerators (2 each).

e. To assess social acceptance of the units.

f. To survey locally-available materials and technology for manufacture/assembly of systems.

g. To disperse up to 50 locally manufactured/assembled units.

h. To make impact assessment studies on the dispersal program.

i. To develop a refrigeration technology dispersal program.

10. PROJECT MANAGEMENT:

The successful implementation of the project shall be the responsibility of the Project Director, who shall be assisted by a full-time project coordinator. The project coordinator shall attend to the day-to-day routine activities of the project.

The project shall seek technical advice from local consultants and direction from the advisory committee whose

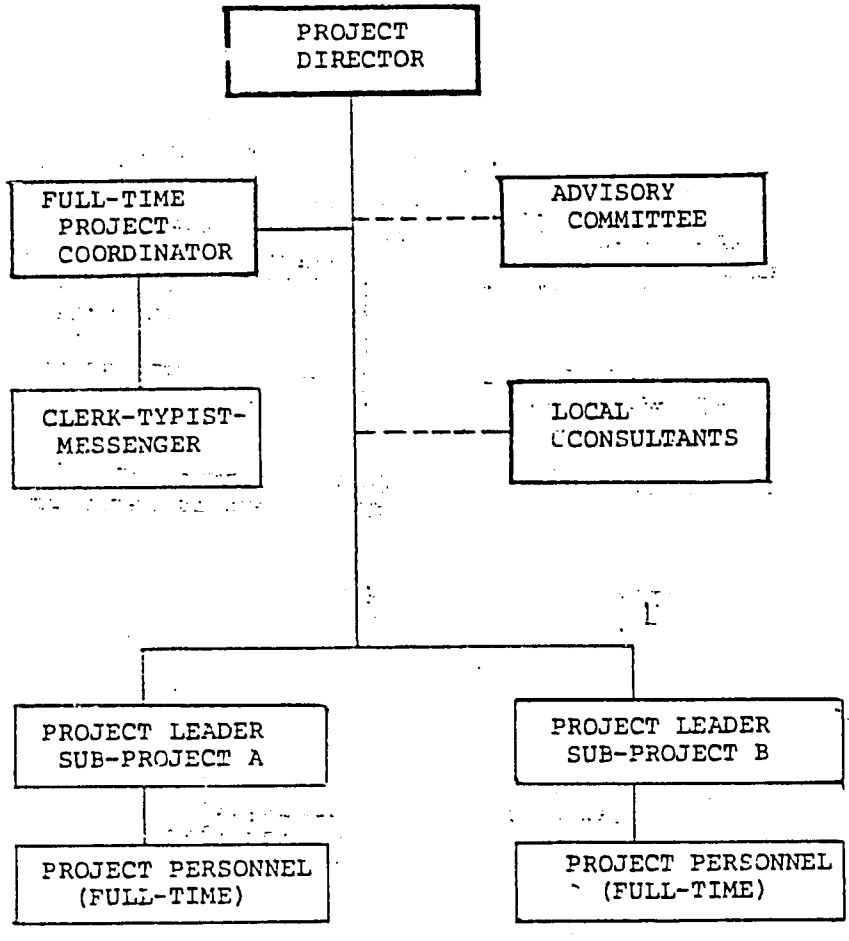
membership will be drawn from government/private agencies that may be affected by the dispersal phase of the project.

Due to the difference in the nature as well as the implementation sites of the two subprojects, it will be desirable to have two (2) separate sets of full time personnel each to be headed by a Project Leader. However, in order to maximize efficient utilization of personnel expertise and time, some degree of flexibility must be built-in so that the Project Director, in consultation with the Project Leaders, may tentatively re-assign personnel from the subproject to the other.

The research and development aspect of Subproject B (Solar Refrigerators) will be conducted mainly at the ERDC Laboratories while those of Subproject A (Biomass Ice Makers/ Cold Storage) will be done at the U.P. Mechanical Engineering Shops and Laboratories.

The following chart shows the proposed organizational set-up.

SEE NEXT PAGE...



ORGANIZATIONAL SET-UP

11. PROCEDURE/METHODOLOGY:

Identified government and/or private agencies who will be directly affected by the dispersal aspect of this project will be invited to send one representative each to sit in the Advisory Committee. The constituted Committee with the Project Director as Chairman and the Project Leaders and Consultants as resource persons shall draw the guidelines for selecting the sites for the initial field tests as well as the guidelines for the dispersal phase. Using these guidelines, the committee will then identify as many candidate sites as possible from which the committee will choose the final sites for both the initial field tests and for the dispersal units.

The committee shall be called upon from time to time, to provide advice and direction to the project.

The two (2) Subproject leaders with the assistance and coordination of the Project Coordinator shall:

Biomass Ice Makers/Cold Storage

1. Procure local and foreign supplies, materials, and equipment.

2. Research and develop Model I. This model is a system that makes use of mechanical energy from producer-gas-fueled internal combustion engine to drive a conventional packaged ice maker/cold storage requires minimal research and development.

3. Research on and develop a heat-operated refrigeration unit using producer gas and/or alcohol as heat source (Model II). Research and development for this model will require a slightly longer period than Model I.

4. Fabricate, field test, gather data, and process the data from the additional Model I units under field testing.

5. Fabricate, field test, gather data, and process the data from the additional Model II units under field testing.

6. Design and fabricate up to twenty (20) self-contained refrigeration units.

7. Disperse the self-contained units.

8. Make impact assessment studies.

Solar Refrigerators

1. Procure several photovoltaic-powered refrigerators and zeolite-water refrigerators and install the same in the selected sites.

2. Monitor the operating performance and gather relevant weather data.

3. Survey locally available materials and technology for the manufacture/assembly of systems.

4. Make comprehensive evaluation of test results.

5. Design and construct improved components.

6. Design, construct, and install locally manufactured/assembled prototypes

7. Make comprehensive evaluation of prototype performance.

8. Monitor performance of prototypes.

9. Design and construct/assemble up to 50 commercial household size units.

10. Disperse up to 50 commercial units.

11. Make impact assessment studies.

PART III. WORK PLAN

12. SCHEDULE OF ACTIVITIES:

(See Annex I)

13. FINANCIAL PLAN SUMMARY:*

ITEM	TOTAL	USAID	GOP	FX
I. Personnel Services	₱ 474,000	-	₱ 474,000	-
II. Equipment/Furniture/ Accessories	3,070,000	₱2,860,000	210,000	₱2,860,000
III. Maintenance and Operating Exp.	3,570,000	1,800,000	1,770,000	500,000
IV. Special Purposes including administrative costs	861,500	330,500	531,000	-
	₱7,975,500	₱4,990,500	₱2,985,000	₱3,360,000

This does not include UP and ERDC counterpart estimated as follows:

	U.P./ERDC
A. Equipment/Furniture/Accessories	₱ 200,000
B. Maintenance and Operating Exp.	35,000
C. Capital Outlay (Laboratory & office Space)	25,000
	₱ 360,000

(See Annex II for Line-Item Budget)

14. PERSONNEL REQUIREMENTS:

(See Annex II Line-Item Budget)

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ANNEX I - SCHEDULE OF ACTIVITIES

BIOMASS ICE MAKERS/COLD STORAGE

1. Field Test Site Identification and selection
2. Canvassing and purchasing of local materials, supplies and equipment.
3. Research and development of Model I at U.P. College of Engineering
4. Research and development of Model II at U.P. College of Engineering
5. Preparation and submission of requisitions, shipment, receipt of shipment.
6. Fabrication of additional Model I units for the field test sites, testing and data gathering and processing.
7. Fabrication of additional Model II units for the field test sites, testing and data gathering and processing.
8. Design and fabrication of commercial refrigeration units
9. Dispersal and field assembly of the commercial units
10. Impact assessment studies and preparation of final report
11. Development, testing, evaluation, revision, and documentation of refrigeration technology dispersal program.

ANNEX I. SCHEDULE OF ACTIVITIES

SOLAR REFRIGERATORS

1. Field Test Site Identification and selection
2. Request for proforma, preparation and submission of requisitions, shipment, test of components at ERDC, shipment to sites.
3. Installation and commissioning of units at site.
4. Monitoring of unit performance, gathering of weather data.
5. Comprehensive evaluation of test results and social acceptance.
6. Survey of locally available materials and technology for manufacture/assembly of systems.
7. Design and construction of prototypes
8. Installation and commissioning of prototypes
9. Monitoring of prototype performance, gathering of weather data, and design of improved components.
10. Comprehensive evaluation of test results
11. Design and construction of commercial units
12. Dispersal of commercial units
13. Impact assessment studies and preparation of final report
14. Development, testing, evaluation, revision, and documentation of refrigeration technology dispersal program.

ANNEX II. LINE-ITEM BUDGET FOR THREE (3) YEARS*

ITEM	TOTAL	USAID	GOP
I. Personnel Services*:			
1 Project Coordinator	₱ 83,340	-	₱ 83,340
2 Senior Project Engineer at ₱1,500/mo. each for the 1st yr.	124,920	-	124,920
2 Project Engineers at ₱1,200/mo. each for the 1st year.	100,000	-	100,000
2 Research Aides at ₱900/mo. each for the 1st year.	75,000	-	75,000
2 Utilitymen at ₱700/mo. each for the 1st year.	58,340	-	58,340
Living Allowance at ₱100/mo./ person	32,400	-	32,400
	₱ 474,000	-	₱ 474,000

*With up to 15% increase per year.

ITEM	TOTAL	USAID	GOP
II. Equipment/Furniture/ Accessories			
Refrigeration Systems, PV-Systems, & other components:			
a) Local	₱ 500,000	₱ 300,000	₱ 200,000
b) FX	1,900,000	1,900,000	-
Instrumentation & Controls			
a) Local	10,000		10,000
b) FX	660,000	660,000	-
	₱3,070,000	₱2,860,000	₱ 210,000
III. Maintenance and Other Operating Expenses			
Supplies & Materials			
a) Local	1,000,000	300,000	700,000
b) FX	600,000	600,000	-
Travelling Cost/ Transportation/ Shipping Expenses	1,020,000	600,000	420,000
Sundry (Other Miscellaneous expenses, would include contractual services for fabrication	950,000	300,000	650,000
	₱3,570,000	₱1,800,000	₱1,770,000

ITEM	TOTAL	USAID	GOP
IV. Special Purpose			
1. Professional fees/ honoraria for project officers, consultants & resident operators	₱ 330,500	₱ 330,500	-
2. Advisory Committee (4 members at ₱250/meeting/mo.)	36,000	-	₱ 36,000
3. Administrative Cost	495,000	-	495,000
SUB-TOTAL	₱ 861,500	₱ 330,500	₱ 531,000
T O T A L	₱7,975,500	₱4,990,500	₱2,985,000

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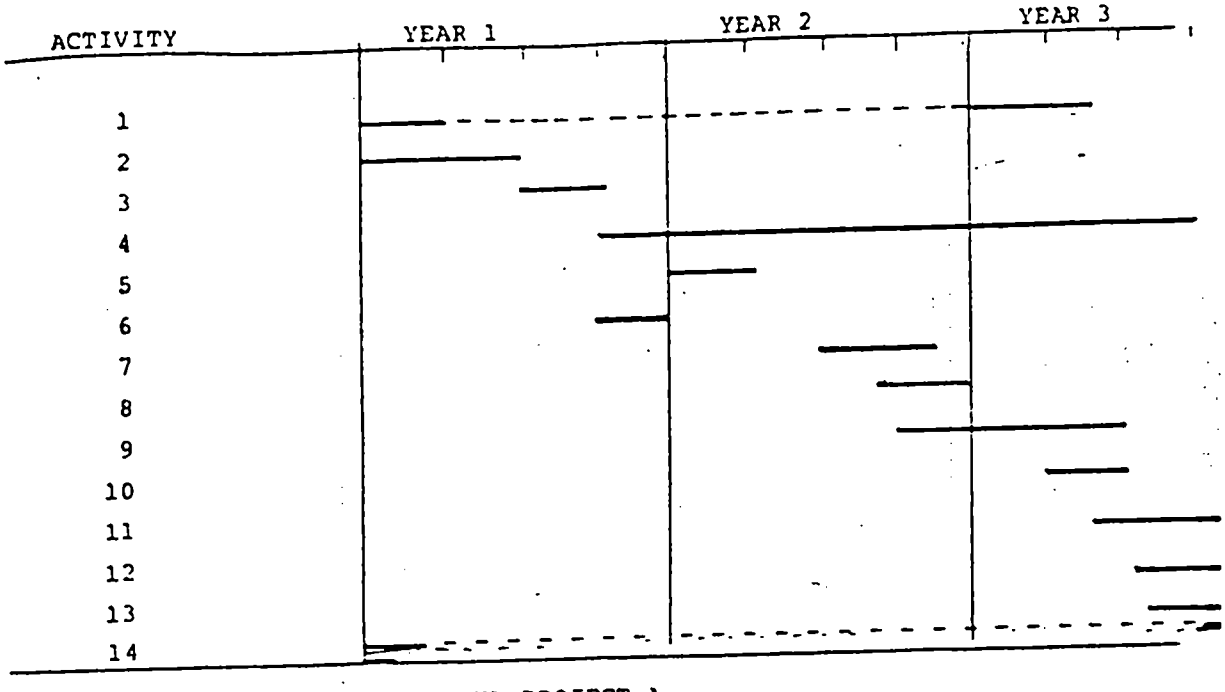
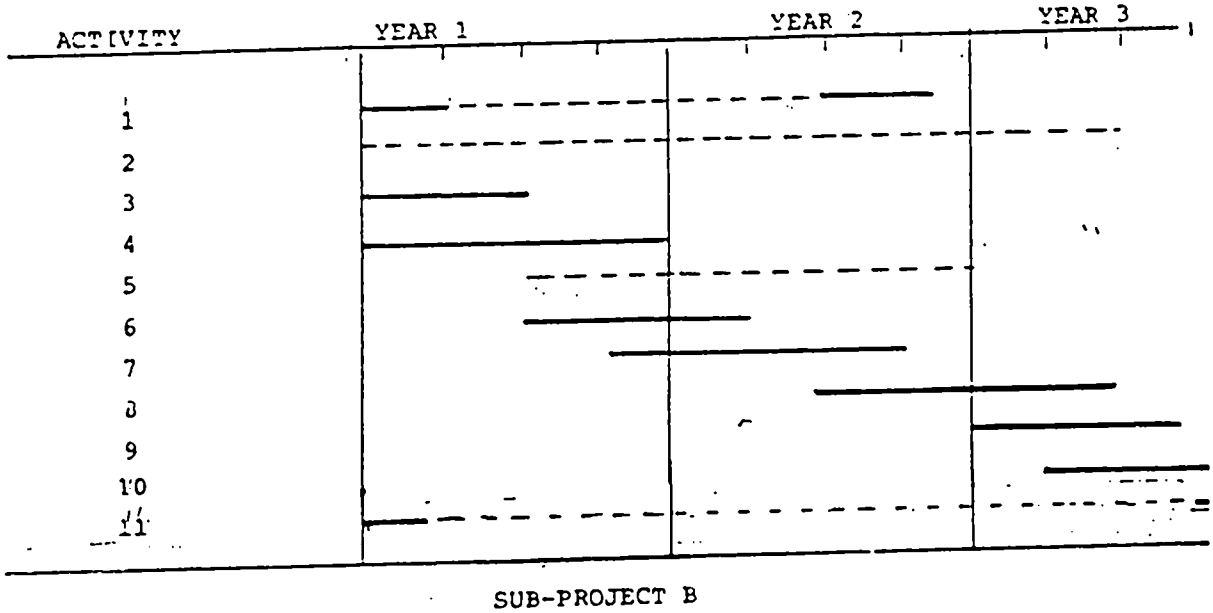
GANTT CHART



SUB-PROJECT A

1



SUB-PROJECT B

Decision point 1: selection of system for adoption

PROPOSAL FOR FINANCIAL ASSISTANCE

PROJECT TITLE: Evaluation and Utilization of Stirling Engines and Ormat Energy Converters

PROPONENT: PNOC Energy Research and Development Center

PROJECT COST:

Total: ₱ 6,524,000

USAID Funding Requested: ₱ 5,350,000

Proponent's Counterpart: ₱ 1,174,000

PROJECT DURATION: Thirty (30) months

PROJECT SUMMARY:

Today's ever increasing prices of imported fossil fuels have necessitated development of alternatives to petroleum-based power. In a developing country such as the Philippines, this research should be as short as possible so as not to disrupt the pace of development.

There exist today at least two promising technologies which are on the verge of being commercially introduced. These are the Stirling engines and Ormat enrgy converters (OEC).

The multi-fuel capability of Stirling engines makes it a good candidate for isolated areas, far from the reaches of expensive fossil fuels and where renewable fuels such as wood, charcoal and agri-forestry wastes abound. Some work has already been done on this technology to show the feasibility of using Stirling engines for cogeneration applications, agricultural and light industry applications as well as general purpose power conversion.

The Ormat energy converters (OEC), on the other hand, have been shown to operate well using only low temperature heat sources (90°C to 300°C). The OEC is also versatile in terms of heat source - solar energy, combustion of wood, charcoal, biogas, coal, alochol, geothermal heat, industrial waste heat.

Although there are a number of working prototypes of both technologies abroad, there exist a need to evaluate them to see which would be better suited for local adaptation. The project's main outputs are thus: working prototypes of each of the two technologies separately installed in a rural area; studies/ data analysis which will be used for the evaluation; an assessment of each of the two technologies.

SIGNIFICANCE OF THE PROJECT:

The Stirling engine is a technology that is often claimed viable for rural application. Recent developments in Stirling engines have indicated the feasibility of fabricating a unit from materials locally available in developing countries through high labor, low capital methods. According to the United States National Academy of Sciences, fabrication of Stirling engines using indigenous materials can be done with low carbon steel, cast iron and aluminum; containers of various sizes - cans, drums, barrels; automotive and bicycle debris - tires, inner tubes; and even bricks, clay, glass, wood and fibers.

The Ormat energy converters have been shown to operate well on a stand-alone basis. The flexibility of the OECs in terms of fuel supply makes it an attractive candidate for rural applications, especially for powering light industries.

The project envisions to field test several units of both systems under various rural application.

The succes of the field tests would then lead the way for the distribution of locally fabricated engines to rural folk.

Thus, oppurtunity will be generated for productive employment of people otherwise unemployed or underemployed. Furthermore, opportunity will be present for technological education and feedback from users to designer and manufacturer by which an evolution of the most effective forms and uses can occur.

Benefits of local manufacture and utilization will not only be the achivement of an end use, such as water pump irrigation and increased crop production, but also the satisfaction of the human need to be useful, effective and at ease with and in control of one's technology.

SPECIFIC OBJECTIVES:

1. To determine and assess suitable rural application for SStirling engines and/or Ormat energy converters.
2. To fabricate and install working models of each of the two systems in a selected rural site.
3. To monitor performance of the two systems under various rural applications.
4. To gather techno-economic data and undertake data analysis.

METHODOLOGY:

One unit of each technology shall be locally fabricated and the other one or two shall be readily available units, to provide know-how for the fabrication.

The project envisions to install two or three units of Stirling engines for the following application; rural power generation, motive power for light industries and rural cold storage application. Two or three units of the Ormat energy converters will also be installed mainly for rural electrification and/or communication systems, and another to power a light industry in a rural area.

Each oft the installations will be monitored. Data will be gathered and techno-economic evaluation undertaken.

WORK ACTIVITY:

(See Gantt Chart)

1.	Site selection/site survey	3 months
2.	Literature survey of existing installations, determination of minimum economic size unit, size and capacities available in the market	3 months
3.	Finalization of size/capacities of the various units	1 month
4.	Fabrication of units	9 months
5.	Purchase of commercial units, lead time for delivery	9 months
6.	Installation of units	9 months
7.	Monitoring/data gathering	12 months
8.	Techno-economic evaluation	3 months

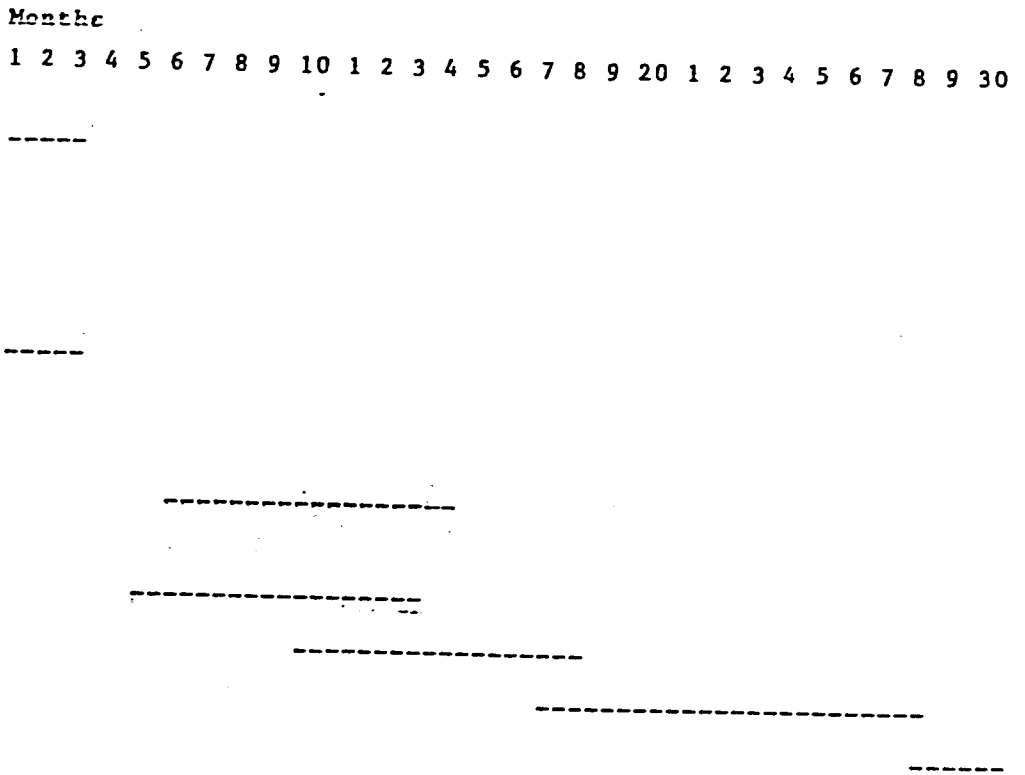
FINANCIAL PLAN:

(See Line Item Budget)

		AID	ERDC
1.	Personnel	₱ 400,000	₱ 324,000
2.	Equipment and Accessories *	4,700,000	
3.	Maintenance and Operating Expenses		450,000
4.	Capital Outlay		300,000
5.	Contingencies	250,000	100,000
		₱ 5,350,000	₱ 1,174,000

* ₱ 3,200,000 ($ 400,000) in foreign exchange.

SCHEDULE OF ACTIVITIES (Gantt Chart)



LINE ITEM BUDGET

	Requested from USAID	Proponent's Counterpart
I. PERSONNEL		
2 consultants	₱ 400,000	₱
1 project leader		48,000
5 staff engineers		180,000
4 technicians		96,000

	₱ 400,000	₱ 324,000
II. EQUIPMENT AND ACCESSORIES		
Materials for fabrication of Stirling Engines/OECs	₱ 500,000	
Ready-made Stirling engine ($ 250,000)	2,000,000	
Ready-made Ormat energy converter ($ 150,000)	1,200,000	
Accessories (generators, etc.)	1,000,000	
	₱ 4,700,000	
III. MAINTANANCE AND OPERATING EXPENSES		
Travel, per diems		₱ 100,000
Soldering lead		1,500
Welding rods		5,000
Metal sheets		50,000
Pipes		50,000
Angle bars, flat bars		75,000
Wires		5,000
Lumber		50,000
Metal plates		20,000
Nuts and bolts		1,000
Nails		1,000
Pipe fittings and valves		10,000

	Requested from USAID	Proponent's Counterpart
Rubber tubings		1,500
Miscellaneous hardware		50,000
Cement		20,000
Documentation		10,000
		₱ 450,000
IV. CAPITAL OUTLAY		
Land Rental		₱ 300,000
V. CONTINGENCIES	₱ 250,000	100,000
TOTAL	₱ 5,350,000*	₱1,174,000

* ₱=3,200,000 ($ 400,000) in foreign exchange.

DAH
File - New
Field

PROPOSAL FOR FINANCIAL ASSISTANCE

Justification for equipment to follow on 11/22/81

PART I. PROPOSAL SUMMARY

1. PROJECT TITLE : Adaptation of Engines for Fuel Interchangeability

2. PROPONENT : PNOC Energy Research and Development Center (Conventional Department)

3. COOPERATING AGENCIES :

4. PROJECT COST :

   Total: ₱ 6,060,000

   a) USAID Funding Requested : ₱ 4,754,000

   b) Proponent's Counterpart : ₱ 1,306,000

5. DURATION OF PROJECT : Three (3) Years

6. PROJECT SUMMARY :

The Philippines is chiefly an agricultural country with 8 million hectares, or 27 percent, of its land area under cultivation. An estimated quantity of agro-forestry produced energy runs into 67 million barrels of oil equivalent annually.

A variety of waste materials and agriculture-based products may be used as fuel substitutes. Well-documented experiences in the past have demonstrated the feasibility of utilizing various biomass-based fuels for internal combustion engines.

Alterations on these engines,however, have accommodated only one or two alternative renewable fuels to run in conjunction with, or as an alternate to, the conventional gasoline or diesel.

This project aims to develop alternative ways of running a single internal combustion engine on a variety of fuels derived from renewable sources of energy, the range of which shall include gaseous (e.g., producer gas, pyrolytic gas, biogas), liquid (e.g., alcohol, coconut oil, pyrolytic oil) and solid fuels (e.g., charcoal, pyrolytic char). Suitable add-ons shall be developed and standardized to allow a single engine to run on any given fuel (alternative or conventional; solid, liquid, or gaseous), or a combination thereof, at any given time.

Duplication of work already proven or undertaken shall not be attempted. The project has no intention of starting out on its own with no heed of past accomplishments. Instead, it seeks to pick up where others left off and collate all the efforts of running individual alternative fuels, such that it would then be possible for a single engine to run on a variety of renewable fuels.

Furthermore, where gaps of discrepancies exist in the analysis of chemical properties or engine performance previously undertaken by local or foreign institutions, the biomass-based test materials shall be analyzed accordingly to provide verification and first-hand information.

Bench-scale testing will be followed by intensive field runs and road tests to determine practical application, social acceptability and techno-economic implications of engine add-ons, as well as biomass-based test fuels, in preparation for eventual dispersal.

Attention will also be given to the determination of the economic viability of engine add-ons and estimated fuel costs of the biomass-based test materials.

PART II. TECHNICAL ASPECTS

7. SIGNIFICANCE OF THE PROJECT:

The Philippines has a variety of abundant waste materials generated in the processing of agricultural and forest products

at various scales: farms and villages, small and medium industries, and large industrial enterprises. Apart from these agricultural wastes, the country also produces agriculture-based products which can be used as fuel substitutes, such as alcohol and coconut oil.

Past experiences show that agricultural wastes and agriculture-based products are suitable replacements for conventional fuels in running internal combustion engines.

The internal combustion engine is widely used today in the transportation of agricultural and marine products and as a prime mover in small rice mills, corn mills, farm machineries, irrigation systems and other small industries. In rural areas particularly, small bancas, hand-held mini-tractors, threshing machines, among others, utilize gasoline and diesel as the sole power source.

With an abundant potential source of energy and such a wide prospective application, this project shall incorporate the analysis and utilization of wastes generated by agricultural and other suitable industries, as fuel substitutes, with the development and standardization of suitable engine add-ons to enable a single internal combustion engine to run on a variety of fuels derived from these wastes.

The results of the project will be better put to use in the energy poor nations and developing countries where petroleum based fuels are becoming increasingly expensive for the majority of users, than in the industrialized nations where conventional fuels are still dominant despite the expense.

Benefits derived by both rural and urban communities shall include potential employment generation, self-sufficiency stemming from the ability to run local industries on local fuel substitutes using the above-mentioned add-ons and an independence from the dictates of the conventional fuel market.

The project finances provided by USAID will serve as seed money which would ultimately redound to the benefit of the rural dwellers. Although a portion of the assistance will be used to procure instruments and other laboratory equipment, the equipment itself will continue to provide technical know-how for dissemination in depressed areas of the country. The benefits to be derived from the equipment shall be no means be co-terminus with the project.

8. PRESENT STATUS OF THE PROJECT:

Some of the fuels being contemplated as test materials for the project have already been used successfully to power internal combustion engines in work done independently by various groups.

Studies on the use of indigenous alternative fuels for internal combustion engines at the University of the Philippines under Dr. Ibarra E. Cruz have shown promising results. Technical feasibility of using producer gas, coconut oil and ethyl alcohol have been proven.

The following alternative fuels are included in the project. A summary of activities undertaken on their use in internal combustion engines is given.

a. Biogas

Biogas is a versatile fuel which may be used for direct heating as well as for running internal combustion engines. The gas engines in turn provide power to operate equipment, machinery and motor vehicles either directly or through electricity generation. Internal combustion engines may be converted to use biogas as fuel. For diesel engines, fuel cannot be totally replaced with biogas. Some amount of diesel fuel is required for ignition. However, with biogas, diesel injection may be reduced to 15 - 25 %. For gasoline engines, biogas can be made to replace gasoline completely. Conversion is done by modifying the carburetors.

Using biogas with stationary engines presents no problem. The gas can be piped directly from the gasholder to the engine. For mobile engines, a sufficient amount of gas should be carried around to allow the vehicle to negotiate reasonable distances.

A concrete example of the use of biogas in internal combustion engines is the integrated meat processing-canning enterprise in Angono, Rizal. The operation of Maya Farms, the agro-industrial division of Liberty Flour Mills, has generated enough biogas to run old converted gasoline engines to replace the electric motors running the two deep-well pumps in the farm. It runs old gas engines to pump manure slurry and to provide power for the feed mills and corn grinder in the feed mixing plant. Biogas is used to generate electricity in the evening to make use of the gas produced at night.

b. Alcohol

As a liquid energy source, alcohol is almost as versatile as petroleum and can be used readily as fuel for motive power and as petrochemical feedstock. Conventional engines could run even on straight alcohol, as demonstrated in World War II.

Studies at the University of the Philippines under Dr. Ibarra E. Cruz on the use of alcohol for diesel engines were done on two vehicles aside from four stationary engines. They suggest that the use of alcohol displaced as much as 80% diesel particularly when the alcohol was diluted with 30 - 40% water to suppress engine knock in the diesel engine. In the studies conducted, it was observed that alcohol may be used as a supplementary fuel for compression-ignition engines in the same manner as gaseous fuel is used.

The alcogas program under the Philippine National Alcohol Commission, currently being undertaken in the Visayas region, utilizes 85% anhydrous alcohol and 15% gasoline in automotive vehicles.

c. Coconut Oil

Crude coconut oil (unrefined) has a potential as a better fuel for diesel engines than diesel oil. It was until recently about twice as expensive as diesel fuel based on urban prices. With the recent low in international demand for coconut oil, however, and with the remoteness of villages where transportation costs add greatly to the price of diesel fuel, and where coconut oil can be milled in place, the cost of coconut oil may well be competitive with that of diesel fuel.

According to the studies done by Dr. Ibarra Cruz at the University of the Philippines, coconut oil as substitute fuel performed equally well as diesel fuel. The problems of coconut oil congealing during cold weather conditions in the Philippines was solved by mixing it with 20 - 30% diesel fuel be weight.

d. Coconut oil methyl esters

Little work has been done on the use of these esters as fuel for internal combustion engines. Dr. Julian Banzon, one-time professor of the University of the Philippines, notes that ester fuels have a tendency to soften and erode gaskets and contribute an odor that is not liked by some, although it can be considered mild and rather pleasant.

e. Producer Gas

Research and experimental studies have shown that coconut shell charcoal, rice hulls and sawdust are suitable for a gas producer to supply gaseous fuel to a diesel engine. These engines can in turn provide the necessary shaft horsepower for rice milling operations, sawmill operations or for electricity generation.

Dr. Ibarra E. Cruz of the University of the Philippines has used producer gas as fuel for both gasoline and diesel engines. His studies indicate that the producer gas displaced diesel fuel by as much as 80% in dual-fuel operations of diesel engines.

A cyclone separator is used for segregating fine particles of ash or dust from the gas before going into the engine. If charcoal is the fuel used in the gas producer, the cyclone is the only equipment necessary for gas cleaning. If other fuels like coconut shell or wood chips are used, it is necessary to have a gas scrubber where the gas is washed with water to remove the tar and other condensables.

Dr. Cruz further adds that the connections of the gas pipeline to the engine can be made between the carburetor and the intake manifold through a T-connection as a modification.

f. Plant latex

Certain plants rich in hydrocarbon-like materials have been suggested for cultivation as renewable photosynthetic products. Dr. Melvin Calvin of the University of California in Berkeley has performed studies to indicate that certain species of Copaifera in Brazil and other tropical areas produce a diesel-like oil upon tapping. He adds that this material can be used directly by a diesel-powered car. Furthermore, the oil has been placed directly in diesel engines of Toyota pick-up trucks, in a project that has been underway under the auspices of the Instituto Nacional du Pesquisas de Amazonia for two years. Consumption is slightly higher than regular gasoline because the copaiba oil burns cooler, but performance appears to be the same.

Although these studies more than indicate the feasibility of using various biomass-based alternative fuels as substitutes for conventional fossil fuels in internal combustion engines,

little if any work has been done towards the collation of these independent efforts into a collective study that will allow a single engine to run on a variety of these alternative resources. Instead, researches have been concentrated mainly on individual engines runring on individual sources such thata shift in the trend or availability of an alternative resource would indicate a necessity to alter the engine to accommodate the new source or, on the extreme, to design a new engine for the purpose.

Further research is called for in an attempt not to duplicate but rather to fuse past efforts at separate and disjointed studies into a single conclusive work towards utilizing biomass resources as fuel for internal combustion engines through the development of engine add-ons designed for fuel interchangeability.

9. SPECIFIC OBJECTIVES/TARGETS :

a. Development of simple engine add-ons to enable a single internal combustion engine to run on a variety of biomass-based fuels

b. Chemical analysis and engine performance tests of various biomass-based materials suitable for internal combustion engines to account for gaps and discrepancies in previous similar works; bench-scale performance tests and rural site tests of engine add-ons

c. Determination of socio-techno-economic implications of both add-ons and test fuels

10. METHODOLOGY :

Design, fabrication and testing of add-on devices for fuel interchangeability as well as analysis of various biomass-based fuels as to chemical properties, engine performance and economic viability are the main targets of the project.

As detailed in the schedule of activities, the following approach will be taken to attain the set objectives.

The first phase involves an extensive literature and institutional survey of biomass-based fuels suitable for utilization in an internal combustion engine. Industries that can profitably utilize the resulting fuel in lieu of imported fuel oil will also be identified. Other applications, such as motive power, will also be looked into.

Results of these surveys will be collected and compared to verify, integrate and arrange the data into informative and significant order. These results will aid the project personnel in avoiding unnecessary duplication and enable them to start where others left off in the search for alternative ways to run internal combustion engines.

The next step involves a chemical analysis of biomass-based fuels and possible fuel blends. This will be undertaken in order to fill gaps and verify discrepancies brought about by conflicting independent studies on similar fields and so that first hand information maybe obtained on the biomass based test materials to be used.

Simultaneously, add-on devices to suit these test materials shall be designed and prototyped. Bench scale testing of both fuels and add-ons will then be carried out to determine their engine performance rating. Part of the electricity requirements of the ERDC building should provide a concrete load.

Finalization of the improvements and modifications on the add-ons and test materials will be followed by field testing, envisioned to be carried out in a rural industry to be selected from those identified in the first phase of the project. Among those being contemplated as test sites are small rice mills and corn mill In conjunction with rural field tests are chassis dynamometer runs involving road tests on heavy duty mobile engines and runs on small motorized fishing bancas.

Some emphasis will be given to the determination of social acceptability of add-ons and biomass-based fuels. The economic viability of both shall also be looked into.

Standardization of the add-on devices will pave the way towards eventual regional dispersal, possibly as a future proposal to be based on the results of this undertaking.

PART III. WORK PLAN

11. SCHEDULE OF ACTIVITIES
(See Gantt Chart)

a. Study/inventory/assessment of various biomass-based fuels suitable for internal combustion engines

b. Survey/identification of industries that can profitably utilize biomass-based fuels in lieu of imported fuel oil

c. Collation of results

d. Chemical analysis of biomass-based fuels and fuel blends to account for gaps and discrepancies in previous works

e. Design of add-on devices

f. Prototyping of add-on devices

g. Variable compression engine and bench dynamometer testing of add-on devices and biomass-based fuels

h. Evaluation of performance data

i. Improvements and modifications of add-on devices and test fuels

j. Site selection

k. Rural field tests and road tests of engine add-ons and test fuels

l. Evaluation of performance data

m. Socio-techno-economic analysis of the utilization of engine add-ons and biomass based fuels

n. Standardization of add-on devices

o. Documentation and overall evaluation of results.

12. FINANCIAL PLAN SUMMARY:

(See Line Item Budget)

		Requested from USAID	Proponent's Counterpart
A.	Personnel Services	₱ -	₱ 306,000
B.	Equipment and Accessories*	3,160,000	-
C.	Maintenance and Other Operating Expenses	1,344,000	-
D.	Capital Outlay**	-	1,000,000
E.	Special Purposes	250,000	-
		₱ 4,754,000	₱ 1,306,000

TOTAL: ₱ 6,060,000

* ₱ 2,205,000 ($294,000) in foreign exchange.
** In kind.

SCHEDULE OF ACTIVITIES: (Gantt Chart)

Activity / Months	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6
Study/inventory/assessment of various biomass-based fuels suitable for internal combustion engines	--	--	--																																	
Survey/identification of industries that can profitably utilize biomass-based fuels in lieu of imported fuel oil		--	--	--																																
Collation of results					--	--																														
Chemical analysis of biomass-based fuels and fuel blends to account for gaps and discrepancies in previous works							--	--	--	--	--	--																								
Design of add-on devices							--	--	--	--	--	--																								
Prototyping of add-on devices									--	--	--	--	--	--																						
Variable compression engine and bench dynamometer testing of add-on devices and biomass-based fuels										--	--	--	--	--	--	--	--	--	--																	
Evaluation of performance data																		--	--	--																
Improvements and modifications of add-on devices and test fuels										--	--	--	--	--	--	--	--	--	--																	
Site selection					--	--	--	--																												
Rural field tests and road tests of engine add-ons and test fuels																					--	--	--	--	--	--	--	--	--	--	--	--				
Evaluation of performance data																															--	--	--			

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Months	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6
Socio-techno-economic analysis of the utilization of engine add-ons and biomass-based fuels																											----------									
Standardization of add-on devices																															----------					
Documentation and overall evaluation of results																																		-----		

LINE ITEM BUDGET

I. Personnel Costs (Proponent's Counterpart)

NUMBER	POSITION	TOTAL SALARY/ HONORARIA
One (1)	Consultant	₱ 36,000
One (1)	Supervising Engineer	61,200
Four (4)	Project Engineers	158,400
Two (2)	Technicians	50,400
		₱ 306,000

II. Equipment and Accessories (Requested from USAID)

		Foreign Exchange	Local
1.	Mass spectrophotometer	$ 100,000	₱ -
2.	UV-Vis spectrophotometer	60,000	-
3.	Filter apparatus	6,667	-
4.	Fumehood	13,333	-
5.	pH meter	6,000	-
6.	Resin reaction kettles and heaters	6,667	-
7.	Heating mantles	1,333	-
8.	Purification units	20,000	-
9.	Power measurement and engine analyzing apparatus	80,000	-
10.	Gasoline engine	-	20,000
11.	Diesel engine	-	20,000
12.	Gasoline AUV	-	40,000
13.	Diesel AUV	-	70,000
14.	Electric generators	-	300,000
15.	Platform type Toledo weighing scale	-	30,000
16.	Bench type Toledo weighing scale	-	15,000

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		Foreign Exchange	Local
17.	Engine accessories	-	₱ 10,000
18.	Producer gas reactor	-	100,000
19.	Biogas digester	-	50,000
20.	Extraction units	-	200,000
21.	Miscellaneous	-	100,000
		$ 294,000 (₱ 2,205,000)	₱ 955,000
		SUB-TOTAL:	₱ 3,160,000

III. Maintenance and Other Operating Expenses (Requested from USAID)

1.	Hardware supplies	₱ 500,000
2.	Oxyacetylene supply	5,000
3.	Rubber tubings	1,000
4.	Laboratory chemicals/solvents	150,000
5.	Laboratory supplies/glassware	100,000
6.	Steel tanks	10,000
7.	Gasoline, diesel, alcohol, coconut oil, etc.	300,000
8.	Documentation	8,000
9.	Pipes, fittings, valves	10,000
10.	Travel for surveys, consultations, field testing, etc.	150,000
11.	Office supplies	60,000
12.	Other expenses	50,000
		₱ 1,344,000

IV. Capital Outlay (Proponent's Counterpart)

- In kind

Offices/facilities	₱ 500,000

Workshop and other equipment	500,000
	₱ 1,000,000

V. Special Purposes (Requested from USAID)

Contingencies	₱ 100,000
Civil works	150,000
	₱ 250,000

Draft Only
See comments
attached 11/81

PROPOSAL FOR FINANCIAL ASSISTANCE

PART I. PROPOSAL SUMMARY

1. PROJECT TITLE : MEDIUM-SCALE WIND POWER SYSTEMS FOR RURAL ELECTRICITY AND FERTILIZER PRODUCTION

2. PROPONENT : PNOC-ERDC
PRINCIPAL INVESTIGATOR:
DR. V. L. ALCANTARA

3. PROJECT COST :

TOTAL : $600,000

a) USAID Funding Requested : $350,000
b) GOP Counterpart : $250,000

DURATION OF PROJECT : Two (2) Years

PROJECT SUMMARY :

Installation of three (3) wind turbines in rural setting for electric power generation. Two of the wind turbines would be used for communal lighting, radios, television, refrigeration and educational purposes. One wind turbine would be utilized to provide power for the production of fertilizer using the electric arc method.

PART II. TECHNICAL ASPECTS

SIGNIFICANCE OF PROJECT:

The project proposes installation at different sites with wind turbines for the generation of electricity. As fossil fuels get scarce, intensive efforts must be undertaken to search for alternative resources of energy. Wind power is one such alternative. There are a number of ideal sites available in the Philippines and only a follow-up effort now is necessary to identify the most suitable sites for wind energy utilization. The generated electricity will be of utmost help, especially to rural areas where insufficient or non-existent power lines are available.

P.S. The Center is only writing the proposal as of today and to follow on 11/20/81.

Another significant aspect of the project is the production of fertilizer, employing electric arc method, which becomes viable in the light of the present circumstances. Production of fertilizer employing electrical arc and utilizing only air, water and electricity or incorporating lime or carbonate if these are available, has been known for a long time. But due to the more efficient method utilizing fossil material, the electrical arc method was forgotten during the petroleum boom era. Now, as the fossil material is getting more scarce and expensive, interest in the electric arc method is once again being revived. In places where there is sufficient renewable source of energy like wind and where the cost of commercial fertilizer is prohibitive, the electric arc method may be advisable to improve agricultural productivity.

7. PRESENT STATUS OF PROJECT.

There are available in foreign markets several types and sizes of windmills. The country has acquired some examples of these but are of the small-scale types. The proposed project will introduce in the country for the first time medium-scale (30-kw and up) wind power systems. The medium-scale wind power turbines are just appropriate to our conditions-not small enough to be of insignificant use and not too big to require an intensive engineering and construction effort on our part.

8. SPECIFIC OBJECTIVES/TARGETS:

a) Installation of two (2) 30-kw capacity windmills for rural electrification

b) Installation of a 30-kw capacity windmill for fertilizer production

c) Implementation of the program to develop and accelerate the use of wind energy

d) Transfer of technology thru the training, experience, and studies associated with the installation and operation of the wind turbines

9. METHODOLOGY

There are several sites in the country which have been identified as having the most promising potential in terms of wind energy. Project Implementation will initially involve a more detailed assessment of the sites to determine the energy requirements and available wind energy resource. This shall also include socio-eco-demographic surveys needed for the successful implementation of the project. After the assessment, site preparation (which involves physical effort like cleaning of obstacles, digging of foundations) will follow. The wind turbines would then be installed after the site assessments and preparations. When the wind turbines become operational, an intensive monitoring and data gathering would be conducted for at least one year to evaluate the performance of wind turbines in the country. Additional studies would also be made regarding the further use of wind generators in providing energy to our country.

III. WORK PLAN

10. SCHEDULE OF ACTIVITIES:

a)	Administrative & Logistic Preparations which shall include paper work, foreign liaison, drawing up of plans and agreements, etc.	Months 1-2
b)	Site visits and Assessments. This phase will involve occular inspections of the sites, surveys, conducting of demographic-eco polls, setting-up of instruments for wind climate data gathering and other related activities	Months 3-7
c)	Site Preparation mainly concerned with the physical preparation of the sites. This will include cleaning of sites, foundation laying, and other related civil works necessary for the installation of the wind turbines. Training program for personnel should also start at this period.	Months 8-10

d) Installation and testing. Concerned mainly with the assembly and erection of the wind turbines. Months 10-12

e) Wind turbine operation and data gathering. As the wind turbines become operational, intensive data gathering and monitoring would be made leading towards project review and analysis. Months 13-24

11. FINANCIAL PLAN SUMMARY :

		USAID	GOP
I.	Personnel Services	$ 24,000	$ 40,000
II.	Equipment & Accessories	316,000	40,000
III.	Other Operating Expenses	10,000	25,000
IV.	Capital Outlay		35,000
V.	Special Purposes		110,000
	T O T A L S.	$ 350,000	$ 250,000

ANNEX I: LINE-ITEM BUDGET

PROJECT TITLE: MEDIUM-SCALE WIND POWER SYSTEMS FOR RURAL ELECTRICITY AND FERTILIZER PRODUCTION

PROPONENT : PNOC-ERDC

	USAID	GOP	FX
I. PERSONNEL COSTS:			
Project station personnel	$ 10,000.00	$ 10,000.00	
Consultants	14,000.00	30,000.00	$ 10,000.00
Labor & utility			
TOTAL	$ 24,000.00	$ 40,000.00	$ 10,000.00
II. EQUIPMENT:			
Three (3) units of 30-kw capacity wind turbines, each complete with controllers, regulators, & monitoring meters	$ 150,000.00		$ 150,000.00
Tower 80' height (3 units)		$ 25,000.00	
Storage system; consists of 12v 500AH heavy duty batteries, 12kw 220vac 60hz inverters, 12V 25a battery chargers and other accessories to provide at least 1 day storage at 50% rated capacity for 2 windmills	100,000.00		100,000.00
Fertilizer production equipment consisting of: gas recovery and neutralization equipment nitrogen fertilizer generator			

	USAID	GOP	FX
multitester meter (8 units)	$ 2,000.00		
frequency meter (8 units)	1,200.00		$ 1,200.00
anemometer with chart recorder and accessories (4 units)	27,800.00		27,800.00
tachometer (4 units)	2,000.00		2,000.00
cup counter anemometer (no recorder but with counter to record total revolution, 4 units)	8,000.00		8,000.00
T O T A L	$316,000.00	$ 40,000.00	$156,000.00

III. OTHER OPERATING EXPENSES

A. Transportation & communication		$ 20,000.00	
B. Training (training of 2 personnel abroad for 1 mo. each for total of 2 man-mos.)	$10,000.00		10,000.00
C. Supplies		5,000.00	
T O T A L	$10,000.00	$ 25,000.00	$ 10,000.00

IV. CAPITAL OUTLAY

Civil works (includes battery sheds, fences, equipment shacks, wires & cables, electrical accessories)		$ 20,000.00	
B. Building for fertilizer plant		15,000.00	
T O T A L		$ 35,000.00	

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	USAID	GOP	FX
V. SPECIAL PURPOSES			
Contingency funds (for unexpected labor costs, unforseen increase in prices, and other exigencies)		$ 110,000.00	
T O T A L		$ 110,000.00	
GRAND T O T A L	$350,000.00	$ 250,000.00	$324,000.00

MEMORANDUM

August 26, 1981

To: en, Zany

cc: Dr. Cruz
Zerny
Rufi

Ref: AID Proposed Wind Power System Project

Code:

The following are my comments on the Medium-Scale Wind Power System project proposed for financing under the AID-GOP Joint Concor Energy Project.

1. Can we discuss the Personnel costs? With Consultancy costs at $44,000 and Station Personnel at $20,000 — or a total of $64,000, I wonder if we're being reasonable.

   Also concerning Personnel, what is the ERDC or NRCD contribution? Are there no such people involved?

2. Equipment: My personal opinion is that the high cost of storage ($100,000 for two windmills) justifies at least a cursory economic assessment, given some realistic assumptions, of the systems. What do we expect the cost per kw hour to be? If this is within some reasonable parameters compared to alternatives than ok, but if not than perhaps the project should be discussed further.

3. With the proposed procurement of three windmills <u>why</u> are we also requesting:

   8 multitester units
   8 frequency meters
   4 anemoters
   4 tachometers and
   4 cup counter anemometers?

   These items are no doubt necessary, but why in such quantites particularly when included in the windmill costs themselves are controllers, regulators and <u>monitoring meters</u>?

4. Other Operating Expenses: Training abroad needs to be justified. If we're already paying over $40,000 for project consultants, why can't they do the training while they are here?

5. Special Purposes: Contingency at $110,000 is almost 20% of total project costs. Can this be justified?

Lets sit down and discuss these questions. How about tomorrow afternoon at 2;00 in the Board Room.

David

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PROPOSAL FOR FINANCIAL ASSISTANCE

PART I - PROPOSAL SUMMARY

1.	PROJECT TITLE	:	Commercialization of Selected Alternative Cooking Devices
2.	PROPONENT	:	Energy Research and Development Center
3.	FUNDING AGENCY	:	USAID / GOP
4.	DURATION	:	One (1) Year
	PROJECT COST	:	TOTAL : ₱ 2,094,200 GOP : ₱ 591,200 ERDC : ₱ 260,000 USAID FUNDING : ₱ 1,243,000
5.	PROJECT SUMMARY	:	

The Energy Research and Development Center (ERDC) of the Philippine National Oil Company has anticipated a shift towards the increased utilization of agro-forestry products as fuel for cooking. Under its auspices as the then Center for Nonconventional Energy Development, it initiated the ground work activities in the area of evaluating efficiency and standardizing designs of locally available cooking stoves with the University of the Philippines at Los Baños. Although it was relatively a small scale project, vital baseline information were collected and studied. As an output several promising cooking devices have been identified as ready for widespread adoption and two standardized designs as ready for mass production.

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To follow up on what CNED has started, ERDC is launching this project on Commercialization of Selected Alternative Cooking Devices to enhance the widespread adoption of cooking devices on a nationwide scale using alternative and nonconventional fuels.

Aware of the need to undertake an intensive promotional and educational program as support activities, media as well as public, private and civic organization may be tapped. Likewise, tie ups with marketing firms will be explored. Depending on the projected size of the market, production schemes will be set. The ultimate objective is establish a sustained market growth. A supply network for firewood and other fuel will be developed and hopefully institutionalized.

PART II - TECHNICAL ASPECTS

7. SIGNIFICANCE OF THE PROJECT

In a census conducted in 1970, the consumption pattern of domestic cooking fuel in the country revealed that four out of five households (79%) used firewood as their cooking fuel. The fossil fuels - Kerosene with 10.9% and gas with 5.7% were second and third places. Firewood as fuel for cooking abound the country. However,

studies show that at the rate our forests are being denuded, scarcity of forestry products is soon to come. Likewise, agricultural wastes are at the moment in abundant supply in many places throughout the country. What needs to be done is to develop well coordinated usage programs which will conserve the use of these resources and maximize benefits in the light of current forest denudation problems and fast rising costs of conventional cooking fuel.

It is therefore, through this project that we aim primarily to introduce efficient stoves both in the rural and urban areas. In the rural areas, where there is abundant supply of agricultural wastes, the project shall initiate the displacement of the inefficient stoves currently on use with more efficient ones. In the urban areas however, where there is heavy usage of conventional energy relative to other regions, these alternative cooking stoves shall be used to supplement the existing stoves used.

The national usage of non-conventional fuel would have the greatest impact on the government's energy conservation program. This project would enhance wide-spread adoption which when successfully implemented will have the following long term effects:

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1. reduction of household expenditures for fuel
2. conservation of Philippine Forests
3. professionalization of stove manufacturing
4. institutionalization of fuel marketing channel and,
5. over-all attitudinal improvement towards energy conservation.

Information on local cooking practices must be obtained if only to make sure that modification over existing stoves or that new stove designs would satisfy the cooking needs of housewives with lesser amount of fuel.

To carry out detailed surveys is a highly skilled, time consuming and expensive operation. In most parts of the country, cooking practices and stoves used essentially differ from one area to another. Aware of various activities of the ERDC such as in the area of "Energy Survey" as well as of the agencies in related areas of concern, collaborative efforts will be ensured to save time and resources.

8. OBJECTIVES OF THE PROJECT

(a) General

To bring into the Filipino homes alternative cooking devices that are energy-efficient and cost-effective using appropriate indigenous fuels.

(b) Specific Objectives

To achieve this project objective the ERDC has deemed it necessary to conduct a study whose objectives are to:

- Make an inventory of all locally available stoves both of indigenous and foreign designs.
- As a corollary, indicate the indigenous and renewable energy sources to match the inventoried cooking devices. Supplementary data on resources shall be taken from the output of ERDC project on Energy Survey to be conducted in selected regions.
- Develop a system of test procedures in order to determine stove performance in the field and in the laboratory optimizing the fit between the stove design and the given socio-cultural setting.
- Formulate a marketing plan to penetrate and capture the potential market with sustained physical growth as a long-term objective.

- o Identify production schemes with a view to establishing production volumes corresponding to near-to-long-term potential demand.
- o Develop a technical - and - financial assistance program aimed at a) modifying and improving the "best" prototypes, according to the criteria established and b) facilitating the commercialization of those prototypes.
- o Propose ways and means of facilitating linkages between manufacturers on the one hand and government and private institutions on the other hand, particularly in financing and product marketing.
- o Finally, propose strategies involving communication, community organization and civic or citizen participation, and funding especially as it bears upon long-term goals.

9. METHODOLOGY

The approach for commercializing selected nonconventional energy cooking devices would be as follows:

I. Inventory of locally available stoves and fuel used by means of:

- o a sample survey of households in the country

- o gathering of secondary data on foreign designs not yet locally prototyped.
- o a survey of available resources to really identify the specific place where these cooking stoves would be most applicable.

The survey should be able to establish

1. the local cooking practices (type and quantity of fuel used, length of time for cooking and method of food and fuel preparation, where the cooking is done whether indoor or outdoor)
2. the standard type and size of pots, stoves and fuel used,
3. who constructs the stove or where it is bought; time devoted to repair and maintenance.
4. the method of gathering firewood and other fuel.

II. Evaluation of identified stoves and selection of those to be introduced for commercialization.

- o Development of criteria and rating plan for the initial screening of identified cooking devices. Data sources for the evaluation criteria would include the survey respondents (users), manufacturers of the working devices, distributors and dealers, available literature, embassies, and

relevant government and private institutions.

- o Selection of cooking devices to be considered for commercialization and a further short-listing of models for implementation. The second stage of the evaluation process could take the form of the acquisition of sample of the models chosen and laboratory tests for their efficiency and cost-effectiveness. Based on the results of the selection process and laboratory tests, a representative locality in each region will be piloted for the commercialization project. Results will then be generalized to reflect the characteristics of the region.

III. Further product development/improvement. (for cooking stove models chosen for commercialization)

IV. Development of production strategies for the mass production of the models to be marketed.

- o Production Schemes
  1. Private enterprise oriented or significant government involvement.
  2. One large producer vs. many small entrepreneurs.
  3. Development of new enterprises or encouragement of and support to existing manufacturers.
  4. Government support requirements (incentives, government policy, etc).

5. Linkages/assistance from financing institutions

V. Formulation of marketing plan to penetrate and capture the potential market with sustained physical growth as a long-term objective. Strategies include pricing policies that best suit the financial capabilities of each market segment down to the regional level.

(2)

). FINANCIAL PLAN SUMMARY

		TOTAL (₱)	USAID FUNDING (₱)	ERDC COUNTERPART (₱)	GOP FUNDING (₱)
I.	Personnel Services	₱ 247,200	₱ 108,000	₱ 48,000	₱ 91,200
II.	Equipment/Furniture/ Facility	137,000	5,000	132,000	-
III.	Maintenance/Operating Expenses	620,000	570,000	50,000	-
IV.	Special Purposes	370,000	370,000	-	-
V.	Other Expense Items	720,000	190,000	30,000	500,000
	T O T A L	₱2,094,200	₱1,243,000	₱260,000	₱591,200

Specific details on all of the above areas will be determined from a consultancy job ERDC will be awarding to a qualified individual or firm. The main objective is to integrate the mechanics in systematically implementing the various components of the commercialization program, details of which will be based mainly upon the recommendation of the consultant firm. With this output, the actual implementation of strategies and plans for commercialization will be greatly facilitated.

The above 5-step program will be carried out on a regional level and ultimately spread to selected regions throughout the country. A test area representative of each region will be piloted inorder to establish a general framework adjustable to specific requirements of the various localities in the region.

ANNEX I

LINE ITEM BUDGET

	TOTAL (₱)	USAID FUNDING (₱)	ERDC COUNTERPART (₱)	GOP FUNDING (₱)
I. PERSONNEL SERVICES				
a. 1-Project Leader ₱1,000/mo. (hon).	₱ 12,000	-	-	₱ 12,000
b. 3-Research Associate IV ₱1,700/mo.	61,200	-	-	61,200
c. 6-Research Associate III ₱1,500/mo.	108,000	₱108,000	-	
d. 1-Sr. Information Specialist ₱2,500/mo.	30,000	-	₱ 30,000	-
e. 1-Clerk Typist ₱700/mo.	8,400	-	8,400	-
f. 1-Artist/Illustrator ₱800/mo.	9,600	-	9,600	-
g. Emergency Personnel ₱1,500/mo.	18,000	-	-	18,000
SUB - TOTAL	₱247,200	₱108,000	₱ 48,000	₱ 91,200
II. EQUIPMENT/FURNITURE/FACILITY				
a. 1 Unit Tape Recorder and Accessories	₱ 5,000	₱ 5,000	-	-
b. Office Facilities/Equipment (typewriter, tables, chairs etc. ₱ 5,000/mo.	60,000	-	₱ 60,000	-
c. Office Space (₱6,000/mo.)	72,000	-	72,000	-
SUB - TOTAL	₱137,000	₱ 5,000	₱132,000	-
III. MAINTENANCE/OPERATING EXPENSES				
a. Supplies and Materials	₱350,000	₱300,000	₱ 50,000	-
1. Office Supplies (This would include reproduction costs, mimeographing, survey sheets, bond papers, pens, etc)	-	200,000	-	-
2. Materials for construction of stoves in rural extension seminars		100,000	-	-
b. Travel (max. of 3 trips/mo. with 3 persons/trip at approx. ₱2,500/person/trip at 2-4 days per trip)	270,000	270,000	-	-
SUB - TOTAL	₱620,000	₱570,000	₱ 50,000	-

	TOTAL (₱)	USAID FUNDING (₱)	ERDC COUNTERPART (₱)	(FUNI
IV. SPECIAL PURPOSES				
a. Subcontracting (This shall be awarded to a deserving consultancy firm to conduct surveys, evaluation of cooking stoves on a nation-wide scale)	₱ 350,000	₱ 350,000	-	
b. Contingency	20,000	20,000	-	
SUB-TOTAL	₱ 370,000	₱ 370,000	-	
V. OTHER EXPENSE ITEMS				
a. Rural Extension Seminar	₱ 30,000	₱ 30,000	-	
b. Media Advertisement	70,000	40,000	₱ 30,000	
c. Printing & Documentation	90,000	90,000	-	
d. Fairs and Exhibits	30,000	30,000	-	
e. Assistance to Entrepreneurs (ex. soft loans, government bulk purchases, etc.)	500,000	-	-	₱ 5
SUB-TOTAL	₱720,000	₱190,000	₱ 30,000	₱5(
T O T A L	₱2,094,200	₱1,243,000	₱260,000	₱5

ANNEX II

ACTIVITIES RELATED TO OTHER EXPENSE ITEMS

a. RURAL EXTENSION SEMINARS

As stated in one of the objectives to identify production schemes with a view to establishing production volumes corresponding to near-to-long-term potential demand, one activity would be to train school youths to make their own stoves in vocational courses. This concept can be extended to encompass out-of-school youth and, even further, adult education classes. The idea here is to remove labor cost as a factor in the price of a stove.

Another is the possibility of collaborating with the National Manpower Youth Council (NMYC) regional centers and other linkage agency centers as venues not only for training would-be stove makers but also entrepreneurs. This will also cover training and development programs for entrepreneurs in the areas of construction, testing, production and marketing of cooking stoves in their respective areas.

b. MEDIA ADVERTISEMENT

This activity shall include intensive promotion of alternative cooking devices on a nationwide scale. Different private and civic energy groups shall be tapped to

work hand in hand with government agencies.

Brochures on fuel preparation, storage and usage will be printed and distributed. Aside from the print media, TV, radio and movie house exposures will also be developed. For the rural areas, advertisement shall be in the form of radio and ads in their locally available magazines and other print media. For the urban areas, TV commercials shall be produced aside from the radio and movie house advertisements.

This activity shall greatly enhance information dissemination of selected alternative cooking devices.

Manufacturers will also be assisted in the preparation and printing of their respective instructional brochures.

c. PRINTING AND DOCUMENTATION

This shall include preparation and publication of brochures, instruction booklets, directory for the alternative cooking devices. An aggregate amount of ₱30,000 shall be used for the preparation of audio-visual aids and considered for use in the rural extension seminars. Details of printing costs:

1. Brochures (at least 5 sets)		₱ 37,500
No. of copies/Brochure	2,500	
Unit Cost	₱ 3.00	

2. Hand-outs and Manuals		₱10,000
3. Directory of selected alternative cooking devices		12,500
No. of copies	2,500	
Unit Cost	₱5.00	

d. FAIRS AND EXHIBITS

The fairs and exhibits are aimed at showcasing the different alterantive cooking devices. There shall be a series of fairs and exhibits in different places to adequately promote these stoves and give them the necessary exposures.

Based on the standards and criteria set in the evaluation of these cooking stoves, "best prototypes" shall be selected. These units shall then be evaluated for commercialization.

e. ASSISTANCE TO SMALL ENTREPRENEURS AND MANUFACTURERS

To facilitate linkages between manufacturers and government and private institutions, they shall be given financing and product marketing assistance. This may be in the form of soft loans, fiscal incentives, bulk purchases by the government and others.

Soft laons shall be granted to deserving small entrepreneurs in cooperation with a duly authorized bank. Money alloted for soft loans shall be deposited

to the bank which in turn shall handle the processing of papers of those applying for soft loans. Screening and evaluation shall be done by an evaluation committee in close coordination with ERDC who will give the final approval.

This activity is aimed at modifying and improving the "best" prototypes according to the criteria established which shall consequently facilitate the commercialization of those prototypes.

PROPOSAL FOR FINANCIAL ASSISTANCE

PART I. PROPOSAL SUMMARY

1. PROJECT TITLE: Assistance to the Development of ERDC's In-House Research Capabilities

2. PROPONENT: PNOC Energy Research and Development Center

3. PROJECT COST:

TOTAL:	₱ 2,540,412
USAID Financing Requested:	₱ 1,523,304
GOP Counterpart:	₱ 1,017,108

4. DURATION OF PROJECT: Nine (9) Months

5. PROJECT SUMMARY:

The Center for Nonconventional Energy Development was created by Ministry Order in 1979 with the primary mission to act as "the government's lead agency for carrying out research, development and demonstration programmes designed to effect significant contribution of nonconventional energy sources to the nation's socio-economic growth". The three major research divisions of CNED: Biofuels Division, Solar Energy Division and the Wind and Water Power Division, were tasked with undertaking appropriate, goal-oriented, applied and adaptive projects to establish technical and economic feasibilities of identified noncon areas.

With the organization of PNOC's Energy Research and Development Center (ERDC), however, the CNED has been abolished with its personnel reverted back to BED-NCRD. NCRD will retain all its functions and powers embodied in PD 1068 which directed the acceleration of R & D and utilization of nonconventional energy resources.

The PNOC-ERDC shall continue CNED's past efforts in carrying out R & D work which will cover the identification and reduction of technical and other barriers to specific applications of nonconventional energy sources. It will provide support and consultancy services to companies and individuals who manufacture or use noncon energy systems and devices, primarily for those technologies taking off commercially. It will also perform tests and rating services for prototypes, commercial noncon devices and new fuels.

To realize these goals, ERDC is requesting assistance in the development of its in-house research capabilities. The assistance to ERDC may be in the form of the following:

1. acquisition of specialized equipment and instruments for research laboratories to include:

   a) Instruments for analytical laboratory such as elemental analyzer, atomic absorption spectrophotometer, infrared spectrophotometer, equipment for liquid fuel analysis, etc.

   b) Biofuels Workshop Equipment such as water dynamometer, pressure transducers, function generators, etc.

2. acquisition of a computer system for use in simulation and optimization of prototype design and experimental set-ups, and numerical analysis.

PART II. TECHNICAL ASPECTS

6. SIGNIFICANCE OF PROJECT:

Many of the promising technologies are still in the "proof-of-concept", experimentation or piloting stage. The commercial development of these noncon systems have lagged due to the lack of economic incentives prior to the advent of the oil crisis to develop new fuels and the nature of the noncon resources themselves. Unlike oil which is energy-dense and easy-to-handle, noncon resources are difficult to collect and store. Research and development activities, therefore, predominate over actual resources exploitation or utilization. For most of these technologies, a period of conceptualization, design, testing, scaling-up, feasibility studies and demonstration is necessary and unavoidable. The important outputs from these activities are technical and sociological data that can point to future directions.

Recognizing the noncon energy potential to evolve into a significant contributor to the country's socio-economic development goals, ERDC will carry out these R & D work to cover the identification and reduction of technical and other barriers to specific applications of noncon resources. The development of its in-house research capabilities through the acquisition of hardware and software as well as the compilation of data bases would contribute immensely to the realization of these objectives.

7. SPECIFIC OBJECTIVES/TARGETS:

Through this project, the proponent aims to upgrade its in-house research capabilities through the acquisition of more research facilities.

6. METHODOLOGY:

The equipment listed in Annex I of this proposal are necessary for the development of ERDC's capabilities to: (a) identify and measure the energy values of various liquid, solid, and gaseous fuels; (b) test various noncon devices and fuels, (c) simulate and optimize prototype designs and experimental set-ups, and (d) perform economic and market analyses using mathematical models. Equipment sales proposals from various suppliers/distributors will be solicited, selected and recommended for the funding agency's approval. To assure optimum benefits from the use of these equipment, local training for personnel who will handle the equipment will be conducted.

PART III. WORK PLAN

7. SCHEDULE OF ACTIVITIES:

The following activities will be undertaken:

a) Solicitation of equipment sales proposals (Months 0-2)

b) Procurement/Lead time for delivery (Months 2-8)

c) Installation and Local Training (Months 7-9)

8. FINANCIAL PLAN SUMMARY: (Refer to Annex II for the detailed Line-Item Budget).

	Item	Total	USAID Funding	GOP COUNTERPART
I.	Personnel	-	-	-
II.	Equipment & Accessories	₱2,440,304	₱1,523,304	₱ 917,000
III.	Maintenance & Other Operating Expenses	100,108	-	100,108
	TOTAL	₱2,540,412	₱1,523,304	₱1,017,108

ANNEX I. A.

EQUIPMENT FOR ANALYTICAL LABORATORY

1. LABORATORY MILL WITH CRYOGENIC ATTACHMENT

   Designed specifically for reduction of analytical samples. For the preparation of materials for analysis, but modified for use with cryogenic attachment for grinding heat sensitive materials or those not brittle enough at room temperature.

2. EQUIPMENT NEEDED FOR LIQUID FUEL ANALYSIS

   Essential for liquid fuel analysis. Tests to be performed to meet certain specifications which ensure that they can be handled safely and easily, that they will burn properly, and that they will meet air pollution regulations. These tests include flash point, fire point, cloud and pour point, carbon residues, sediment, sulfur content, ash content, viscosity and color of fuel oils and other viscous materials and suspensions.

   With equipment such as: Cleveland Open-Cup Tester, Ramsbottom Carbon

3. ROOM DEHUMIDIFIER

   Dehumidifier soaks up moisture like a sponge, continuous protection against dampness, musty odors, mildew, rust and corrosion. Needed for the Instrument Room.

4. BALANCE, TOP-LOADING (Mettler E2000)

   Ideal for use in control applications where speed, reliability and ability to withstand rough handling are important.

5. NUCLEAR MAGNETIC RESONANCE SPECTROMETER

   Various types of quantitative analysis are possible, including analysis of numbers of substitute groups in the molecule, analysis of the molecular composition of mixtures, elemental analyses, and molecular weight determinations.

6. ELEMENTAL ANALYZER

   Adequate methods for the microchemical analysis of carbon, hydrogen, nitrogen, sulfur and oxygen are essential for the ever-expanding areas of energy research.

   The Elemental Analyzer in addition to its primary purpose of analyzing pure materials for their C, H, N, content, has found numerous applications wherever the determination of these elements, as well as oxygen and sulfur, serves a useful analytical purpose.

With the Elemental Analyzer, C, H, and N results of high accuracy and reliability can be obtained in approximately 13 minutes on such materials increasing the efficiency and capacity of the laboratory.

7. ATOMIC ABSORPTION SPECTROPHOTOMETER

Its major use is in the analysis for trace metal determination; it has high sensitivity for many elements, with perhaps 60 or so elements measurable in the parts-per-million range; it is simple, rapid, relatively low-cost and highly specific (few interference).

8. INFRARED SPECTROPHOTOMETER

Can be used to identify pure chemical compounds by comparison of the spectrum of an unknown with previously recorded spectra of pure compounds; to identify the constituents of mixtures; to show the presence of a group of atoms in a molecules of unknown or doubtful structure and quantitative analysis of mixtures by infrared means is feasible.

This instrument may be fully utilized in a wide range of applications including research on molecular structures, purity assessments, physico-chemical studies, and qualitative and quantitative analysis.

9. HIGH-TEMPERATURE FURNACE

Needed for tool and die hardening, annealing, carburizing, ashing, tempering and other heat treating processes in the machine shop, in connection with chemical analysis, determination of ash content, and general metallurgical work.

ANNEX I. B.

BIOFUELS WORKSHOP EQUIPMENT

1. PRESSURE TRANSDUCERS

This is essentially needed for monitoring the internal pressure build-up inside an engine (gasoline, diesel or gas) used for testing various fuels. Pressure transducers are electronic devices which converts the internal pressure build-up in cylinders before and during ignition to electronic impulses. Coupled to an oscilloscope, the Lissajous figures generated may be seen on its screen. In fuel research work such as that undertaken at the center, its importance lie in noting how different engines perform internally with respect to the different fuels being utilized. With this equipment, optimum working parameters of the engine like ignition timing, compression ratio, temperature build-up and others may be defined.

No. of units needed: 3 air cooled (spark plug type)
1 water cooled

2. DUAL TRACE OSCILLOSCOPE

This goes hand in hand with the pressure transducers. It is basically a cathode-ray tube where the electronic impulses from a pressure transducer can be seen on the screen. The pressure build-up, the rapid peaking of pressure due to ignition and the sloping downward of a continuous segment for exhaust in one power cycle is just one aspect of engine performance which can be monitored. A dual trace oscilloscope serves the purpose of locking on any of this curve to be able to observe and note the engine performance with a specific parameter involved.

3. WATER DYNAMOMETER

In testing for engine performance, a static loading system is required. A water dynamometer function is based on the incompressibility of water as opposed to the reverse motion of the engine being tested. This is a totally mechanical device which attributes to its high durability and good performance as compared to those electrical in nature. A dynamometer simulates road loading conditions of an engine on a test bed and it thus measures the actual load. With this device, a specific engine like a gasoline engine may be initially tested with gasoline fuel. This will serve as a standard for comparison before the same engine is run on alternative nonconventional fuels. Actual road loading performance may thus be protected with the different fuels based on the brake thermal efficiencies gathered.

4. FUNCTION GENERATORS

The equipment is used in connection with a pressure transducer and oscilloscope to provide a fixed reference for tracing piston movement of the engine being tested. Together with the pressure transducer a complete PV diagram of what is actually happening inside the engine can be viewed from the oscilloscope.

No. of units needed: 3 units

5. 12-CHANNEL DOTTING STRIP CHART RECORDER

Used for recording data gathered during tests of various fuels in an internal combustion engine.

6. X-Y RECORDER/PLOTTER

Used where it is desired to plot the relationship between two variables, instead of plotting each variable separately as a function of time. The chart moves in response to changes in a variable instead of at a uniform time rate. Ideal for data printing, during tests in an internal combustion engine.

7. ENGINE INDICATING SYSTEM AMPLIFIER

This is the master control module which is responsible for amplifying the electronic pulses that a pressure inducer forms. With this, a visual pressure-volume relationship can be seen and plotted on an X-Y plane as seen on an oscilloscope screen. This will be a visual record of the actual internal engine performance.

ANNEX I. C.

MICRO COMPUTER SYSTEM

The availability of a computer as a general tool for ERDC has the following significant advantages and capabilities which are not possible without it:

(a) Simulation and optimization of prototype design and experimental set-ups before they are actually constructed. This is one way of fine tuning designs which may reduce the number of prototype models separating the concept and the commercial model (a most economical way of utilizing financial resources).

(b) Highly sophisticated analysis can be adopted when needed using mathematical models and the like in the following areas:

1. Economic evaluations
2. Market forecasting and analysis
3. Long-range and short-range forecasting of the noncon program targets and requirements
4. Financial systems planning and analysis which covers budget planning, auditing systems and other financial related activities.

(c) An extremely high speed and highly efficient storage and retrieval system for data and information.

MICRO COMPUTER COMPONENTS

ITEM	CAPABILITY
Desktop Computer	- BASIC OR FORTRAN LANGUAGE
	- complete buffered I/O capability with 15 assignable levels of priority interrupt plus direct memory access (DMA)
	- user Read/Write memory expandable from 50K to 250K bytes.
	- typewriter-like, alphanumeric keyboard
	- alphanumeric CRT display

Master flexible disc drive	- for application that require data access and transfer speeds faster than those of tape, yet don't warrant the expense of a fixed disc - 450K bytes capacity - Data transfer rate about 23K bytes/sec.
Mass storage ROM	- provides fast access and large data storage - data capacity 2M byte - data transfer rate 800 bytes/sec - program transfer rate 2K bytes/sec.
Serial impact printer	- dot matrix printer with microprocessor control for optimization of printing functions High print speed (180 cps) optimized bidirectional printing, delection of leading and trailing blanks, and high speed skip over embedded blanks
Interface Card	- This interface card permits up to 14 instruments to be connected to the computer at the same time
Multicolor Plotter	- programmable multicolor graphs microprocessor based plotter selectable pen speed point digitizing window plotting error-free off-scale data handling

ANNEX II

LINE-ITEM BUDGET

ITEM	TOTAL	USAID FUNDING	GOP COUNTERPART (BED)
I. PERSONNEL SERVICES	-	-	-
II. EQUIPMENT & ACCESSORIES			
A. Equipment for Analytical Laboratory			
1) Laboratory mill with cryogenic attachment	₱ 15,000	₱ 15,000	-
2) Equipment for liquid fuel analysis	200,000	200,000	-
3) Room dehumidifier	12,000	-	₱ 12,000
4) Top-Loading Balance	30,000	-	30,000
5) Nuclear magnetic resonance spectrometer	250,000	250,000	-
6) Elemental analyzer	300,000	-	300,000
7) Atomic Absorption spectrophotometer	200,000	-	200,000
8) Infrared Spectrophotometer	200,000	200,000	-
9) High-temperature furnace	100,000	-	100,000
	₱1,307,000	₱ 665,000	₱ 642,000
B. Biofuels Workshop Equipment			
1) Pressure transducers	₱ 112,000	₱ 56,000	₱ 56,000
2) Dual trace oscilloscope	30,000	30,000	-

ITEM	TOTAL	USAID FUNDING	GOP COUNTERPART (BED)
3) Water dynamometer, 100 Hp	₱ 460,000	₱ 460,000	-
4) Function generators	90,000	-	₱ 90,000
5) 12-Channel Dotting Strip Chart Recorder	65,000	-	65,000
6) X-Y Recorder/Plotter	24,000	-	24,000
7) Engine indicating System amplifier	40,000	-	40,000
	₱ 821,000	₱ 546,000	₱ 275,000
C. Micro Computer System CIF Manila	₱ 312,304	₱ 312,304	₱ -
Sub-Total	₱2,440,304	₱1,523,304	₱ 917,000
III. MAINTENANCE & OTHER OPERATING EXPENSES			
A. For Analytical Laboratory Supplies & Materials	₱ 50,000	₱ -	₱ 50,000
B. For micro computer system Maintenance, 9% of cost	28,108	-	28,108
Supplies	12,000	-	12,000
Training for 10 persons at ₱2,000/each	10,000	-	10,000
	₱ 100,108	-	₱ 100,108
TOTAL	₱2,540,412	₱1,523,304	₱1,017,108

DRAFT 11/10/81

COLLEGE OF ENGINEERING
University of the Philippines

THE PROPOSED Ph.D. PROGRAM IN ENERGY SCIENCE AND TECHNOLOGY

OBJECTIVES

The Ph.D. Program in Energy Science and Technology aims to provide students with an advanced graduate training in the field of energy, with particular emphasis on energy research subjects of special interest to the country.

ADMISSION REQUIREMENTS

To be admitted into the Ph.D. (Energy) Program, an applicant must have (1) a B.S. or M.S. degree in Chemical, Electrical, or Mechanical Engineering or their equivalents from a recognized institution of higher learning and (2) a very high degree of intellectual capacity and aptitude for advanced study and research.

These qualifications shall be determined by a College Graduate Committee on Energy on the basis of (1) the applicant's undergraduate and graduate scholastic records; (2) the written recommendations from three (3) of the applicant's former professors regarding his/her abilities; and (3) a personal interview with the applicant, if possible.

All applications for admission into the Ph.D. (Energy) Program are subject to the approval of the Director, Graduate Division, College of Engineering. The College Graduate Committee on Energy shall be constituted by the Dean, College of Engineering, upon the recommendation of the

Director of Graduate Division.

PLACEMENT EXAMINATION

Students who are admitted into the Ph.D. (Energy) Program with only a B.S. degree shall be required to take the Placement Examination which will be scheduled about two (2) weeks before the start of the First Semester. This Examination, which is a written and/or oral examination, is intended to determine the level and extent of the student's undergraduate preparation.

A student who does not perform satisfactorily in the Placement Examination may be required to complete the appropriate remedial courses.

GENERAL DEGREE REQUIREMENTS

To qualify for the Ph.D. (Energy) degree, a student must -

(1) Complete a minimum of 24 units of formal graduate courses if he/she has a masters degree, and a minimum of 45 if he/she has a bachelor's degree;

(2) maintain a cumulative weighted average grade of "2.00" or better in his/her course work; a grade below "2.00" shall not receive graduate credit;

(3) complete at least two (2) units of graduate colloqium;

(4) obtain a doctoral passing grade in the Comprehensive Examination;

(5) pass the Candidacy Examination;

(6) submit a doctoral dissertation based on an independent and original research in energy science and technology;

(7) successfully defend this dissertation in a Final Doctoral Examination;

(8) submit a preprint based on the approved dissertation and endorsed as an accepted article for publication in a scientific journal.

PROGRAM OF STUDY

Each student admitted into the Ph.D. (Energy) Program shall be assigned to a Program Committee composed of five (5) members to be appointed by the College Graduate Committee on Energy from among the faculty members of the Ph.D. (Energy) Program. This Committee shall, in consultation with the student, draw up the latter's program of study on the basis of his/her performance in the Placement Examination and his/her lines of interest and specialization. In accordance with this program of study, the student will then be advised and supervised in his/her course work by the Program Committee until he/she is advanced to candidacy for the Ph.D. degree and is given a Dissertation Committee.

The normal study load per semester shall be nine (9) units of formal graduate courses for full-time students as well as graduate (teaching or research) assistants.

COURSE REQUIREMENTS

Every student in the Ph.D. (Energy) Program shall be required to complete a minimum of 24 units of formal graduate courses if he/she has

a master's degree, and a minimum of 45 if he/she has a bachelor's degree, consisting of the following:

A. Core Courses: 18 units

Core Course I ..... 3 units

Core Course II ..... 3 units

Core Course III ..... 3 units

Core Course IV ..... 3 units

Core Course V ..... 3 units

Core Course VI ..... 3 units

B. Speciality Courses: 12 units of graduate courses in the student's chosen area of specialization

Basic Specialty Course I ..... 3 units

Basic Specialty Course II ..... 3 units

Advanced Specialty Course I ..... 3 units

Advanced Specialty Course II .... 3 units

C. Electives: 15 units of any graduate course in energy or a closely related field

The electives must be chosen by the student with the advise and consent of his/her Program Committee or Dissertation Committee. Depending on his/her particular needs and interests the student may also be advised by his/her Program Committee or Dissertation Committee to take additional graduate courses beyond the minimum ____-unit course requirements.

TRANSFER OF CREDITS

For equivalent graduate courses completed prior to entry into the Ph.D. (Energy) Program and/or taken in another institution whose graduate program is comparable in standards to that of the University of the Philippines, the following maximum number of units may be credited to the minimum 45-unit course requirements, subject to the recommendation of the student's Program Committee and the approval of the College Graduate Committee on Energy:

(1) a maximum of 18 units in the case of the core courses

(2) a maximum of 18 units in the case of the other course requirements.

Any graduate course taken previously and/or elsewhere, which is disapproved for credit by the Graduate Committee, will have to be repeated or validated.

GRADUATE REQUIREMENT

Each student's scholastic performance in his/her course work shall be evaluated at the end of each academic year by his/her Program Committee. To remain in good standing in the PhD. (Energy) Program, a student must maintain a cumulative weighted average grade of "2.00" or better in his/her course work until he/she is advanced to candidacy for the Ph.D. degree. Failure to maintain this scholastic standard shall entail disqualification from the Ph.D. (Energy) Program unless for special reasons the student, upon the recommendation of his/her Program Committee and the approval of the College Graduate Committee on Energy, is given another chance to improve his/her scholastic record through an additional

semester of course work. A student who obtains a grade below "3.0" in any course within his/her approved program of study shall be automatically disqualified from the Ph.D. (Energy) Program.

COLLOQUIUM REQUIREMENT

In addition to the formal course requirements, each student in the Ph.D. (Energy) Program shall be required to complete at least two (2) units of graduate colloquium. This requirement is intended to acquaint the student with local research activities and current international developments in energy.

COMPREHENSIVE EXAMINATION

Within eighteen (18) months after the student has completed the graduate core courses, he/she must take the Comprehensive Examination which will normally be scheduled during the summer session of each academic year. This Examination, which shall be administered and evaluated by the Program Committee, is intended to test the student's ability to integrate and apply knowledge that he has acquired in the graduate core courses.

If the student obtains a doctoral passing grade in the Comprehensive Examination, he/she will be allowed to continue in the Ph.D. (Energy) Program and be entitled to the master (Energy) degree, provided he/she satisfies the other requirements for the masters degree, the thesis or non-thesis option. If the student fails to get a doctoral passing grade, he/she will be allowed to take the Examination again within one (1) year after the first attempt. Failure to obtain a doctoral passing grade in the second attempt will disqualify the student from the Ph.D. (Energy)

Program. Nevertheless, a student who fails to get a doctoral passing grade in the Examination can still qualify for the Masters (Energy) degree if his/her performance in the Examination comes up to the masteral standard.

CANDIDACY EXAMINATION

Within one (1) year after passing the Comprehensive Examination for the Ph.D. (Energy) degree, the student must take the Candidacy Examination, which is an oral examination conducted and evaluated by his/her Program Committee. In this oral Examination, the student is required to present a graduate-seminar-report on a previously approved topic in his/her chosen area of specialization and is examined on his/her grasp of the chosen specialty mastery of the basic principles, and readiness for dissertation research.

If the student passes the Candidacy Examination, he/she is advanced to candidacy for the Ph.D. (Energy) degree. If the student fails, he/she will be allowed to take the Examination again, on the basis of a different seminar topic within one (1) year after the first attempt. Failure at a second attempt will disqualify the student from the Ph.D. (Energy) Program.

DISSERTATION REQUIREMENT

After the student advances to candidacy for the Ph.D. (Energy) degree and finds a Dissertation Adviser in his/her chosen area of specialization, he/she will be required to submit a written formal research proposal for his/her doctoral dissertation and be provided with a Disserta-

PREPRINT REQUIREMENT

Before the graduation of the successful Ph.D. candidate can be officially approved, he/she must first submit to the Graduate Division, College of Engineering, a preprint which is based partly or entirely on his/her approved dissertation and endorsed by his/her dissertation Committee as an acceptable article for publication in a reputable scientific journal.

RESIDENCE REQUIREMENT

The Ph.D. candidate is required to be in residence for at least one (1) year prior to the award of the Ph.D. (Energy) degree.

TIME LIMIT

As a general rule, the time limit for the completion of all the requirements for the Ph.D. (Energy) degree shall be no more than seven (7) years for those who enter with an M.S. degree. In special cases, however, a student may be granted by the Graduate Division, College of Engineering, an extension of one (1) year at a time up to a maximum of three (3) years.

PROGRAM SCHEDULE

The normal program schedule that can be followed by full-time students and graduate assistants, who enter the Ph.D. (Energy) Program with only a B.S. degree and no undergraduate deficiencies, shall be as follows:

FIRST YEAR

The first year of the course will be based upon the MS course in Energy Science and Technology.

First Semester		Second Semester	
Core Course I	3	Core Course IV	3
Core Course II	3	Core Course V	3
Core Course III	3	Core Course VI	3
Graduate Colloquium	(1)	Graduate Colloquium	(1)
	9		9

SECOND YEAR

The second year of the course will be tailored to suit the needs of the individual student and will consist of basic specialty courses and electives.

First Semester		Second Semester	
Basic Specialty Course I	3	Basic Specialty Course II	3
Elective	3	Elective	3
Elective	3	Elective	3
	9		9

THIRD YEAR

The third year of the course will have advanced specialty courses and dissertation research.

First Semester		Second Semester	
Advanced Specialty Course I	3	Advanced Specialty Course II	3
Elective	3	Dissertation Research	(9)
Dissertation Research	(6)		
	6		3

SUMMER: Dissertation Research .... (9)

FOURTH YEAR

The fourth year of the course will be spent entirely on the research project.

First Semester		Second Semester	
Dissertation Research ...	(12)	Dissertation Research	(12)

EXISTING COURSES

ES 201 ADVANCED MATHEMATICAL METHODS IN ENGINEERING I
Credit 3 units

ES 202 ADVANCED MATHEMATICAL METHODS IN ENGINEERING II
Credit 3 units

ES 204 NUMERICAL METHODS IN ENGINEERING
Credit 3 units

ES 100 INTRODUCTION TO NUCLEAR ENGINEERING
Credit 4 units

ES 101 USE OF RADIOISOTOPES
Credit 2 units

ES 102 REACTOR MATERIALS
Credit 2 units

ES 103 NUCLEAR INSTRUMENTATION
Credit 3 units

ES 104 HEALTH PHYSICS AND SHIELDING
Credit 3 units

ES 105 REACTOR TYPES
Credit 1 unit

ES 106 NUCLEAL LABORATORY I
Credit 1 unit

ES 107 NUCLEAL LABORATORY II
Credit 1 unit

DRAFT 11/10/81

NATIONAL SCIENCE DEVELOPMENT BOARD
Bicutan, Taguig, Metro Manila

1. PROJECT TITLE: ESTABLISHMENT OF AN INTERDISCIPLINARY POSTGRADUATE PROGRAM IN ENERGY SCIENCE AND TECHNOLOGY

2. PROJECT PROPONENT: U.P. COLLEGE OF ENGINEERING
DILIMAN, QUEZON CITY

3. PROJECT DIRECTOR: DEAN MARINO M. MENA
U.P., COLLEGE OF ENGINEERING

4. COOPERATING AGENCIES: CENTER FOR NONCONVENTIONAL ENERGY DEVELOPMENT
U.P. INDUSTRIAL RESEARCH CENTER

5. SUMMARY:

The time is now opportune for the establishment of a postgraduate program in engineering, with initial emphasis in the multi-disciplinary subject of energy. The National Science Development Board, in its role as a catalyst for the development of manpower in science and technology has appreciated the need for such an advanced academic program. In recognition of this need, and of the NSDB's aforementioned role, the U.P. College of Engineering which has a strong tradition of energy research engendered by its current staff and facilities, makes this proposal to NSDB for assistance in the establishment of a POST-GRADUATE PROGRAM IN ENERGY SCIENCE AND TECHNOLOGY.

15

As conceived, the program will cover both the M.S. and Ph.D. levels, with particular emphasis being given to energy research subjects of special interest to the country. While strongly engineering in flavor, the program will draw upon other University and outside experts in such areas as environmental protection, economics, sociology and public policy.

It may readily be imagined that the UP Engineering Energy Postgraduate Program will be able to draw students and researchers from the ASEAN region and other developing countries.

6. OBJECTIVES OF THE PROJECT:

(a) To identify the needs of the Philippines and similar developing countries worldwide for engineers trained beyond the baccalaureate level in energy science and technology and allied areas.

(b) To establish a formal academic program leading to the Master's and Ph.D. degrees responsive to the foregoing needs.

(c) To provide opportunities for post-baccalaureate studies in current energy technology and science through continuing-education activities such as short courses, seminars, workshops, and publications.

(d) To establish linkages with government agencies, private entities, and foreign or international organization

for purposes of research, extension and teaching through the identification of areas of need, provision of support and the exchange of personnel.

(e) To conduct research activities in appropriate topics involving energy and related or affected fields.

7. SIGNIFICANCE OF THE PROJECT

The rapid expansion of energy development activities in both the so-called conventional and nonconventional areas, accompanied by the start of industries requiring the use of large amounts of fuel and electricity make it imperative that the country have the capability to provide the engineering manpower suitably prepared beyond the baccalaureate level for the needs of government and industry. Such manpower will be needed for research and development works in such areas as energy source development, management and conservation, design and optimal operation of generating plants, transmission and utilization systems.

Aside from the requirements in the hard-technology fields, it can be expected that the country will be able to properly utilize experts for policy studies and formulation.

Out of the program will also come those who will go back into the academic sector to bring energy science and technology down to the undergraduate level.

8. PROCEDURE AND METHODOLOGY

(a) A full-time academic program for master's and Ph.D. degrees in engineering, with concentration in energy will be set up. The formal coursework will consist of existing mathematics, physical science, and engineering course that will be strengthened and of new courses to be instituted. Both credit and non-credit work will be required on a case-to-case basis in research methodology and techniques, computer languages, and economics.

(b) A highly selective admissions program will be instituted, together with a graduate-student stipend plan which will encourage full-time study and research.

(c) In a parallel effort, the University's research facilities will be strengthened and addititional research support personnel will be hired. In particular the Library and the research instrumentation will receive special attention.

(d) The present high level of energy research will be expanded through additional grants to faculty and graduate students.

(e) Close liaison will be established with institutions having energy research needs and /or which may be able to support research by the program's staff.

The Philippines is now recognized as being a leading country in the area of alternative-energy sources and such reputation can help attract foreign support.

(f) An exchange program involving both Philippine and foreign research and educational institution will be encouraged.

9. CURRENT STATUS OF THE PROJECT

The University of the Philippines College of Engineering currently offers M. Engineering and M.S. program in traditional engineering disciplines. Certain graduate courses in engineering and other U.P. units may be included in the upgraded postgraduate program.

Faculty members and graduate students now conduct various energy research studies using facilities which can be improved.

The present library holdings and services are deemed inadequate.

Computation facilities-mainframe, mini and microcomputers - appears to be adequate.

10. COOPERATING AGENCIES

The success of a research-oriented academic program such as that for energy necessitates the close cooperation between the educational institution (U.P.), the

funding sources (government, industry, and foreign agencies), and the potential "end-users" (employers) of the future M.S. and Ph.D. holders.

Initially, the following agencies in addition to NSDB have been identified as those whose participation in the program will be essential:

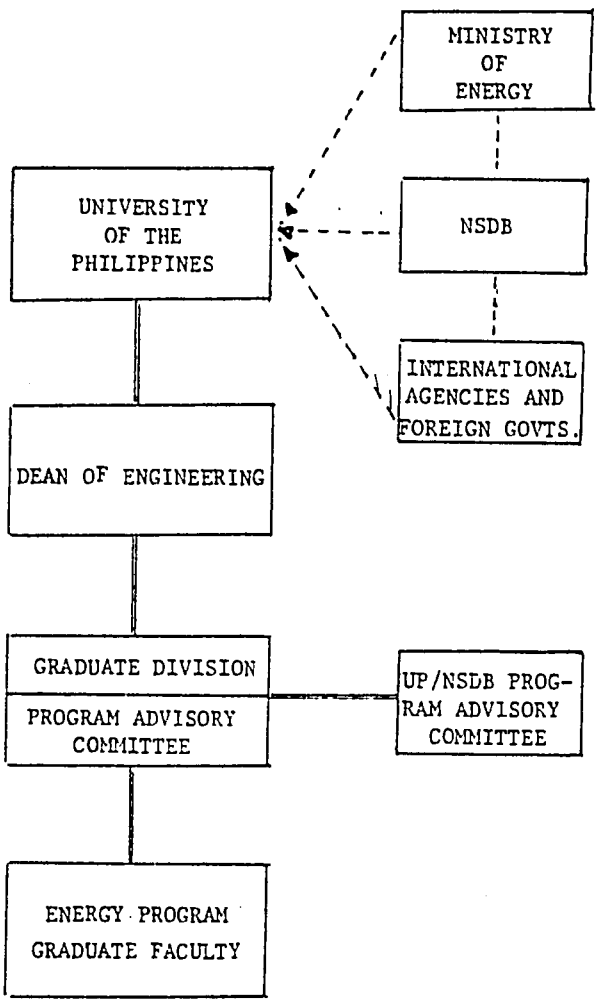
(1) Ministry of Energy
  (a) Center for Nonconventional Energy Development
  (b) Bureau of Energy Utilization
  (c) National Power Corporation

(2) National Electrification Administration

(3) Ministry of Education

International organizations and foreign governments will be tapped for support.

11. PROJECT ORGANIZATION



Note:

----- support (funds, equipment, experts)

A C T I V I T Y	1981		1982		
	JUNE-JULY	AUGUST-DECEMBER	JANUARY-MARCH	APRIL-JUNE	JULY-DECEMBER
A - Formulation of academic programs					
B - Solicitation of local and foreign support					
C - Acquisition of library materials and laboratory equipment					
D - University approval of program					
E - Development of materials for formal and support courses					
F - Testing, screening of applicants					
G - Improvement of laboratory facilities					
H - Orientation of new graduate students					
I - First semester of program					

PROJECT SCHEDULE - FIRST FOURTEEN (14) MONTHS

APPENDIX A

PROPOSED INSTITUTION OF A POSTGRADUATE PROGRAM IN ENERGY TECHNOLOGY

Rationale

During the present as well as the coming decade, the Philippines is likely going to feel the pressures from both increased energy demand and oil prices hikes. The present concerted government efforts in the energy sector arose primarily as a consequence of a supply and price crisis. Thus, the national energy plan has three key objectives:

1. Supply Objective. To provide timely, adequate and secure energy supplies at publicly-affordable price levels, in such forms and at such locations as shall be most useful to the markets.
2. Usage Objective. To minimize inefficient and wasteful consumption of energy fuels, within the context of given socio-cultural institutions and constraints.
3. Environmental Objective. To ensure that both objective above are met in an environmentally-acceptable fashion.

In support of this national thrust, there will be an urgent need for specialists in the energy field to develop indigenous energy resources, to improve the efficiency of energy use and to introduce appropriate alternative energy technologies.

The existing masteral program in Nuclear Engineering will become a component of this proposed program in Energy Technology. In other words, nuclear energy will become only one of the several options which will include other conventional as well as non-conventional energy sources.

Academic Program

1. Existing Courses that can be availed of:

   - Mathematical Methods for Engineering
   - Thermodynamics
   - Heat Transfer
   - Fuels and Combustion
   - The existing courses in nuclear engineering and engineering fluid mechanics

2. Possible New Courses (These are only examples. Final list of proposed new courses will be prepared by a Committee to be formed for this purpose).

   - Energy Resource I
   - Energy Resource II
   - Energy Conservation and Management
   - Energy Technologies for Rural Development
   - Analysis of Energy Systems
   - Analysis of Energy Economics
   - Energy, Society, and Public Policy

3. A Typical coursework schedule

   Note: An example schedule will be prepared by the committe

Laboratory Facilities and Research

An energy research laboratory will be established which will be partiallly equipped with facilities to be acquired from the UNDP Grant to the UP College of Engineering for the Establishment of the National Engineering Center. Some equipment for energy research and development have already been received from UNDP in 1979 and 1980.

A tie-up can be explored with the Center for Non-Conventional Energy Development which is located at the PAEC compound in Diliman for cooperative research efforts in the area of new sources of energy. An area in the U.P. Diliman Campus may be used as an "Energy Demonstration Area".

Academic Staff

The following faculty members of the College of Engineering are involved in energy research and development. They will form the core of a multi-disciplinary team which will handle the courses in the program.

1. Dr. Leopoldo Abis
2. Dr. Jose Azarcon, Jr.
3. Dr. Ibarra Cruz
4. Prof. Teodorico Festin
5. Dr. Ruben Garcia
6. Dr. Rufino Lirag
7. Dr. Leonardo Liongson
8. Dr. Rogelio Panlasigui

APPENDIX B

POST GRADUATE PROGRAM IN ENERGY
PROJECTED ANNUAL BUDGETARY REQUIREMENTS
FISCAL YEARS 1981 TO 1984

	ITEM	YEAR			
		1981	1982	1983	1984
I	PERSONAL SERVICES	50,000.00	300,000.00	350,000.00	400,000.00
II	MAINTENANCE AND OPERATING EXPENSES				
	Foreign Travel	60,000.00	120,000.00	200,000.00	250,000.00
	Library (Literature & Equipment)	500,000.00	500,000.00	500,000.00	500,000.00
	Fellowships (10 Ph.D. & M.S. students)		200,000.00	400,000.00	600,000.00
III	EQUIPMENT AND FURNITURE				
	Laboratory Equipment (Local & Foreign)	4,000,000.00	2,000,000.00	2,000,000.00	2,000,000.00
	Furniture and Office Equipment	50,000.00	200,000.00	100,000.00	50,000.00
IV	SPECIAL PURPOSES		200,000.00	220,000.00	240,000.00
V	CAPITAL OUTLAY		1,000,000.00		
		4,660,000.00	4,520,000.00	3,770,000.00	4,040,000.00

PART I - PROPOSAL SUMMARY

1. PROJECT TITLE	:	A Survey of the Potential for the Utilization of Biomass Fuels in the Philippines
2. PROPONENT	:	Energy Research and Development Division (PNOC)
3. COOPERATING AGENCIES	:	Ministry of Natural Resources (MNR) Forest Research Institute (FORI) Presidential Committee on Wood Industries Development (PCWID) Forest Products Research and Industries Development Commission (FORPRIDECOM) Philippine Coconut Research and Development Foundation (PCRDF)
4. PROJECT COST	:	TOTAL : ₱1,785,250.00 USAID : ₱1,152,000.00 GOP : ₱ 633,250.00
5. PROJECT DURATION	:	Two (2) Years
6. PROJECT SUMMARY	:	

A survey on selected geographical areas of the country will be conducted to assess the availability and utilization of biomass resources and to collect and analyze data on the technical, social, environmental, political and economic aspects of renewable energy production and consumption. The purpose of the project is to establish a data base on the agricultural and forestry resources in the Philippines sufficient to provide a basis for articulating policy directions for : 1) the applied research and technology dissemination efforts of ERDC and the Ministry of Energy; 2) the resource management activities of the Ministry of Natural Resources; and 3) the development of programs by NEDA, private and voluntary organizations, and international assistance entities.

Designed upon an interdisciplinary framework, the survey will focus on the identification and matching of resource base characteristics with the characteristics of established technical options that can be harnessed to utilize those resources. Thus, the survey will provide a detailed and comprehensive assessment of the various characteristics of each resource including origin, concentration, accessibility, collection, utilization, ownership, present pricing structure, processing, seasonal variations, market and non-market factors, and incentives which could be used to augment the supply and use of such resources. Similarly, an assessment of selected technologies will be undertaken to match their characteristics - in terms, for example, of fuel adaptability, sizing, technical complexity, cost, dissemination potential - with resource base characteristics.

The scope of the survey will be limited to six specific biomass resources and nine specific technologies related to those resources:

Resources:

Coconut Trunks, Shells & Husks	Sugar Cane Residues
Rice Hulls and Straw	Bamboo
Wood	Animal Waste

Technologies:

Producer Gas	Charcoal Formation
Alcohol	External Combustion Engine (Stirling, Rankine, and Ormat)
Biogas	Direct Combustion Processes
Pyrolysis	Cooking Stoves
Gasification	

Additionally, only specified geographical areas will be examined in the study. Nonetheless, great attention will be given to the selection of these areas to assure that they are representative of the primary resource zones in the Philippines. Moreover, these areas shall in turn be used as test locations for the evaluation of alternative technologies prior to any large-scale dissemination efforts.

Approximately 3 geographical areas will be studied for each of the selected resources. These geographical areas will be identified on the basis of the predominance of the selected biomass resource concentrations and the degree to which they are representative of those resource zones in terms of industrial concentration, demographic characteristics, potential uses and users, volume of trade, economic base, resource-technology applicability, and other indices. Areas that are representative of the above characteristics in each of the primary resource zones will be selected as the survey sites. Six sectors within these locations shall then be considered: agriculture, household, transport, cottage industry, light industry, and heavy industry. For the household sector, the survey size will be approximately 1,500

respondents for the survey. In addition to the survey of potential users and producers, the study will incorporate relevant secondary data and the actual measurement of resources stocks. Results of these efforts, together with the survey shall then be compiled, re-classified, tabulated, and analyzed. The results of the analysis will form the basis for the development of policy directions in the research and technical dissemination efforts of NCRD and other government and private entities, including recommended intervention strategies for specific types of programs and technologies.

In summary, therefore;

- Approximately 3 geographical areas for each resource shall be considered.
- The first screening of geographical areas shall be accomplished according to the predominance of a certain biomass resource in that location.
- Actual selection of survey zones will be based on an analysis of secondary data with the general aim being to identify sites that most closely reflect the characteristics of each primary resource region as a whole (i.e. income distribution, land ownership, economic base, population density, distribution of industry, employment, etc.)
- Each selected survey zone will be divided into various sub-sectors - agricultural, transport, household, light, medium and

and heavy industry - and will be treated separately in the formulation of questionnaires, survey forms and field observation plans.

Local interviewers will be recruited and trained for the household sector. Professionals for the other sectors will be hired to conduct technical observations and measurements.

PART II - TECHNICAL ASPECTS

7. SIGNIFICANCE OF THE PROJECT:

Our country, being an agricultural one, abounds in biomass resource potentials, equivalent to more than 87 million barrels of oil annually. For any country to make optimum use of its resources, quantitative knowledge of resource stocks is vital, as is knowledge of the various means and processes by which such resources are being and may be utilized. With this information effective strategies can be developed serving to identify technical and resource linkages in line with government plans to accelerate the country's movement toward energy self-sufficiency.

While various government and private institutions are exerting efforts to assess the amount of the country's renewable resources, it is widely acknowledged that significant information gaps exist relating to the determination of the factors affecting resource availability and

utilization,as well as accurate data on resource stocks themselves. In addition, much of the data that does exist is not in the form needed to accomplish the goals of this project — the generation of an in-depth data base necessary for the development of specific programs and strategies for renewable energy utilization. There is a need to bridge existing information gaps by reviewing presently available data in the field and identifying additional information needed to attain a more practical assessment of the country's biomass potentials and to formulate relevant policy directions.

8. OBJECTIVES:

A. General

1. To generate a data base in the renewable energy sector sufficient to provide a foundation for articulating policy directions for: 1) the applied research and technical dissemination efforts of ERDC and the Ministry of Energy; 2) the resource management activities of the Ministry of Natural Resources; and 3) the development of projects by NEDA, private voluntary organizations, and international assistance entities.

2. To develop feasible intervention strategies for specific programs and to provide policy recommendations for the specific technology - resource combinations studied.

B. Specific

a) In selected geographical areas of the country, to provide baseline data on biomass resource availability and utilization in

the agricultural, household, transport, cottage industry, light industry and heavy industry sectors.

b) To identify appropriate biomass-based technologies deserving of greater or lesser institutional support giving emphasis to resource availability (seasonal variations, ownership patterns, economic factors, etc.), technology adaptability, dissemination potential, cost, complexity, and other pertinent criteria.

c) To develop a relatively site specific environmental, socio-economic, institutional impact analysis of identified technologies in the selected geographical locations of the survey.

d) Determine the different characteristics (physical, chemical, and otherwise) of selected biomass resource fuels at both source and at end consumers.

e) Determine problems, obstacles, issues and other barriers involved in the procurement, processing and utilization of such resources.

f) Assess government policies that affect the use of renewable energy resources and technologies and to recommend policy modifications necessary to expand the use of these resources.

g) Identify specific areas in the country which can serve as pilot areas for agro-forestry energy development and utilization programs.

9. METHODOLOGY

Phase I - Preparatory Phase (Three Months)

The preparatory phase will serve to examine available data that could be availed of, including efforts that have been expended by the government as well as other concerned institutions, in line with the needs of the project. Subsequently, the specific data requirements shall be determined and the survey coverage defined. A consultant with adequate experience in the technologies and resources considered herein as well as in the conduct of surveys, shall be tapped to provide professional services. He/she will be consulted during the course of the preparatory phase and as may be necessary, for the succeeding phases of the project.

The preliminary activities that will serve as starting points for the survey are as follows:

a) Gathering and Studying of Secondary Data:

This would include the technical, economic, social, and political aspects of the utilization of biomass resources in the country. Regarding selected technologies, the types of information required for the survey on each technology will be identified, procured, and compiled into a form meaningful for the project's purpose.

All information gaps and data inconsistencies shall be identified. At the same time, information sources shall be traced and cross-checked to determine their validity. For this part of the preparatory phase, one research associate will be working on each resource, with the assistance of two (2) research assistants for each associate. This is expected to take 3 months, with the output being: the selection and description of geographical areas that would best serve as the survey sites; approximate sample size; definition of the types of data and information relevant for each technology and resource; compilation and presentation of crude data on both resources and technologies; and identification of gaps and inconsistencies as well as additional inputs necessary for the efficient and effective implementation of the project.

b. Literature Survey:

This would involve gathering of all available information on the nature and characteristics of the selected resources and the different aspects of the processes/technologies being considered herein. Likewise, a study of existing government and private programs and policies as well as previous surveys of a similar nature or thosethat could be useful to the project, shall be examined.

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c) Seminar/Workshop on Survey Mechanism

This is envisioned to strengthen the energy survey methodology through the participation of experts, including two international consultants, with significant experience in the conduct of renewable energy surveys in a developing country. The workshop component scheduled for a five day period, is tentatively set for the last month of the preparation phase. The foreign consultants will share their experiences and help finalize the survey methodology. They shall be briefed beforehand on the nature of the project, its needs, and the relevant background issues. Local consultants, familiar with the conditions prevailing in the country, shall be invited to participate and help in threshing out the necessary requirements and techniques most suited for the project. For this purpose, one local consultant shall be hired for each resource to be covered by the survey. The secondary data collection and literature search will be undertaken before the workshop is convened. The people designated to prepare the survey forms in the next phase shall be the workshop participants.

d) Analysis of Gathered Data/Technical Data

All secondary data and survey literature shall be interpreted and analyzed. Research associates, assistants, the project director, and consultant will prepare a tentative outline of the survey questions to be asked for each technology,

resource, and sector; determine the appropriate sample size in terms of geographical coverage; and formulate the specific outlines of the survey methodology to be incorporated in the survey.

Part II - Design of Survey and Control Forms (Two Months)

This phase will involve the design and preparation of questionnaires and survey forms for the different geographical areas and specific sectors.

Phase II is expected to take about 2 months. The research associates and consultant who have worked on the preparatory phase shall now incorporate and operationalize the corresponding input gathered in that phase. Working with them will be an expert from the Bureau of Census with knowledge of survey methodologies and a sociologist or an anthropologist, and 5 more research associates (given the number and kinds of resources, technologies and sectors that will be covered by the survey).

Phase III - Pre-Testing and Revision of Survey Forms (Two Months)

After the questionnaires and survey forms have been prepared, pre-testing in selected areas representative of the different characteristics of identified survey sites will be conducted. If necessary, such pre-testing may be implemented in areas where the actual survey will be conducted. The pre-testing is intended to determine the appropriateness of the questionnaires, the revisions/

modifications that need to be made, and the data still required to accomplish the set objectives of the survey. Questions/ inquiries found unnecessary may also be deleted or re-stated to make them more appropriate.

The original core group (research associates and consultant), together with people selected to conduct the experimental survey, shall go to chosen sites during the pre-testing and actually interview people from the different sectors and regions being represented in the study. This way the survey staff will obtain a feel of how people from different sectors will react or respond to the survey questions.

In line with the sequential schedule of surveying, this pre-testing may or may not be over a contiguous period of time. This will allow for the incorporation of lessons learned from the implementation of the earlier actual survey activities.

Phase IV - Training of Personnel to Implement the Survey (One & one half mo.)

Phase IV will be a field-based activity which shall involve hiring of locals in selected areas for survey implementation training. The original research associates (one per resource), with the help of the research assistants, shall arrange for the recruitment of local university graduates to help conduct the surveys. Each survey team will consist of a Manila based individual and a native speaker. The staff will explain to local and regional agencies and officials the purpose and timing of the surveys. After having selected the

interviewers, the staff shall instruct them on the basic background needed for each resource and technology area, and the proper techniques for the conduct of the surveys. Two interviewers shall be hired for each sector, with the whole survey-study being undertaken in sequential rather tham simultaneous manner.

In line with the training of qualified interviewers, professionals will be tapped to take charge of technical measurements and observations. This may include economists, foresters, or engineers who would have the capability to observe and relate activities in the various sectors that may be missed using the typical survey/interview technique exclusively.

The training activities of local personnel will be done sequentially just before each survey is conducted.

Phase V - Conduct of Actual Survey and Field Editing (One Year)

In order to facilitate project implementation the different sets of surveys will be conducted sequentially rather than simultaneously. If a certain area has been selected for more than one survey, the surveys will be scheduled so as to minimize transportation costs and hiring and training time.

A minimum of 3 geographical areas for each resource will be selected according to the predominance of a certain biomass resources and other indices mentioned earlier.

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Energy consuming activities in the selected areas will be identified and analyzed as will be existing and potential uses of technologies and resource flows. The procedure will involve random sampling stratified by resources, technologies and geographical areas. Whenever possible, the survey teams will make actual measurements and observations to corroborate respondent statements.

Six surveys will be conducted over a period of one year, one for each sector. Interviews will be scheduled to be compatible with end use patterns throughout the year to identify seasonal and other cyclical variations of resource availability. Field editing of surveys by research associates will be necessary.

During the course of the survey, research associates and local speakers will form teams of two for control purposes as well as to assist interviewers in answering questions which are likely to arise during interviews or observations. The consultant and project director will make site inspections to assess the development of the survey and make changes and modifications as necessary.

Phase VI - Final Editing and Organization of Survey Results (Two Mo.)

Final editing is important in survey research to ensure proper coding and to spot apparent surveyor errors and respondent inconsistencies. This will be done by the research associates in Manila.

Phase VII - Analysis of Data/Survey Results (Two Months)

After the completion of each survey set, computer analysis, and report preparation can be undertaken by the research associates in conjunction with the consultant. Computer processing will be subcontracted to a private firm following the specifications of the research team.

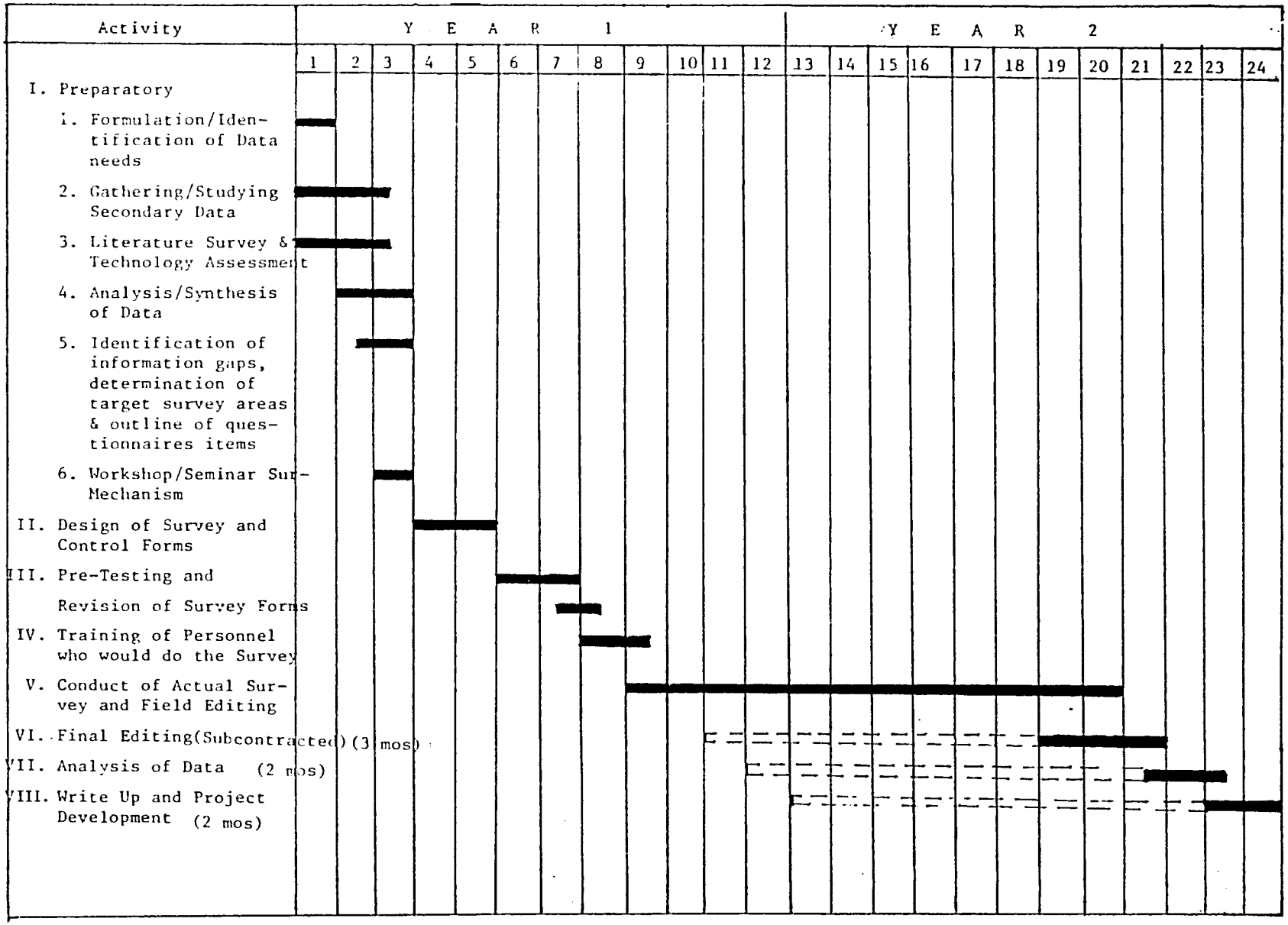
Phase VIII - Write-Up and Project Development (Two Months)

The final report will integrate and compare the analysis of the separate surveys completed in preliminary form during Phase VII. Emphasis will be placed on the development of feasible intervention strategies for specific programs and on appropriate technologies deserving institutional support.

10. SCHEDULE OF ACTIVITIES

(See Gantt Chart)

11. SCHEDULE OF ACTIVITIES



12. FINANCIAL PLAN SUMMARY

	Total Cost	USAID	GOP
I. Personnel Services	₱ 506,640		
II. Equipment and Accessories	10,960		
III. Maintenance and Other Operating Expenses	432,545		
IV. Capital Outlay	-	-	-
V. Special Purposes	835,105		
T O T A L S	₱1,785,250	₱1,152,000	₱ 633,250

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ANNEX I. LINE-ITEM BUDGET

	YEAR I				YEAR II (+ 15% Inflation rate)			
	TOTAL	USAID	GOP BED	GOP ERDC	TOTAL	USAID	GOP BED	GOP ERDC
I. Personnel Cost								
1 Project Leader (2 yrs.) ₱2,000/mo.	₱ 24,000				₱ 27,600			
1 Administrative Assistant (2 yrs.) ₱800/mo.	9,600				11,040			
1 Clerk Typist (2 yrs.) ₱500/mo.	6,000				6,900			
5 Research Associates (2 yrs.) ₱1,700/mo.	102,000				117,300			
5 Research Associates III (for survey design) (2 mos.) ₱1,500/mo.	15,000							
10 Research Assistants III (9 mos.) ₱900/mo.	81,000							
2 Research Assistants III (for survey proper, to act as technical observers - may be 2 from previous Research Assistants III (1 yr.) ₱900/mo.	7,200 (4 mos.)				16,560 (8 mos. + 15%)			
3 Science Aide III (for survey proper, to act as household interviewers - locals) (1 yr.) ₱550/mo.	6,600 (4 mos.)				20,240 (8 mos. + 15%)			

	YEAR I				YEAR II (+ 15% Inflation rate)			
	TOTAL	USAID	GOP BED	GOP ERDC	TOTAL	USAID	GOP BED	GOP ERDC
1 Consultant (2 yrs.) ₱2,000/mo.	₱ 24,000				₱ 27,600			
1 Sociologist (for design of survey forms) (2 mos.) ₱1,000/ mo.	2,000							
1 Expert from Census (for design of survey forms) (2 mos.) ₱1,000/mo.	2,000							
TOTAL PERSONNEL COST	₱ 279,400				₱ 227,240			
II. Equipment and Accessories								
1 Binding Machine	₱ 2,000							
1 Typewriter	5,000							
1 Weighing Scale	3,000							
24 Stanley Meter Tape (₱40 each)	960							
TOTAL EQUIPMENT & ACCESSORIES	₱ 10,960							

	YEAR I				YEAR II (+ 15% Inflation rate)			
	TOTAL	USAID	GOP BED	GOP ERDC	TOTAL	USAID	GOP BED	GOP ERDC
III. Maintenance and Operating Expenses								
Transportation:								
2 Foreign Consultants (Workshop) (roundtrip) ₱24,000 each	₱ 48,000							
5 Local Consultants (Workshop) ₱1,000 each	5,000							
1 Project Leader (on visit to survey sites) ₱1,400 roundtrip x 12 sites; 2 visits	16,800				₱ 19,320			
1 Consultant (on visit to survey sites) ₱1,400 round trip x 12 sites; 2 visits	16,800				19,320			
5 Research Associates III (to survey sites) ₱1,400 round trip x 2 visits x 12 sites	84,000				96,600			
Supplies and Materials	35,000							
Documentation Fee	12,000				14,950			
Communication	10,000				11,500			
Contingencies	25,289				17,966			
TOTAL MAINTENANCE AND OPERATING EXPENSES	₱ 252,889				₱ 179,656			
IV. Capital Outlay					-			

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	YEAR I				YEAR II (+ 15% Inflation rate)			
	TOTAL	USAID	GOP BED	GOP ERDC	TOTAL	USAID	GOP BED	GOP ERDC
V. Special Purposes								
Honorarium:								
2 Foreign Consultants (Workshop) $500/day ; 5 days	₱ 48,000							
5 Local Consultants (Workshop) ₱1,000/day ; 5 days	25,000							
Accomodation, per diem of 2 Foreign consultants (7 days) ₱1,000/day	14,000							
Accomodation, per diem of Project Leader (upon visit to survey sites) 3 days visit at ₱300/day x 1 visit x 12 sites	5,400 (6 sites)				6,210 (6 sites + 15%)			
Accomodation, per diem of Consultant (upon visit to survey site) 3 days visit at ₱300/day x visit x 12 sites	5,400				6,210			
Accomodation, per diem of Research Associates IV (during survey proper/field editing), 5 RA IV/ site, 12 sites, 5 days/visit, 3 visits/site (including training of personnel) ₱300/day	135,000 (6 sites)				155,250 (6 sites)			
Per diem of 5 Research Associate IV (during preparatory phase) ₱35/day x 22 days/mo. x 3 mos.	11,550							

	YEAR I				YEAR II (+ 15% Inflation rate)			
			GOP				GOP	
	TOTAL	USAID	BED	ERDC	TOTAL	USAID	BED	ERDC
Per diem of 5 Research Associates IV during pre-testing including transportation ₱50/day x 22 days/mo. x 2 mos.	₱ 11,000							
Per diem of 10 Research Assistants III (during Preparatory phase) ₱35/day x 22 days/mo. x 3 mos.	23,100							
Per diem of 10 Research Assistants III (during pre-testing) ₱50/day x 22 days/mo. x 2 mos.	22,100							
Transportation and per diem of 3 Science Aide III (interviewers for survey proper) ₱100 x 40/day x 22 days/mo. x 12 mos.	55,440 (6 mos.)				₱ 63,756			
Transportation and per diem of 2 Research Assistants II (Technical Observer for survey proper) ₱100 + ₱40/day x 22 days/mo. x 12 mos.	36,960 (6 mos.)				42,504 (6 mos. + 15%)			
Sub-contracted Organization of Data/Information Base					150,000			
Living Allowance of Clerk Typist (25% of ₱500 for 24 mos.)	1,500				1,725			
Sundries	15,000							
TOTAL, SPECIAL PURPOSES	₱ 409,450				₱ 425,655			
TOTAL PROJECT COST	₱ 952,699				₱ 832,551			
	₱1,785,250							

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ANNEX II

Terms of Reference for Consultancy on the Project

A Consultant's services could be very helpful at the following stages which are tied into the current draft of the proposal:

Phase I - Preparatory

A. Review the reports on 1) utilization of agro-forestry resources and characteristics of the regions and 2) technologies and processes in order to assist in the decision making on the selection of the locations and characteristics of the sample regions.

B. Prepare a paper providing guidelines for the proper conduct of the rural energy survey.

C. Participate in the workshop on survey methods.

D. Provide suggestions on sampling methodology.

Phase II - Design of Survey and Control Forms

A. Assist in the design of the survey instruments.

Phase III - Pre-Testing and Revision of Survey Forms

A. Go on field work, during part of the pre-testing to identify specific problems and opportunities for improvements in the operation of the survey.

B. Assist in post-pretesting revisions of the questionnaires.

Phase IV - Training of Personnel who would Do the Survey

A. Help train the core group in proper survey techniques and caveates in survey implementation.

Phase V - Conduct of Actual Survey and Field Editing

A. Be available for consultation as needed during actual implementation.

Phase VI - Final Editing (Sub-Contracted)

A. Assist in preparation of a plan for the analysis of the data.

Phase VII - Analysis of the Data

A. Assist in preparation of the final report and associated articles for journal publication.

Phase VIII - Write-Up and Project Develcpment

The above schedule is predicated on the availability of a consultant for at least part-time service during the entire operation of the project. If this is not feasible, the minimum recommended operiod of a consultancy should be through phases 1 to 4 , also including phase 6 for the plan for analysis which can also be prepared in the beginning, after completion of the post pre-testing revisions.