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nd quarterly REPORT

SAID - Government of the Philippines Joint Project on Nonconventional Energy Development

BUREAU OF ENERGY DEVELOPMENT
Philippine Ministry of Energy

REPUBLIC OF THE PHILIPPINES
MINISTRY OF ENERGY

BUREAU OF ENERGY DEVELOPMENT

11 June 1979

Dennis P. Barrett
Acting Director
USAID, Philippines
1401 Ramon Magsaysay Center
1680 Roxas Boulevard
Metro Manila

Dear Mr. Barrett:

In accordance with the provisions of our agreement for Nonconventional Energy Development, AID Loan No. 492-W-052, we hereby submit our second Quarterly Project Report covering the period ending March 31, 1979. The report describes various actions taken to provide for administrative and technical management of the overall Project.

We are aware of the unique nature of this Project and are quite optimistic regarding its near and long-term implications for rural development internationally. While the efforts we make here may not produce energy in any nationally significant quantities, inherent in the small-scale energy technologies we shall be demonstrating, are possibilities for improving the quality of life for million's of rural inhabitants here in the Philippines and in other under-developed nations as well.

Sincerely,

Dr. Ernesto N. Terrado
Manager for Nonconventional Resources

Carol Harlow
Carol S. Harlow
Project Coordinator
USAID-GOP Joint Project on Nonconventional Energy

W. R. DE LA PAZ
Acting Director

MERRITT ROAD. FORT BONIFACIO. METRO MANILA. PHILIPPINES
TEL. NO. 85-38-11

USAID-GOP JOINT PROJECT ON NONCONVENTIONAL ENERGY DEVELOPMENT

SECOND QUARTERLY REPORT

for Period Ending

MARCH 31, 1979

Report Prepared by

Carol S. Harlow
Project Coordinator

Rosalinda A. Polido
GOP Project Liaison

AID PROJECT NO. 492-0294

AID LOAN NO. 492-W-052

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SECOND QUARTERLY REPORT
(Ending March 31,1979)

PREFACE

In May of 1978, the Philippines and U.S. governments signed an agreement which provides for $7.1 million in loan and $1.65 million in grant funds for the purpose of determining the technical and economic feasibility of exploiting nonconventional renewable energy resources as an alternative to foreign-procured fossil fuels. The government of the Philippines will be supplying an equivalent of approximately $3 million in counterpart funding.

The program, signed by President Marcos and Vice-President Mondale consists of eight individual demonstration projects designed to utilize renewable energy resources through direct solar conversion, small-scale hydro plants, wind generators and bioconversion. Training of Philippines Ministry of Energy personnel in the U.S., 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 well-established,currently available and appear to have relevance to the rural areas of the Philippines. It is now believed that it will be technically and economically feasible to utilize these technologies for specific small-scale applications in the short term.

In the area of direct solar conversion, three projects will be undertaken:

1. & 2. Solar drying units for grain and lumber

3. Solar powered ice plant for application in remote rural areas to preserve perishable foodstuffs, particularly meat and fish.

The approximate budget for these projects is $1.2 million from the U.S. and ₱3.3 million in Philippine counterpart.

In the second area, small-scale hydro, several mini-hydro units will be installed. Although no specific sites have yet been chosen, approximately $1.3 million from the U.S. and ₱3.2 million in Philippine counterpart has been budgeted for this effort.

The wind research project is focusing on two general areas:

1. Dispersal of wind-driven water pumps for agricultural and domestic use.
2. Demonstration of wind-driven electrical generators for remote rural electrification.

with an approximate budget of $360,000 from the U.S. and ₱872,000 from the Philippine government.

Bioconversion projects include:

1. Construction of a wood-fired ("dendrothermal") power plant fuelled from an energy plantation of "ipil-ipil" Leucana leucocephala, known locally as giant ipil-ipil, or lepili.
2. Construction of a rice-hull fuelled power plant.

These two projects will consume a great portion of the total project budget, approximately $4 million from the U.S. and ₱16 million of the Philippine counterpart. But it is now apparent that both of these technologies have a large near-term national potential for supplanting oil for the purpose of generating electricity.

In the final project area, an Integrated Village Energy System (IVES) project is now being planned to substitute for two other previously planned projects in the application of photovoltaics and small-scale pyrolysis. Since funding commitments for these two projects have been received from the United Nations and the West German government, approximately $400,000 and ₱1.1 million are being budgeted for the IVES Project, in which an integrated renewable energy system will be installed in an existing rural village. Site selection and project design are now underway.

In addition to technology projects, the program also includes:

1. A survey to determine rural energy use patterns and surveys
2. Short and long term training of Ministry of Energy personnel at relevant U.S. training institutions to improve Philippine institutional capability to conduct independent research.
3. A program to inform the public and promote the use of renewable energy.
4. Procurement of equipment to improve the capability of the Philippine Atmospheric, Geophysical and Astronomical Service Administration to monitor solar radiation and wind characteristics.

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

These efforts will cost approximately $1.6 million from the U.S. and ₱3.3 in Philippine counterpart.

The program is expected to be complete by March, 1984.

INTRODUCTION

The first quarterly report was submitted to USAID April 11, 1979. The report summarized the status of all USAID-GOP subprojects as of December 31, 1978.

Activities in the second quarter (January to March, 1979) consisted mainly of negotiations with subproject implementors and completion of subproject proposals. Nine (9) implementors have been identified to handle the various fields of research activity. They are:

1. Solar Refrigeration - Ministry of Natural Resources (MNR)
2. Mini and Micro Hydropower - National Power Corporation (NPC)
3. Solar Dryers - University of the Philippines at Los Baños (UPLB) and Forest Products Research and Industries Developemnt Commission (FORPRIDECOM)
4. Windmill Dispersal - Project Sta. Barbara (PSB) and Farm Systems Development Corporation (FSDC)
5. Waste Fired Thermal Plant - National Grains Authority (NGA)
6. Dendro Thermal Plant - National Power Corporation (NPC)
7. Solar and Wind Energy Mapping - Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)

As of March 31, only MNR (solar refrigeration) has signed a memo of agreement with Bureau of Energy Development (BED) and is currently awaiting for the release of funds. The other implementors are still in the process

of revising their proposals to meet the approval of BED's evaluation panel. BED is also negotiating with these implementors the fraction of funding they will put up for the GOP counterpart. Part of the GOP counterpart will be shouldered by BED from its 1979 Grants-in-aid.

To summarize other major Project events: Mrs. Carol S. Harlow has started working as USAID Project Coordinator as of February 10, 1979. A tentative list of participants for short-term training was drawn up consisting mainly of members of staff from the BED's Nonconventional Energy Resources Division. A group of consultants, Drs. Murphey, Bowersox, Massey, and Blakenhorn submitted a draft of their report on the feasibility of the Dendrothermal Plant.

Details of the activities for each subproject are discussed below.

LOAN ACTIVITIES

1. SOLAR DRYING

Three (3) proposals were submitted to BED. Only two (2) were selected for USAID funding due to failure of Economic Development Foundation (EDF) to meet the necessary USAID-BED requirements. The two (2) implementors for the solar drying subproject are UPLB* which will undertake the construction of four solar dryers for agricultural crops and FORPRIDECOM** which will undertake construction of a lumber dryer.

A. UPLB Solar Dryer Proposal

This proposal which is entitled "Solar Crop Dryers Research and Development Project" will establish a systematic development of solar crop dryers. With Dr. Emerico Mendoza as the Project Director, this project aims to:

(1) develop and test four types of solar crop dryers with agricultural waste as auxiliary fuel. The dryers to be installed are two batch-type ,air-heated ,two ton capacity ; a one-ton capacity ,continuous-type ,air-heated dryer;and a one-ton ,hot-water-heated dryer.

(2) Monitor their performance and reliability in the face of weather differences in different localities, and varying operating characteristics.

The result of this activity is expected to fully assess the actual potentials, to design & develop, and field test solar

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*University of the Philippines at Los Baños
** Forest Products Research and Industries Development Commission

crop dryers, and provide guidelines and recommendations for the future wide-scale use of solar crop dryers. Among the agricultural crops to be studied are peanuts, palay and other grains.

The project will be for a two year period with leadership coming from the Department of Agricultural Process Engineering and Technology, Institute of Agricultural Engineering and Technology, UPLB. Support will be drawn from the other units of the University especially on agro-meteorology, economics and agronomy. Existing facilities of the UPLB expected to be utilized in the project are the Agricultural Process Engineering Laboratories, Agro-Meteorology Station and the Agricultural Resource Center.

Field tests will be carried out in farming areas in the identified provinces. Field based technicians will be hired to take care of the daily monitoring of operation, maintenance and management of the dryers.

Research associates, based at UPLB will be in charge of the coordination of field activities to ensure a synchronized flow of information and materials between the field site and the UPLB. They will also be in charge of planning general field activities as well as evaluating the systems.

Study leaders from the UPLB staff will be appointed to work on specific disciplinary areas needed in establishing important points in the research.

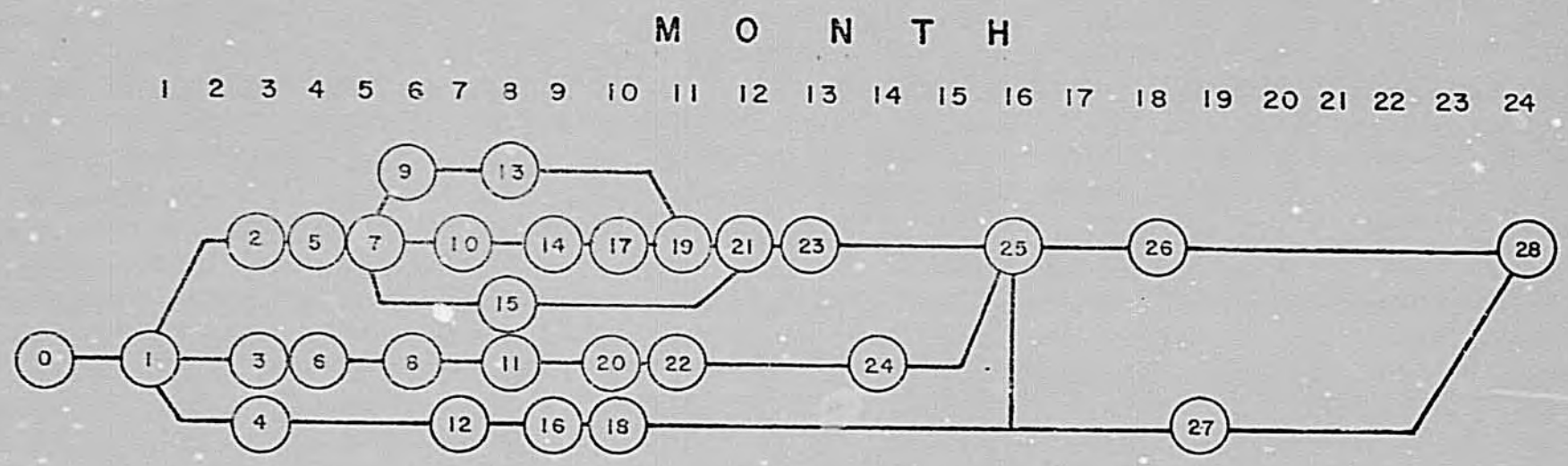
Prototypes of the improved UPLB design of two tons capacity per batch will be erected for evaluation in each of the selected sites. A one ton water heated dryer will be constructed at UPLB for comparative performance tests. These dryers will be equipped with supplemental furnaces.

Fundamental and adaptive research will be carried out at the Agricultural Process Engineering Laboratories.

The total project cost is ₱1,734,696 of which ₱1,283,116 will be funded by USAID loan counterpart. ₱77,400 will be shouldered by BED and the remaining ₱374,180 will be the implementor's counterpart.

A summary of subproject costs and activities is as follows:

SCHEDULE OF ACTIVITIES



*LEGEND:

0 - Project Implementation
1 - Hiring of Personnel
2 - Preparation of Batch Dryer specs and blue prints
3 - Prepare continous flow dryer specs
4 - Compile solar data
5 - Canvass cost of equipment
6 - Canvass continous flow dryer component
7 - Select sites
8 - Purchase continous flow equip't
9 - Hire field technicians
10 - Prepare lease
11 - Construct Continous Flow Dryer
12 - Prepare computer program
13 - Train field techs
14 - Select contractors
15 - Order pyranograph
16 - Test run solar data
17 - Purchase solar equipment
18 - Improve solar data analysis
19 - Construct dryers
20 - Test continous flow dryer
21 - Initial test
22 - Test collector
23 - Field Test I
24 - Design Improvements
25 - Modify/improve dryer
26 - Field Test II
27 - Continue solar data compilation and analysis
28 - Final Report

	LOCAL CURRENCY			
	Total Cost	Funds from USAID Loan	GOP* Counterpart	FX Costs (USAID)
I. Personnel Cost	₱ 418,096	₱ 350,816	₱ 67,280	₱ -
II. Equipment/Furniture/ Facility	922,100	486,700	339,900	95,500
III. Maintenance & Operating Expenses	350,100	350,100	-	-
IV. Special Purposes	44,400	-	44,400	-
TOTAL	₱1,734,696	₱1,187,616	₱451,580	₱ 95,500

*From BED and UPLB Sources

Line-Item Budget

Cost Components		LOCAL CURRENCY		
	USAID	B E D	UPLB	FX (USAID)
I. Personnel Cost				
a) Local Consultancy	₱ 185,616	₱ 18,000	₱ -	₱ -
b) Contractual Wages (labor for installation, construction, etc.)	165,200	15,000	34,280	-
TOTAL	₱ 350,816	₱ 33,000	₱ 34,280	₱ -
II. Equipment/Furniture/ Facility				
a) Pyranograph - 3 units				₱ 24,000
b) Trailer				8,000
c) Solar Dryer Components (4 dryers)	₱ 486,700			-
d) Potentiometer (1 unit)				50,000
e) 24 units dial thermometer, ₱250/ea.				6,000
f) 3 units "Low Moisture meter, ₱2,500/pc				7,500
g) Research Shop Facility and Equipment			₱ 50,000	
h) Research Laboratory Equipment			122,400	
i) Vehicles			40,000	
j) Office Equipment			7,500	
k) Office Space			120,000	
TOTAL	₱ 486,700	₱ -	₱339,900	₱ 95,500

	USAID	B E D	UPLB	FX (USAID)
III. Maintenance and Operating Expenses				
a. Supplies & Materials	₱ 156,200			
b. Travel	58,000			
c. Vehicle Rent	30,000			
d. Repair of Dryer Components	22,000			
e. Repair of Equipment	6,000			
f. Lube & Gasoline for dryer operation & maintenance	30,000			
g. Materials for construction of solar dryer test area	47,900			
TOTAL	₱ 350,100			
IV. Special Purposes				
a. Documentation		₱ 14,400		
b. Contingencies		30,000		
TOTAL		₱ 44,400		
GRAND TOTAL	₱1,187,616	₱ 77,400	₱ 374,130	₱ 95,500

Breakdown of Funds: 2 Years Duration

A. Travel

1) 58 trips to field for site identification, installation supervision, and field adaptability tests of dryers at 1,000/trip, a maximum of 3 persons per trip and 5-6 days per trip ₱ 52,000

- 1,500/trip includes vehicle oil fuel and maintenance
- 10 trips for site indentification & hiring of field technicians
- trips to prepare contract of lease for each site
- 6 trips for field technicians to UPLB for 3 days training and orientation
- 10 trips for dryer installation
- 20 trips for dry run and adaptability test of dryer
- 6 trips to field sites for final evaluation

2) Trips to Manila 6,000

₱ 58,000

B. Supplies and Materials

1) Samples ₱50/cavan at 40 cavans/run 12 runs/site - (other samples to come from clientele) ₱ 144,000

2) Office supplies 12,200

₱ 156,200

C. Contingencies

1) Land Lease for sites ₱ 6,000

2) Communication 8,000

3) Data processing 7,000

4) Miscellaneous 7,000

₱ 30,000

B. FORPRIDECOM* Lumber Drying Proposal

The other solar drying subproject that has been approved by BED is entitled "Design, Construction, and Evaluation of a Solar Lumber Dryer with Auxiliary Heating". The implementing agency is FORPRIDECOM with Engr. Ricardo Casin as Project Director. The total project cost is ₱359,269, with USAID funding of ₱220,652 and implementor's counterpart of ₱103,477. BED counterpart will be ₱35,140.

The objectives of this project are: (1) To design and construct a solar lumber drying kiln with supplementary heating from a biomass-fired furnace for the wood-using industries; (2)Conduct performance tests in drying lumber compared to conventional drying methods such as kiln drying in a steam-heated kiln and ordinary air-drying; (3) Demonstrate its adaptability for drying lumber; and (4) Prepare operation manual as a guide to prospective users.

An external solar heater or furnace will be designed and constructed estimated to supply the required heat energy for drying 2,000 bd.ft. of 1-inch lumber for about 25 days. The solar furnace which is the core of the lumber dryer will be provided with rockpile thermal storage to store heat which can be used during overnight drying and/or days with low-light intensity. The kiln proper will be a separate unit from

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*FOREST PRODUCTS RESEARCH AND INDUSTRIES DEVELOPMENT COMMISSION

the heat collector and storage. The 2,000 bd.ft. capacity kiln is envisioned to meet the lumber drying requirements of the average small rural entrepreneur.

In order to have a continuity in output of dried lumber during prolonged rain, an indirect source of of heating will be an added feature in the design. A wood-waste fired furnace will be constructed outside the kiln proper and the heat generated from the furnace will be made to pass through a fluepipe. The flue-pipe will consist of a number of bends located along the length of the kiln beside the lumber stack, and the hot gases will be exhausted through a chimney outside the kiln.

Furnace-type kilns are already utilized by a number of small wood-using industries but are of poor design and of questionable performance. A majority of them are fired with wood wastes but with no proper control of drying temperature or humidity.

FORPRIDECOM has designed and constructed a furnace-type kiln which is undergoing performance tests. Preliminary results done on 1-inch and 2-inch tangile indicated comparative drying rates and quality compared to conventional steam-heated kilns.

The results of this study are expected to benefit wood-using industries in rural areas where proper wood drying facilities are non-existent. Thus, desirability of designing, constructing, and demonstrating a suitable lumber dryer to meet the needs of the small manufacturers in the wood industry is evident. The results of this study could help in developing the growth of Philippine wood-using industries in rural areas, by upgrading the quality of finished products.

Various tests shall be performed. Among them are:

1. Solar-heated kiln drying studies -

Tentative species considered are tangile and narra of 1- and 2-inch thicknesses. Ten sample boards 24-inches long will be prepared from each species following standard procedures in the preparation of kiln drying sample boards.

Periodic weighing and inspection will be conducted during the kiln runs until the minimum moisture content of 10-12% is attained.

1. Air drying studies -

To gather comparative data of drying tangile and narra by ordinary air drying and that of the solar lumber kiln, end matched samples will be prepared and exposed outside near the vicinity of the solar kiln. These will be similarly weighed and inspected periodically.

3. Kiln drying studies -

Results of FORPRIDECOM studies in kiln drying these species using steam-heated kiln will also be utilized in the evaluation process.

Data to be collected are:

1) Inside the heat collector

a. Intensity of heat in the collector system measured at certain points by thermocouples, compared to outside air temperature for a 24-hr period during the test run.

b. Temperature of the air in the thermal rockpile storage at various points for a 24-hour period.

2) Inside the lumber dry kiln

a. Temperature of air entering and leaving the kiln through the ducting system from and to the heat collector.

b. Dry and wet bulb temperature of the drying medium at the air entry side of the lumber stack for the duration of the test.

c. Average air velocity through the lumber layers measured by a velometer at the air exit side of the lumber stack. This will be recorded before the kiln drying phase is started.

3) Outside conditions

A recording thermo-hygrograph will record the outside temperature and relative humidity existing at the test site for a 24-hour period for the duration of the tests.

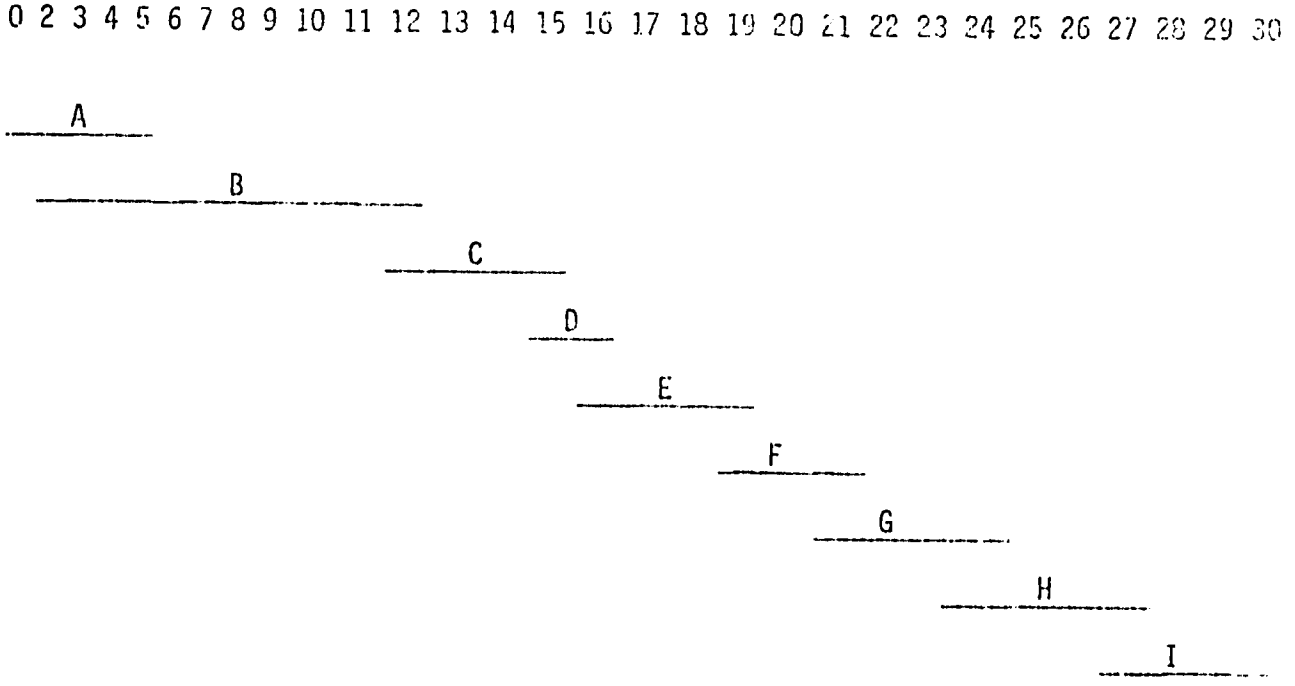
4) Drying rate

The drying rates and quality of end-matched samples exposed outside and inside the kiln will be compared for the different exposure periods.

WORK PLAN

SCHEDULE OF ACTIVITIES

Number of Months



PHASE	DESCRIPTION OF ACTIVITIES	NO. OF MONTHS
A	Design of heat collector/storage, furnace and flue-pipe, lumber dry	5
	Kiln structure, and ducting system	
B	Procurement of supplies, materials, equipment and construction; and preliminary tests	10
C	First Exposure Period	3
D	Evaluation of Performance data	1
E	Second Exposure Period	3
F	Evaluation of Performance Data	2
G	Third Exposure Period	3
H	Evaluation and compilation, and	3
	Analysis of all data	
I	Report Writing	3
	TOTAL	30

Breakdown of project cost is discussed below:

Financial Plan Summary

		LOCAL CURRENCY		
	Total Cost	Funds from GOP* USAID Loan	Counterpart	FX Costs USAID
I. Personnel Cost	₱ 117,467	₱ 86,700	₱ 30,767	₱ -
II. Equipment & Accessories	122,200	23,200	64,000	35,000
III. Maintenance & Operating Expenses	119,602	67,452	43,850	8,300
TOTAL	₱ 359,269	₱ 177,352	₱ 138,617	₱ 43,300

*From BED and FORPRIDECOM Sources

Line-Item Budget

Cost Components	USAID	LOCAL CURRENCY B E D	FORPRIDECOM	FX (USAID)
I. Personnel Cost Local Consultancy	₱ 86,700	₱ -	₱ 30,767	₱ -
II. Equipment & Accessories				
a) Multiprint,capacilog electric strip recorder (1 unit) .	-	-	-	35,000
b) Vane-axial fan (3 units)	7,500	-	-	-
c) Humidifier (1 unit)	6,750	-	-	-
d) Centrifugal blower (1 unit)	2,000	-	-	-
e) Motor damper (2 units)	2,800	-	-	-
f) Humidistat (1 unit)	2,200	-	-	-
g) Heavy duty power rheostat relay	750	-	-	-
h) Electrical acces-sories	1,200	-	-	-
i) Research Equipment Facility	-	-	48,000	-
j) Office/Drafting Equipment	-	-	16,000	-
TOTAL	₱ 23,200	₱ -	₱ 64,000	₱ 35,000

	USAID	B E D	FORPRIDECOM	FX (USAID)
III. Maintenance & Operating Expenses				
a) Travel	₱ 28,660	₱ -	₱ 4,200	₱ -
b) Components/ Supplies for				
1. Heat Collector and Storage	10,615	-	-	8,300
2. Supplementary Heater	10,750	-	-	-
3. Ducting System	3,810	-	-	-
4. Kiln Proper	12,417	-	-	-
5. Photographic & Printing Supplies	1,200	1,400	-	-
6. Office Supplies	-	-	1,000	-
c) Miscellaneous Expenses (includes labor, communication, contingencies, etc.)	-	33,740	3,510	-
TOTAL	₱ 67,452	₱ 35,140	₱ 8,710	₱ 8,300
GRAND TOTAL	₱177,352	₱ 35,140	₱ 103,477	₱ 43,300

Since approximately ₱2,800,000 will still be available from the USAID Solar Dryer Subproject fund allocation, other Solar Drying proposals are to be considered for evaluation by BED for possible future funding.

2. SOLAR REFRIGERATION

The Memo of Agreement between the Ministry of Natural Resources and the Ministry of Energy for the Solar Refrigeration Subproject was signed on January 5, 1979 by Minister Jose Leido and Minister Geronimo Z. Velasco. The total cost of the project will amount to ₱3,723,150 with USAID funding of ₱2,800,650 and implementor's counterpart of ₱922,500.00. The estimated Foreign Exchange component is $ 81,369.86 for concentrating solar collectors to be purchased from the U.S. under a USAID Letter of Commitment/Letter of Credit Arrangement.

The project proposal, memo of agreement, and disbursement schedule were forwarded to USAID for the first release of funds amounting to ₱796,650. Specifications of equipment to be purchased are currently being prepared for the procurement of U.S. - manufactured equipment.

The project calls for the establishment of a 2.3 ton solar-powered ice plant in Navotas, Rizal where fishing is the main commercial activity. Feasibility studies and engineering design for the solar ice plant have been conducted by the Center for Development Studies Inc. Project research will be directed toward gathering of data needed to establish the engineering and economic viability of such system for food preservation in the rural areas. Project duration will be 18 months.

The proposed solar-assisted ice plant is designed to produce 2.3 tons of ice daily over an eight hour period. It will operate on an aqua ammonia absorption system. The complete system will consist of the solar collector loop, the ammonia absorption loop and the ice maker loop. This is shown schematically in Fig. 1.

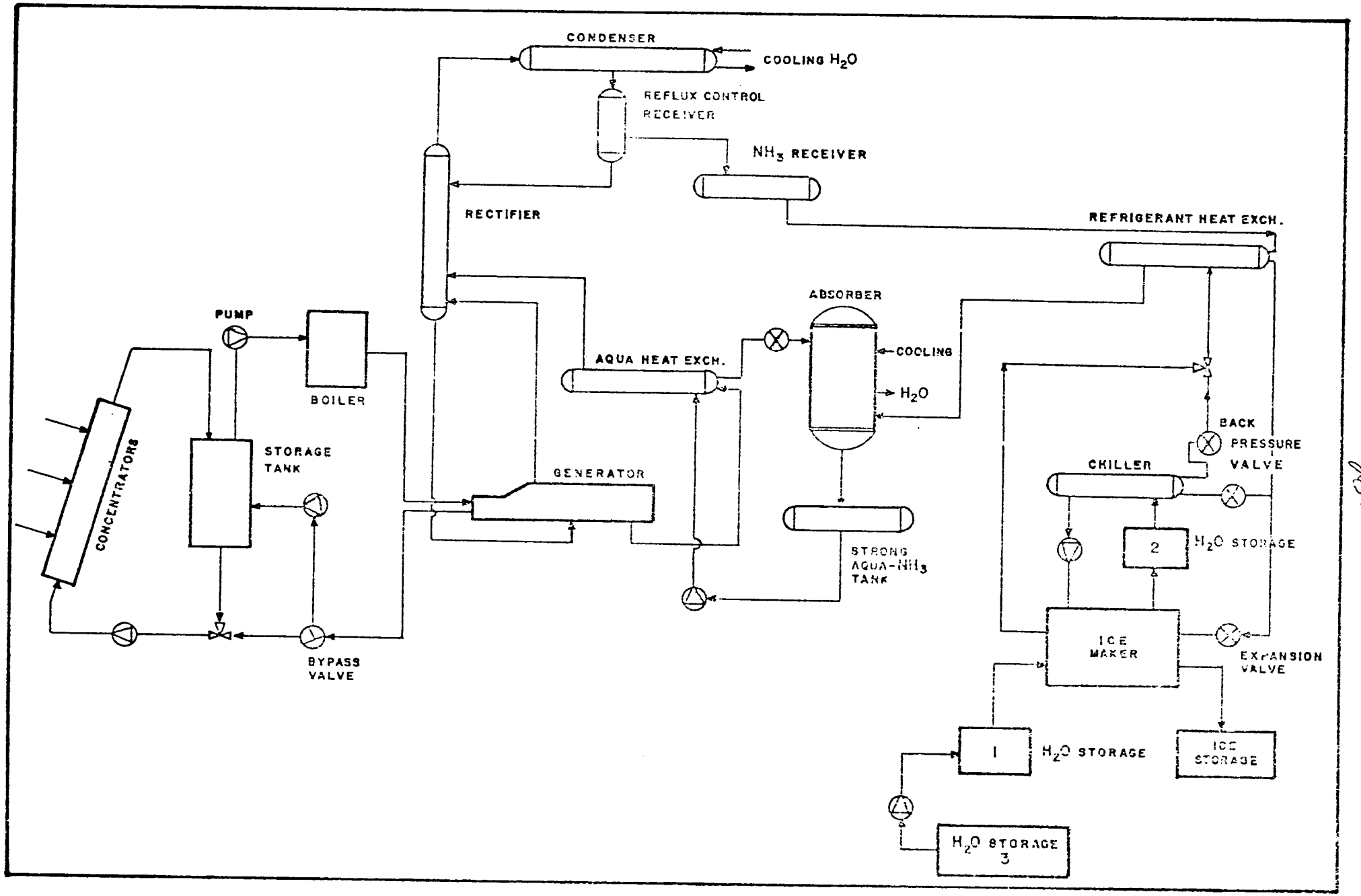


FIG. 1 SCHEMATIC DIAGRAM OF A SOLAR ABSORPTION REFRIGERATION SYSTEM

Solar Collector Loop. The solar collector system was designed with two primary considerations in mind: to provide a system to efficiently utilize the available solar energy for the ice making process and to accomplish this goal using the simplest system available.

The design of the solar power unit consists of parabolic concentrators, a pressurized heat storage tank and an auxiliary hot water boiler. The parabolic reflectors will be controlled by a sun-sensor-driving unit, thereby allowing the array of concentrators to follow the sun during the day. Solar radiation will be concentrated on an absorber system thus providing high temperatures efficiently.

When there is sufficient solar radiation to produce a positive useful energy gain in the system, a constant flow will be initiated through the absorber system of the concentrators. The collected solar energy will then be transferred to the refrigeration system through the hot water storage. The return stream from the refrigeration system will combine with the stream coming from the bottom of the storage tank and together, they will be pumped back to the solar concentrators. This mode of operation will maximize the utilization of solar energy since the resulting stream will be essentially at the lowest temperature within the system.

During periods when there is insufficient solar energy collection, the solar concentrators will be completely bypassed. Flow will be diverted to the energy storage tank fron which hot water is withdrawn.

An auxiliary diesel-fuelled hot water boiler will be used to boost the temperature of the water to the designed level whenever necessary.

The solar collector system will be coupled to a continuous aqua

ammonia absorption refrigeration system through the generator.

Ammonia Absorption Loop. The primary feed to the generator will consist of the bottom stream of the rectification column. This will be heated by the hot water from the solar collector system, causing a part of the ammonia within the aqua solution to be vaporized. This vapor will flow to the rectification column, entering below the bottom plate.

The rectification column will utilize bubble caps to rectify the ammonia, that is, to strip it of all its water vapor. Enough strong aqua will be fed into the column at a predetermined feed plate. Pure anhydrous ammonia will be fed to the top plate from the reflux control received at a controlled rate. This rectification will provide pure ammonia vapor to the condenser.

The ammonia condenser will condense the vapors from the rectification column using primary water from the cooling tower. The ammonia will flow from the reflux control receiver into the ammonia receiver which will be sized to provide storage for ammonia volume variations caused by load changes in the system. The liquid ammonia will then go to a refrigerant heat exchanger where it is cooled by the ammonia vapors from the ice maker system. This will increase the refrigerating capacity of each pound of refrigerant. The ammonia gas which will be heated as it passes through the refrigerant heat exchanger will flow directly to the absorber where it will be absorbed by the weak aqua which has been previously cooled in the aqua heat exchanger. When the weak aqua and the anhydrous ammonia gas combine, heat is generated. This heat of absorption will be removed using primary water from the cooling tower. The strong aqua from the absorber will flow through a strong aqua tank to the aqua

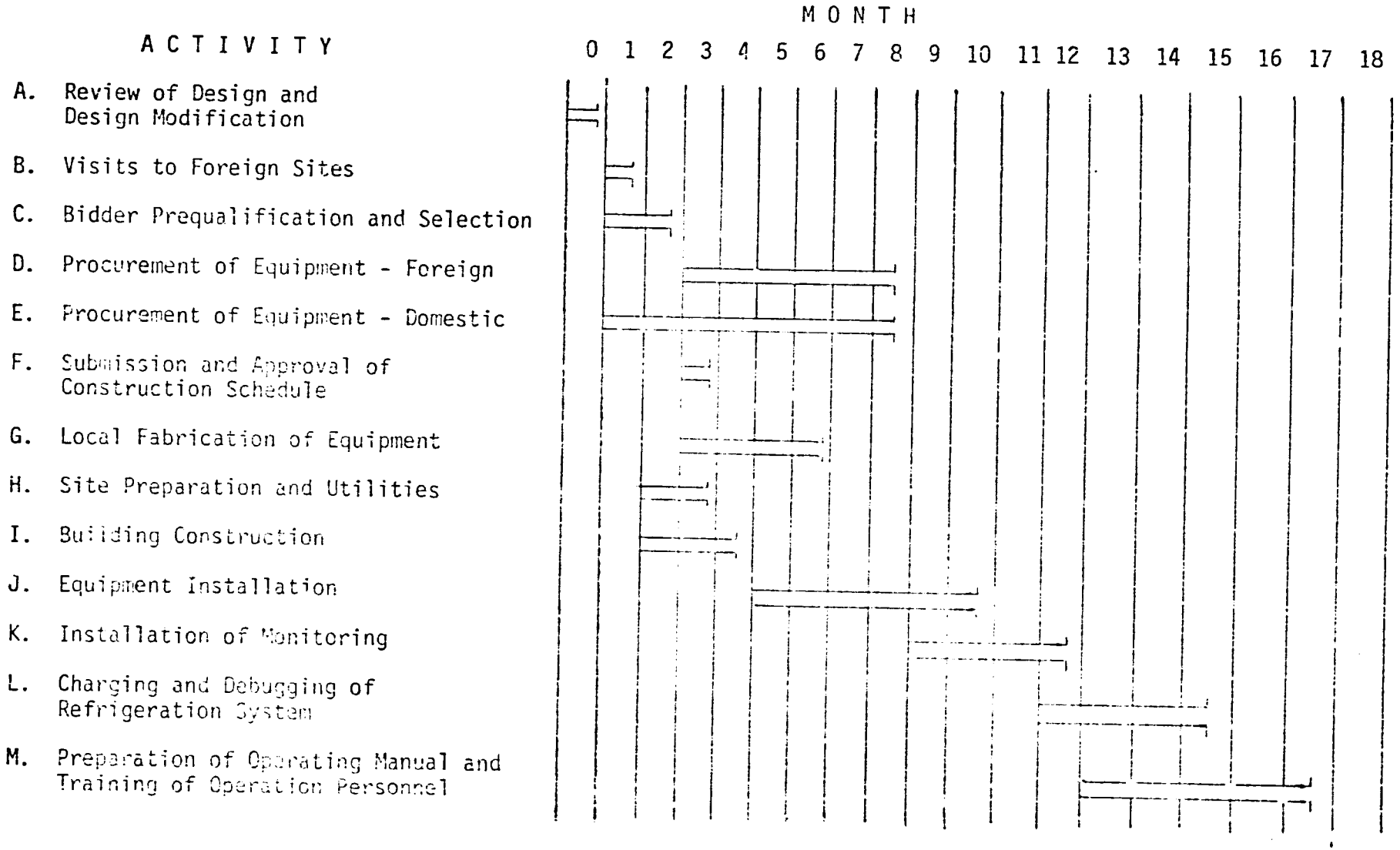
heat exchanger where it will be used as an exchange medium with the weak aqua taken from the low end of the generator. In the process, the strong aqua going to the rectification column will be heated and the weak aqua going to the absorber cooled. This will improve the efficiency of the system and reduce the cooling water requirements of the absorber.

Ice Maker Loop. This system will consist of a plate ice maker, a water chiller and water storage tanks. Liquid ammonia from the refrigerant heat exchanger will go to the water chiller and the evaporator of the ice maker. The chilled water from the chiller will be fed to the ice maker for the ice freezing cycle. The water will be spread on the freezing plates by a circulating pump and by gravity flow. When the desired ice thickness is achieved, the pump will be shut off and the ice harvested.

Fresh water from water storage 1 will be sprayed on the back of the plates to release the ice which will fall by gravity into a breaker bin. The prechilled harvest water will then be diverted to water storage 2 which will supply water to the chiller for another freezing cycle.

Water storage 3 with a two-day capacity is installed to supply the fresh water for ice freezing and harvesting.

SCHEDULE OF ACTIVITIES



Line-Item Budget of the project is given below:

Financial Plan Summary

	TOTAL COST	LOCAL CURRENCY Funds from USAID Loan	LOCAL CURRENCY GOP* Counterpart	FX Costs (USAID)
I. Consulting Service	₱ 120,000	₱ 99,900	₱ 20,100	₱ -
II. Equipment and Accessories	2,110,250	1,516,250	-	594,000
III. Maintenance and Operating Expenses	490,500	490,500	-	-
IV. Capital Outlay	530,000	100,000	430,000	-
V. Special Purposes	472,000	-	472,000	-
TOTAL	₱ 3,723,150	₱2,206,650	₱ 922,500	₱ 594,000

*From MNR Sources

Line-Item Budget

Cost Components	LOCAL CURRENCY		
	USAID	GOP	FX (USAID)
I. Personnel Cost			
Consultancy Services	₱ 99,900	₱ 20,100	₱ -
II. Equipment & Accessories			
Equipment (Collector & Absorption Loop)	₱1,319,000		519,000
Instrumentation & Controls	25,000		75,000
Piping & Insulation	172,250		-
TOTAL	₱1,616,150	₱ 20,100	₱ 594,000
III. Maintenance & Operating Expenses			
Installation (labor, frames, support material cost)	₱ 336,500	₱ -	₱ -
Transportation cost	54,000		
Supplies & Materials	100,000		
TOTAL	₱ 490,500	₱ -	₱ -
IV. Capital Outlay			
Site Development Building	₱	₱ 80,000	₱ -
Building	100,000	350,000	-
TOTAL	₱ 100,000	₱ 430,000	₱ -

	USAID	GOP	FX (USAID)
V. Special Purposes			
Honoraria/Salaries of Personnel	₱ -	₱ 317,400	₱ -
Design, Fabrication and Field Engineering	-	75,000	-
Equipment rental and cost of services for installing	-	60,000	-
Documentation	-	20,000	-
TOTAL	₱ -	₱ 472,400	₱ -
PROJECT COST TOTAL	₱2,206,650	₱ 922,000	₱ 594,000

3. WASTE FIRED THERMAL POWER PLANT

Negotiations with the National Grains Authority (NGA) have been completed and subproject proposal has been finalized. The project involves the establishment of a 300-kw output thermal power plant fueled with rice hulls. This power plant will be established at NGA's Grain Center to provide power for rice mills, driers, and other facilities as well as for lighting and other needs in the grain complex.

Total cost of the project is ₱2,960,226.00 with USAID funding at ₱1,550,000 and implementor's counterpart at ₱1,410,226. Duration of the project is 18 months. Principal investigators of this project are Mr. Francisco Tua, Maximo Ramos and Mauricio Valdez of NGA.

Hulls are the largest milling by-product of rice, constituting 20% by weight of palay. They are generally considered a worthless waste by-product from rice milling and are currently posing serious disposal problems. With the current annual palay production of 128.6M cavans, rice hull production would amount to 1,286 M kilograms, enough to generate power for rice mills, driers and other facilities inside grains processing complexes.

The project when operational will generate energy while providing a means of rice hull disposal and providing a National model for commercial application of rice hulls as source of energy. Compared with the same output rating of a diesel-power plant, an annual fuel saving of about ₱100,000.00 will be realized from the project.

In 1944, it was reported in the USA that the heating value of

rice hulls is 13,802 BTU/kg. of material. The Asian Productivity Organization (APO) also reported that the heating value of rice hulls is from 11,000 to 13,200 BTU/kg. The International Rice Research Institute (IRRI) test result likewise showed that it is about 11,000 to 13,000 BTU/kg. Henceforth an average heat value of 6,000 BTU/lb (13,200 BTU/kg.) can be used for the estimate of power plant size. The heat value of rice hulls is equal to about 1/3 of the heat value of diesel oil on an equivalent weight basis.

At present, a typical Grain Center of the NGA consists basically of a warehouse, a mechanical drier and a rice mill. Other equipment may be added in the Grains Centers as the need arises in support of the operations of the NGA.

Distribution of loads for the proposed 300-KW rice hull thermal power plant will be as follows:

Lighting & household	-	10%
Mechanical drier	-	40%
Rice mill	-	40%
Other equipment	-	10%

Experiments reveal that the limited fuel heat available from rice hulls can be utilized if a steam engine supplying dry and saturated steam is used to generate mechanical power. On the other hand a steam turbine will require 33% more steam. Hence, the steam engine is more economical than the steam turbine.

From the economic study conducted by NGA the project emerges to be economically sound as reflected by several principal indicators. (see attached investment appraisal).

a. The economic cost is ₱2.26 million for acquisition and installation of equipment.

b. The return on investment (ROI) achieved is 34.23% which is above the viability threshold and is considered acceptable.

c. The payback period is 2.92 years which is generally good considering the average economic life of the equipment of 15 years.

d. The benefit-cost ratio is 2.5.

e. The break-even volume (in terms of kw-hrs production) is 4,204,800 which could be achieved in 3 years time.

f. Starting with fourth year, the project will start to earn an annual net income of ₱774,632.50.

The project is divided into three phases, Phase I will involve surveying and design; Phase II Equipment Procurement and Installation; and Phase III - Evaluation.

a. Phase I - Survey and Design

A survey will be made of engineering and economic studies of existing working systems of power plants utilizing rice hulls and other agricultural wastes. The technical data gathered during the survey will be evaluated and a system design drawn up.

b. Phase II - Equipment Procurement and Installation

Based on the design, materials and equipment will be selected and purchased. The selected materials and equipment will be installed after which a test run will be undertaken.

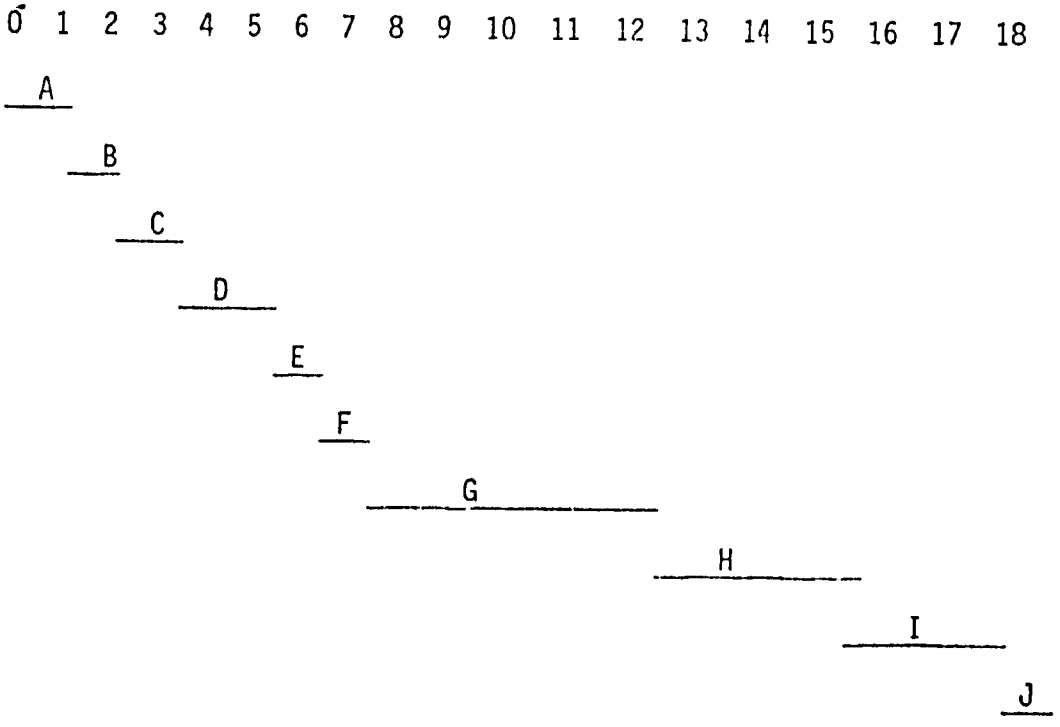
c. Phase III - Evaluation

The project will be operated and evaluated. Performance of individual components will be analyzed and reviewed. Results of the project evaluation will be reported in writing at the end of the evaluation period.

WORK PLAN

SCHEDULE OF ACTIVITIES

Number of Months



PHASE	DESCRIPTION OF ACTIVITIES	NO. OF MONTHS
A	Survey of engineering and economic studies on existing working system utilizing rice hulls as source of thermal power	1
B	Evaluation of technical data gathered from different working thermal plants	1
C	Selection of equipment and machineries	1
D	Purchase of equipment and machineries	2
E	Installation of equipment and machineries	1
F	Test Run	1
G	Operation of Project	5
H	Analysis of Performance	3
I	Review and Evaluate Project	2
J	Report Writing	1
	TOTAL	18

Costings for the project is discussed below:

Financial Plan Summary

	TOTAL COST	Requested By B E D	Proponent Counterpart
I. Personnel Services	₱ 132,539.40	₱ _	₱ 132,539.40
II. Maintenance and Other Operating Expenses	100,000.00	-	100,000.00
III. Capital Outlay	2,612,500.00	1,987,500	625,000.00
TOTAL	₱ 2,845,039.40	₱1,987,500	₱ 857,539.40

Line-Item Budget

	TOTAL COST	Requested from B E D	Proponents In-Cash	Counterpart In-Kind
I. Personnel Cost				
1 Project Director 1/	₱ 6,184.80	₱ -	₱ 6,184.80	₱ -
1 Project Leader 1/	5,072.40	-	5,072.40	-
1 Asst. Project Leader 2/	11,302.20	-	11,302.20	-
2 Mechanical Engrs.	36,000.00	-	36,000.00	-
1 Draftsman	11,880.00	-	11,880.00	-
1 Mason/Carpenter	10,800.00	-	10,800.00	-
1 Welder/Machinist	10,800.00	-	10,800.00	-
5 Laborers	40,500.00	-	40,500.00	-
Sub-Total	₱ 132,539.40	₱ -	₱ 132,539.40	₱ -
II. Maintenance and other Operating Expenses				
Supplies	₱ 20,000.00	₱ -	₱ 20,000.00	₱ -
Traveling	70,000.00	-	70,000.00	-
Sundry	20,000.00	-	20,000.00	-
Sub-Total	₱ 100,000.00	₱ -	₱ 100,000.00	₱ -
III. Capital Outlay				
Land	₱ 200,000.00	₱ -	₱ -	₱200,000.00
Building	300,000.00	-	-	300,000.00
Boiler & Furnace 5/	825,000.00	825,000	-	-
Demineralizer 5/	200,000.00	200,000	-	-
Feedwater Heater and Pump5/	100,000.00	100,000	-	-
Steam Engine 5/	500,000.00	500,000	-	-
Alternator 5/	100,000.00	100,000	-	-
Control Switch & Panel Board 5/	50,000.00	50,000	-	-
Transmission Line	25,000.00	25,000	-	-
Water tank & pipe	75,000.00	-	50,000.00	75,000.00
Special tools and equipment	50,000.00	-	50,000.00	-
Installation cost	187,500.00	187,500	-	-
Sub-Total	₱2,637,500.00	₱1,987,500	₱ 50,000.00	₱575,000.00
GRAND TOTAL	₱2,845,039.40	₱1,987,500	₱ 282,539.40	₱575,000.00

Line-Item Budget continuation....

1/ 10% of time alloted to the project

2/ 30% of time alloted to the project

3/ Existing

4/ To be constructed for the project

5/ To be imported for the project

300 KW RICE HULL THERMAL POWER PLANT
(INVESTMENT APPRAISAL)

I. Capital Investment		
1. Boiler & Combustion Furnace		₱ 825,000
2. Demineralizer		200,000
3. Feedwater Heater & Pump		100,000
4. Steam Engine		500,000
5. A. C. Generator		100,000
6. Control Switch & Panel Board		50,000
7. Transmission Line		25,000
8. Water Tank and Pipe		75,000
9. Building		200,000
		₱2,075,000
II. Installation Cost (10% of Equipment cost)		187,500
III. Total Project Cost		2,262,500
IV. Annual Income and Expenses		
Gross Sales 1/		1,296,000
Less: Operating Cost and Expenses		
Fixed:		
Depreciation 2/	₱125,250	
Repair & Investment 3/	41,500	
Interest 4/	249,000	
Insurance 5/	33,937	
Salaries and Wages 6/	49,344	
Variable:		
Labor 7/	12,336	
Fuel Oil & Lubricant 8/	10,000	
Total Operating Cost and Expenses		521,367.50
NET INCOME		₱ 774,632.50

V. Financial Viability Indicators

a.	Cost of Production per kw-hrs 9/	- ₱0.40/kw-hr
b.	Return on Investment 10/	- 34.23%
c.	Payback Period 11/	- 2.92 years
d.	Benefit Cost Ratio 12/	- 2.483
e.	Break-even volume 13/	- 4,204,800 kw-hr
f.	Break-even sales 14/	- ₱3,784,120

.....

Notes and Assumptions:

1 / Sales is assumed at ₱0.90 per kw-hr. operating at 16 hours per day and 300 days a year.

2 / Depreciation of the total equipment using the straight line method.

3 / Repairs and Maintenance assumed at 2%.

4 / Interest on capital is at 12%.

5 / Insurance charges is at 1.5%.

6 / Salaries and wages on Fixed cost is placed at 80% of total manpower.

7 / Labor is placed at 20% of total manpower.

8 / Fuel oil and lubricant is assumed at this value.

9 / Cost of production computed by total annual operating.

10/ ROI is computed by dividing the net income by the total capital investment.

11/ Payback period is the reciprocal of ROI value.

12/ Benefit cost ratio computed by the present cost method.

13/ Break-even volume is computed by the payback multiplied by the annual power output.

14/ Break-even sales computed at ₱0.90 per kw.hr.

4. WINDMILL DISPERSAL AND TEST PROGRAM

Two implementors, Farm Systems Development Corporation and Project Sta. Barbara will work together on this subproject. To date, both agencies have agreed on the amount each will contribute as a counterpart fund. A financial plan and drafts of memo of agreement have been prepared and submitted to the proponents for comments. PSB will handle the technical aspect of the project while FSDC will be in charge of the community dispersal component.

Total cost of the project will amount to ₱2,912,369 with USAID Financing ₱2,002,969. BED will finance ₱39,200 and the proponent will contribute ₱870,200 (₱410,500 by PSB and ₱459,700 by FSDC). The project director is Maj. Eliseo Rio, Jr. who has proven expertise in the field.

For the 30-month project duration, the following accomplishments are planned:

a) gather data to gauge the socio-economic impact of the use of windmills for local applications.

b) pinpoint the best designs and types of windmills for local utilization, the different applications of which can be profitably realized with windmills, either as the primary or secondary source of power, and the sites in the Philippines that are adaptable to wind energy utilization.

This will be done by dispersing a number of windmills to different parts of the Philippines, 20 units for water supply or irrigation and 6 to 12 units for rural lighting, communication and cottage industries.

The operation of the windmills will be monitored to gather data as to their performance, ease of maintenance, effectiveness, etc.

The project will proceed from a) Data Gathering b) Determination of Windmill Specifications and Acquisition c) Determination of Specific Sites d) Construction/Installation of Selected Windmills e) Performance Monitoring and f) Evaluation.

PROJECT STA. BARBARA will:

a) Conduct a survey of locally available windmills as well as imported windmills for possible utilization under the program.

b) Determine, in coordination with FSDC, the different types for installation in the prospective sites identified by FSDC.

c) Determine, from the list of possible sites submitted by FSDC, the specific sites to be included in the Windmill Dispersal Program.

d) Provide FSDC with the pertinent technical data needed in the identification of sites for windmill installations.

e) Conduct studies and tests on other windmill types which may be developed for installation under the Windmill

Dispersal Program, giving priority to locally invented/ designed windmills.

f) Construct and/or procure windmills selected for site installation.

g) Produce a manual for installation, operation and maintenance of windmills, which could be used by FSDC in windmill installation, as well as by the subsequent users of the equipment.

h) Transport the required equipment and other materials to the different sites included in the Windmill Dispersal Program.

i) Provide technical assistance in structural design, installation of equipment and training of Windmill operators, all activities which are the major responsibility of FSDC.

FARM SYSTEM DEVELOPMENT CORPORATION will:

a) Determine areas suitable for Windmill installations.

b) Coordinate with different government agencies involved in monitoring wind data, as well as with its own Field Offices, in the identification of possible sites for windmill installations.

c) Determine the distribution of windmills for dispersal, according to location and specific site use, upon consultation with the principal implementor.

d) Draw up, in coordination with PSB, a dispersal program, enumerating the specific sites wherein windmills will be installed, the schedules for such activity, and the program's resource requirements.

e) Be responsible for installation and operation of Windmills in the identified areas as specified in the Work Program agreed upon by both PSB and FSDC.

f) Be responsible for training of windmill recipients on the operation and maintenance of installed equipment in their respective areas.

g) Implement the previously determined schemes for evaluation of program impact on beneficiaries.

h) Submit recommendations and findings from the evaluation to PSB for notation/addition and submission to BED and USAID.

i) Be responsible for data gathering with regards to a Market Feasibility Study to be undertaken by an Inter-Agency Committee.

BOTH shall:

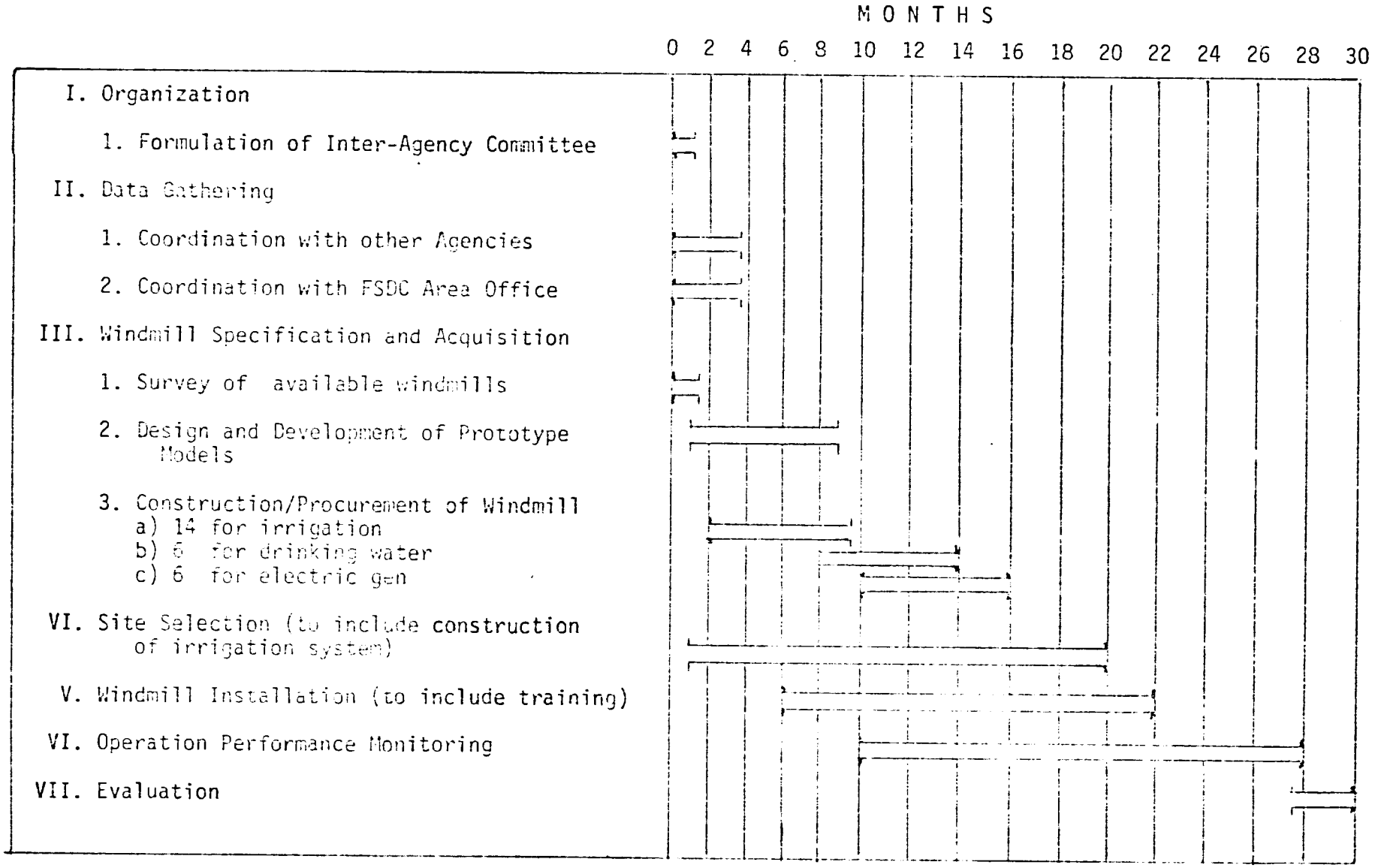
a) Create an Inter-Agency Committee to be chaired by the Project Director, PSB, for purposes of program management, coordination, evaluation, and documentation.

b) Prepare quarterly technical report on the progress of the program.

c) Prepare monthly financial reports.

d) Prepare a comprehensive technical report at the end of the program containing among others discussion of the socio-economic impacts of windmill utilization and recommendations for future governmental policy and actions.

SCHEDULE OF ACTIVITIES



Financial Plans Summary

PROJECT STA. BARBARA

	TOTAL	PROPONENT	B E D	USAID
I. Personnel Services	₱ 361,500	₱ 232,500	₱	₱ 129,000
II. Equipment and Accessories	1,409,700	150,000		1,259,700
III. Maintenance and Other Operating Expenses	50,800	22,000	28,800	
IV. Capital Outlay				
V. Special Purposes	18,000	6,000		12,000
TOTAL	₱1,840,000	₱ 410,500	₱ 28,800	₱1,400,700

FARM SYSTEM DEVELOPMENT CORPORATION

	TOTAL	PROPONENT	B E D	USAID
I. Personnel Services	₱ 519,000	₱ 397,000	₱	₱ 121,800
II. Equipment and Accessories	36,900	26,500	10,400	
III. Maintenance and Other Operating Expenses	478,469	36,000		442,469
IV. Capital Outlay				
V. Special Purposes	38,000			38,000
TOTAL	₱1,072,369	₱ 459,700	₱ 10,400	₱ 602,269
GRAND TOTAL	₱2,912,369	₱ 870,200	₱ 39,200	₱2,002,969

Line-Item Budget

PROJECT STA. BARBARA

	TOTAL	PROPONENT	B E D	USAID
I. Personnel Services	₱ 361,500	₱ 232,500	₱ -	₱ 129,000
II. Equipment & Accessories				
Drafting equipment	1,200	-	-	1,200
Machine shop equipment	150,000	150,000	-	-
20 Units windmills for water pumping (labor, materials, and transportation CIF site)	459,000	-	-	459,000
6 Units windmills for electric generation (labor, materials and transportation)	799,500	-	-	799,500
	₱1,409,700	₱ 150,000	₱ -	₱1,259,700
III. Maintenance & Other Operating Expenses				
Travel	24,000	12,000	12,000	-
Supplies	16,800	-	16,800	
C/H Borden Gas, Electricity generation, etc.	10,000	10,000	-	-
	₱ 50,800	₱ 22,000	₱ 28,800	₱ -
VI. Capital Outlay				
V. Special Purposes				
Contract Labor	12,000	-	-	12,000
Documentation Cost	3,000	3,000	-	-
Contingencies	3,000	3,000	-	-
	₱ 18,000	₱ 6,000	₱ 28,800	₱ 12,000
GRAND TOTAL	₱1,840,000	₱ 410,500	₱ 28,800	₱1,400,700

Line-Item Budget

FARM SYSTEMS DEVELOPMENT CORPORATION

	TOTAL	PROPONENT	B E D	USAID
I. Personnel Services	₱ 519,000	₱397,000	₱ -	₱121,800
II. Equipment & Accessories				
Office Equipment	26,500	26,500	-	-
6 Anemometers	5,400	-	5,400	-
12 Flowmeters	4,200	-	4,200	-
Drafting instruments	800	-	800	-
	₱ 36,900	₱ 26,500	₱10,400	₱ -
III. Maintenance & Other Operating Expenses				
Installation of water pumping windmills to include well-drilling, construction of irrigation systems and potable water systems	300,100	-	-	300,100
Installation of electric generating windmills to include power distribution	112,656	-	-	112,656
Maintenance and training costs	20,000	20,000	-	-
Supplies	25,000	6,000	-	19,000
Travel	20,713	10,000	-	10,713
	₱ 478,469	₱ 36,000	₱ -	₱442,469
IV. Capital Outlay				
V. Special Purposes				
Contract Labor	32,000	-	-	32,000
Documentation cost	3,000	-	-	3,000
Contingencies	3,000	-	-	3,000
	₱ 38,000	₱ -	₱ -	₱ 38,000
GRAND TOTAL	₱1,072,369	₱459,700	₱10,400	₱ 602,269

5. SMALL-SCALE HYDRO

Two proposals have been received by BED and are presently under review. A number of points must still be negotiated with implementors such as scope of work, subproject design, counterpart funding, etc. Identification of possible sites and negotiations with other prospective implementors is underway.

6. DENDROTHERMAL

Evaluation of the feasibility of putting up a dendrothermal power plant was done by the group of Murphey et. al. as a result of the site survey they conducted on Panay in October, 1978. Their analysis of the system was based on the scope of work which they submitted to USAID for review and approval. Details of the scope of work are as follows:

Scope of Work

I Technical Considerations

A. Load Patterns

Recommendation of the appropriate site, capacity (size) and type of Dendro Thermal Plant taking into consideration -

a. typical load pattern of candidate sites

b. population growth projections and future demand of spin-off economic activities

c. optimal load mix for wood fired power plants

d. rate structure and ability of consumers to pay

e. availability of skilled local manpower

f. existing power system

g. resource availability

B. Engineering Designs

1. Description (quantitative and qualitative) of the major engineering features of the project

a. number of boilers/turbines/generators suited for load pattern and sufficient to meet peak demand

b. firing methods

c. plant life

d. plant operation (system design)

2. Plant layout and preliminary engineering drawings

3. Delivery system for plant output to existing power systems and consumers

4. Required site improvements

C. Technical Specifications

1. Outline specifications for equipment to be procured under AID loan

2. Availability of suppliers

3. Anticipated delivery period

D. Resource Availability

1. Fuel Supply

(a) Fuel Availability

(i) Growing stock (sizes and species)

(ii) Growth rates

(iii) Adaptability to development of energy plantation

(iv) Planting method, i.e., spacing of trees.. etc.

(b) Land ownership patterns in the area

(c) Plantation development and fuel procurement

(i) Labor requirements

(ii) Operations and management

(d) Nutrient budget

(e) Fuel delivery

(i) Road network

(ii) Water transport

(iii) Rail transport

(iv) Optimal hauling load per hauling and number of haulings per year/month/days.. etc.

(f) Fuel storage and handling (methods and problems anticipated

(g) Assumptions and limitations

2. Water Resources

(a) Source, quality and availability of plant cooling and boiler make-up water

(b) Recycling

E. Implementation Plan

1. Proposed method of contracting for engineering design, construction, and construction supervision sources and an assessment of local capabilities.
2. Requirements for special consultants
3. Preliminary engineering and construction schedules

F. Operating, Maintenance and Management Organization

1. Description of organization which will be responsible for operating and managing the generating facility.
2. Availability and qualifications of technicians and management personnel.
3. Training programs envisioned.

II Economic Considerations

A. Existing Power System

1. Description of Service Area considering
   (a) prevailing economic activity
   (b) potential for further economic prosperity
   (c) over-all impact of power generated
2. Present method of marketing power, including information on rate structure and ability of consumers to pay
3. Suggested improvements in marketing power

B. Power Demand

1. Current demand by type of consumer
2. Population growth projections and forecast of future demand
3. Method to be used to deliver proposed plant output into existing power system and to potential consumers.

C. Net Energy Analysis

1. Fuel supply versus plant requirements
2. Area requirements at different levels of production
3. Total energy inputs
4. Energy outputs

III Financial Considerations

A. Capital Cost

Preliminary estimate of capital costs broken down into foreign exchange and local currency requirements

B. Annual Operating Costs

1. Fuel
2. Depreciation
3. Operating and maintenance labor,materials, and spare parts
4. Administrative costs
5. Production costs per KWH and comparison with production costs using more conventional methods of power generation.

C. Annual Income

Rate schedules which would have to be adopted to make plant financially feasible and comparison to present rates being paid.

IV Other Benefits

A. Discussion and, if possible, quantification of other benefits which will accrue to the national economy such as:

a. Provision of market for local fuels

b. Increased employment opportunities in the area

c. More effective utilization of labor

d. Benefits resulting from a more dependable source of power and/or lower prices

B. Discussions of intangible benefits to the country.

A preliminary report on the evaluation of the dendrothermal plant has been submitted to USAID. Their conclusion is favorable in terms of:

1. providing employment
2. saving in fuel and subsequently on foreign exchange
3. providing a nucleus of growth to a community which otherwise will not be reached by electricity
4. complementing the national reforestation program.

The summary of results on the feasiblity study of the dendrothermal plant is presented below:

*** The active reforestration program at Aklan, Nabas, Libertad, Culasi and Tibiao could be exploited for fuel for the dendro-thermal plant.

*** The forestry practiced in this region is exceptional. We have the greatest confidence in the personnel. Their acheivements to date reflect this confidence.

*** Panay has a power grid that will allow the entire island to benefit from electricity.

*** A dendro-thermal plant will reduce the reliance on the present diesel plants with concommitant reduction in reliance on foreign oil.

*** The location has sufficient wood to fuel a 32.1 MW plant.

*** The net energy analysis indicates a positive return in the terms of fuel of 251.1 liters per hectare per year for a plant with a life of 40 years.

*** The dendro-thermal system is a labor-intensive activity, as such, it provides a stable base for local farmers.

*** The economic analyses are not yet complete. Plantation establishment can be considered in place since Bureau of Forest Development has an on-going program to reforest sites within economical range of a dendro-thermal plant.

*** One to five megawatt plants are more costly per megawatt than the larger plants, however, several benefits accrue:

1. a smaller land base is required.
2. incremental power can be developed as demand increases.
3. the ready market for wood from the plantations provides an early partial return on investment.
4. local markets can be satisfied - additional power can be placed in the grid.

An additional scope of work has been developed by BED personnel in cooperation with AID for an engineering feasibility - preliminary design study for this project, to be conducted under a direct AID contract.

7. INTEGRATED VILLAGE ENERGY SYSTEM (IVES)

To avoid duplication of existing projects, the photovoltaics and pyrolysis subprojects were replaced with a project to design and install an integrated energy system in an existing village. This subproject seeks to plan, design, construct and monitor technical performance and social impact of an integrated small-scale renewable energy technology system and other appropriate technologies in an existing rural village in the Philippines. The project would thus serve as a test model for future transition efforts, while allowing rural citizens of the Philippines (and other developing nations) to become familiar with the possibilities and problems of non-fossil based energy systems.

USAID is negotiating with Michael G. Harlow, formerly Senior Environmental Scientist with a Seattle, Washington based consulting firm specializing in nonconventional energy technology research and development, and residing in Manila, for his services in assisting in preparation of a technical document (or proposal) which shall fully define the technical aspects of the IVES subproject and set forth all particulars necessary for its timely and efficient implementation. Mr. Harlow proposes to use his own expertise and that of BED personnel and others in order to clearly establish the following major items, which will constitute the body of the Project Proposal.

1. A clear statement of the rationale, background, and objective of the Integrated Village Energy Systems (IVES) Subproject.

2. An evaluation of candidate sites and selection of the village where the integrated energy systems will be instituted.
3. An analysis and documentation of the present energy, economic, and social and environmental situations in the village as these relate to the project.
4. An analysis of possible energy system substitutions/ improvements which could be made in the village situation using technically feasible small-scale nonconventional energy technologies (as defined in the USAID-GOP Project document).
5. Selection of the general integrated energy system(s) design.
6. Detailed definition of engineering design criteria for energy systems equipment and processes.
7. Specification of necessary IVES Subproject Structure including:
   a) Selection of Implementors and sub-contractors
   b) Arrangements for participation by Institutions, Implementors, and other entities
   c) Arrangements for village infrastructure and private sector participation, (including contribution of labor, sites, materials, etc. and project-related training/education).
   d) Financial and Budgetary Arrangements.

8. Design of project evaluation parameters and methodologies, including technical/economic performance of equipment and processes, and effects of the new energy systems on "quality of life" in the village.

9. Implementation Schedules, including a timetable and related strategies for completion of:

   a) all necessary arrangements among or between BED and all participants
   b) Engineering design
   c) Equipment procurement/fabrication
   d) Education/training of Village participants and project personnel
   e) Equipment installation/construction
   f) Operation and maintenance of systems
   g) Collection of technical, social, and environmental data
   h) Post-project shutdown/turnover/disposal of project-related materials
   i) Post-project BED involvement in the village's affairs
   j) Dissemination and utilization of project evaluation information.

Mr. Harlow suggests that the following items constitute an appropriate definition of the scope of services required to accomplish preparation of the proposal. A weekly contract schedule and estimate of level of effort (in hours) follows as Figure 1.

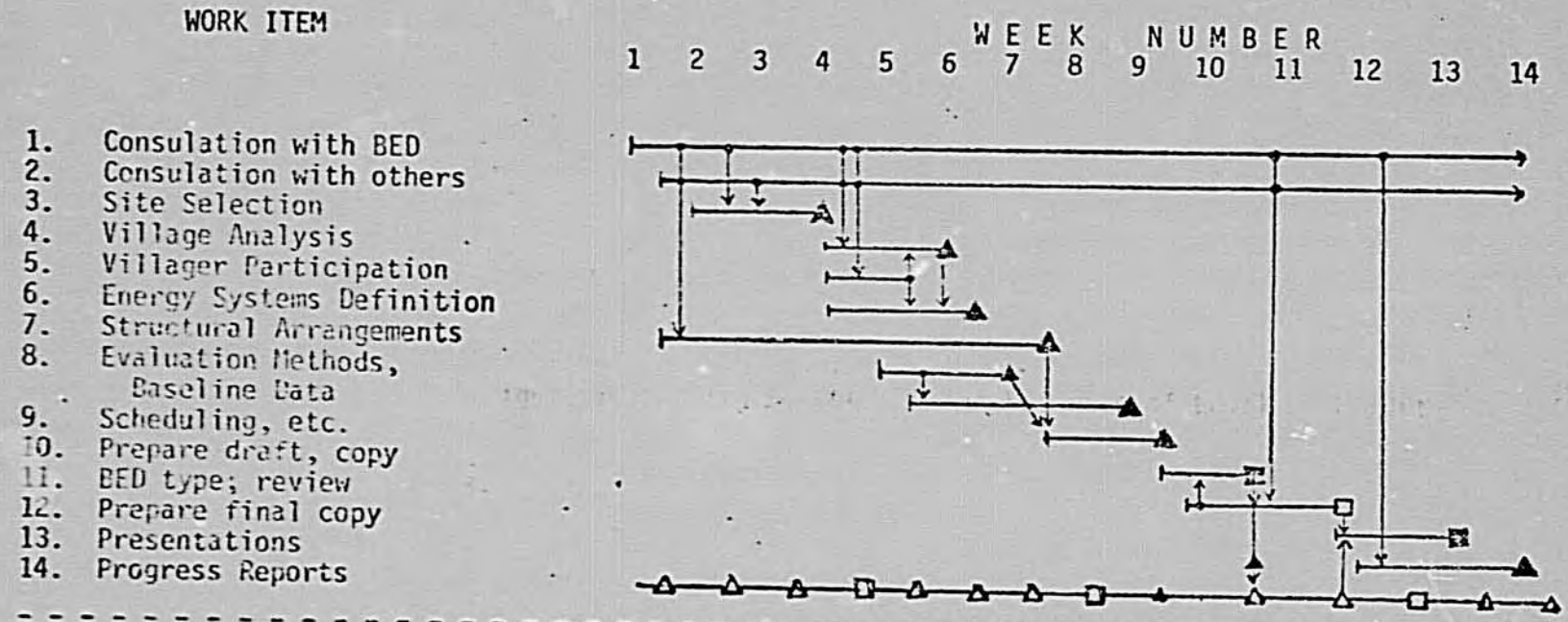
1. Consult with BED personnel, particularly Director of NCRD and USAID-GOP Program Manager, regarding objectives, candidate sites, ongoing and completed energy technology R & D projects in the Philippines and elsewhere, and all other matters pertenant to the objectives of this consulting contract.
2. Consult with other experts and authorities as necessary to develop comprehensive information base and contacts needed for IVES Subproject.
3. In consultation with appropriate BED personnel and others, develop site selection methodology, conduct necessary field investigations, and select site.
4. In conjunction with BED personnel and others, arrange villager education/involvement process; attend meetings and other involvement sessions as needed in order to define villagers' perceptions of energy problems and potential applications of nonconventional technologies. In consultation with BED personnel and others, perform detailed inventory and analysis of village situation.
5. In consultation with BED personnel and others, prepare general integrated energy systems designs; assist BED personnel and others as necessary in defining detailed engineering design specification for energy equipment and/or processes.

6. Prepare, in consultation and conjunction with BED personnel and others, a clear description of necessary structural arrangements among participants/sponsors/etc.
7. In consultation with BED personnel and others, define parameters and methodologies to be used in project evaluation. Coordinate collection of pre-project baseline data.
8. Prepare schedules for project implementation.
9. Prepare draft proposal text and graphics for typing and drafting by BED. Edit draft document and submit to USAID-GOP Project Coordinator for distribution and review, as appropriate.
10. Incorporate review comments into final proposal, which will be typed and drafted by BED for formal submission to USAID.
11. Prepare sketches and rough copy of materials for presentation of the proposal to BED and others. BED will supply drafting and other services necessary to produce final presentation materials.
12. As required, assist BED personnel and/or USAID-GOP Project Coordinator in proposal presentation and discussion.
13. Prepare weekly oral briefings to USAID-GOP Project Coordinator and Director NCRD; submit monthly progress reports in letter form.

Preparation of the project proposal as scoped above will involve about thirteen weeks of full-time (40 hr/wk) work by Mr. Harlow. See Figure 1 for the proposed contract schedule and level of effort. A budget estimate is attached as Figure 2.

Several meetings were held with the participation of representatives of agencies involved in the development of nonconventional energy such as Project Santa Barbara, Ministry of Human Settlements, Philippine Atomic Energy Commission, South China Sea Fisheries, etc.; to define the scope of work. Ministry of Human Settlements might be the possible implementor for this subproject since they are involved in the development of communities. Dr. Rogelio Lopez of Ministry of Human Settlements is participating in the planning phase of the subproject so as to properly identify and provide for the basic needs of the people in the community.

Figure 1: Contract Schedule and Estimate of Level of Effort



KEY:

- START OF WORK
- SUBPHASE COMPLETION
- LETTER PROGRESS REPORT
- ORAL PROGRESS REPORT
- WRITTEN REPORT
- SUBPHASE INTERACTION

Figure 2

BUDGET ESTIMATE FOR CONSULTING SERVICES
OF MICHAEL HARLOW

LABOR		
14 weeks x 40 hours x $16/hr		$ 9,000
TRAVEL & EXPENSES		
Local =	$200	
Site =	$500	700
MISC (Reports, etc.)		300
TOTAL ESTIMATED COST		$ 10,000

GRANT ACTIVITIES

1. PROJECT COORDINATOR

Mrs. Carol S. Harlow assumed the position as Project Coordinator upon her arrival in Manila, on February 10, 1979. With assistance from the NCRD Staff, she has worked on the smooth processing of project proposals. She has also made contacts in the U.S. for the short-term training of NCRD Staff. At present, line-up of short term consultants is being organized with the submission of bio-data of interested parties to USAID Washington and BED.

Expenses incurred to date by the Project Coordinator are $33,135.43. This includes base salary of one and one-half months, housing allowance, travel expenses from Seattle, Washington to Manila, Philippines with her dependents and an advance of $20,000 repayable over the next 18 months.

2. SHORT-TERM TRAINING

This year's recipients of short term training in the U.S. intended to refine the nonconventional energy resources division's expertise, are Laurie O. Bautista, Francisco B. Sta. Ana, Ernesto R. Balleser, Ramon B. Benet and Aldwyn Santos.

Arrangements are being made with NEDA*which organizes and plans for all government employees' training. The recipients are expected to be contracted for three years service at BED in exchange for the training.

*NATIONAL ECONOMIC DEVELOPMENT AUTHORITY

As of the end of March, arrangements for Laurie Bautista and Francisco B. Sta. Ana's travel have been completed. Training programs for the other recipients were still being arranged.

LAURIE O. BAUTISTA was scheduled to leave for the U.S. on April 9. She will be spending approximately one month with each of the three "hosts":

April 9 - May 5 - Foundation for Urban and Neighborhood Development, Denver, Colorado, Dr. James Kent

May 5 - May 27 - Wesleyan University, Middletown, Connecticut, Prof. Howard Brown

May 27 - June 23 - Georgia Tech., Atlanta, Georgia Dr. Donald Grace

Aside from taking short-term training with each host institutions, Ms. Bautista will make side-trips to the following solar research projects:

1. Albuquerque, New Mexico - Sandia Laboratory and Zomeworks, Inc.
2. Fort Collins, Colorado - Colorado State University (Dr. George Löf)
3. Denver - SERI, Rocky Flats Wind Test Facility, Domestic Technology Institute (Malcolm Lilywhite)
4. San Francisco - Farallones Institute Rural Center (Occidental, California) and Urban Center (Berkeley)
5. Sacramento, California - State Office of Appropriate Technology (Gigi Coe)
6. Corona del Mar, California - Ocean Farm Project (Dr. Wheeler North, Ca Tech Marine Laboratory)

7. New Alchemy Institute, Woods Hole, Mass.
8. East Eleventh Street Project, New York, NY
9. Bruce Anderson, New Hampshire; Institute for Local Self Reliance, WA, D.C.
10. University of Georgia, Biomass Project (Dr. Klaus Steinbeck)
11. University of Florida, Solar Laboratory
12. ISES Conference (May 28-June 1)

Others as suggested by Georgia Tech.

FRANCISCO B. STA. ANA has the following itinerary of travel for his solar training program:

May 15 - June 15 - To be based in Atlanta (Georgia Tech)
Contact: Ross Hammond (404)894-3800.
To attend ISES Conference May 27 to June 1.
Visit Biomass Farming Project - Klaus Steinbeck, U. Georgia, Athens, and other appropriate SE projects.
OTEC Conference, Washington, D.C. June 9.
Visit also VITA and local institute for Self-Reliance.

June 17 - July 21 - To be based in Philadelphia, PA (U. PA.)
Contact: Prof. Howard Brown, Wesleyan Univ. (203) 347-9411, ext 319
To attend World Game Workshop with short-

term site visits to MIT-Solar R & D efforts (Cambridge,Mass.); New Alchemy Institute (Woods Hole,Mass.); other NE Solar developments.

July 22 - August 18 - To be based in the San Francisco area (Farallones Institute, Rural Center, Occidental, CA) Contact: Alison Dykstra (707) 874-3060,with short-term site visits to be chosen from but not limited to: California Office of Appropriate Technology (Contact: Gigi Coe) and California Energy Commission - Robert Hodam, Biomass Program Director (Sacramento); Laurence Berkeley Laboratory and Farallones Institute Urban Center (Berkeley); Sandia Laboratory and Zomeworks, (Albuquerque); and Gas Research Institute Marine Farm Project (Corona del Mar, CA); SERI, Domestic Technology Institute, Foundation for Urban and Neighborhood Development (Denver); Bonneville Power Administration - Robert Tallman, Biomass Program Manager, RAIN - contact: Lee Johnson (Portland, Oregon).

GREGORIO U. KILAYKO, also on the NCRD Staff, is slated for a master's degree training in the U.S. Additional recipients will be screened from NSDB's yearly applicants for scholarship, selection of which will be based on an examination and interview of NSDB authorities.

3. SOLAR AND WIND MAPPING

This project which will be undertaken by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) has the following objectives:

a. To provide data and information on solar radiation and wind velocity in the Philippines to various researchers who are involved in the utilization of solar and wind energy resources and other related fields of studies.

b. To determine the seasonal and monthly variation and distribution of solar radiation and wind velocity for the whole country.

c. To determine the relationship of solar radiation versus duration of bright sunshine in the Philippines.

d. To expand and upgrade the present solar/wind network in the Philippines.

$157,858.35 will be spent on the procurement of recording equipment for monitoring wind direction and solar radiation. This will be funded by USAID. The local costs for this project such as monitoring, installations,

etc. will come from BED (₱54,975) and PAGASA (₱1,171,200). Total project cost then would amount to ₱2,378,511.

The project proposal and draft of memo of agreement for this subproject have been finalized. BED's financial and technical committee have evaluated and favorably endorsed the project for USAID funding.

The Philippines' irregular topography requires it to have an adequate network of solar/wind observing stations so that the parameters measured at each station will represent fairly the condition in the surrounding area. To meet this requirement, twelve substations around the country will be expanded and upgraded. The data to be collected are:

SUNSHINE DURATION

The total time that the sun is not obstructed by the clouds will be recorded with the use of a Campbell Stokes Sunshine recorder. This data is normally expressed in minutes or hours per day or month of bright sunshine. It may also be expressed as a percentage of possible bright sunshine.

TOTAL GLOBAL SOLAR RADIATION

The total direct and diffuse radiation from the sun and sky

(global solar radiation) as received on a horizontal surface is measured by a pyranometer. This energy is measured in langleys.

DIFFUSE OR SKY RADIATION

Diffuse solar radiation as received on a horizontal surface is measured by a pyranometer with a shadow band. This energy is measured in langleys.

DIRECT SOLAR RADIATION

This data will be obtained by subtracting the diffuse solar radiation from the global solar radiation.

WIND DATA

The wind direction and wind speed are measured by a combined wind vane and anemometer instrument. Most of PAGASA's regular synoptic stations record only wind direction and wind speed at 3-hourly intervals due to lack of self-recording equipment. These stations do not have continous records of wind direction and wind speed.

PAGASA's present stations are not now capable measuring continuous wind direction and speed and diffuse or sky radiation.

THE PROPOSED EQUIPMENT will expand the capability of existing instrumentation of PAGASA's solar radiation stations:

1. Epply Pyranometer (B & W) Model 8848

- Has a thermopile sensor
- Measures global (total sun and sky) radiation
- Could be used also in continous recording and spot measurements of the solar scattered radiation and the reflected solar radiation (albedo) which is usually used in Field of Agrometeorology, and Forest Science
- Proven also in strictly meteorological network.

2. Wind Indicator
   - Is attached to the wind sensor so as to display simultaneously wind direction and speed on a separate dial.
3. Electrical Recorder for Wind Indicator W 1760 Main Drive Project Case
   - Is used with the wind indicator and sensor
   - Displays and records wind direction and speed on a continous chart

The equipment supplied as PAGASA counterpart to this project does not measure or record continous wind direction, wind speed,diffuse solar or sky radiation. These instruments are as follows:

1. Pyranometer, B & W, Eppley, Model 8-48 (3)
   - Has a thermopile sensor
   - Measuresglobal (total sun and sky) radiation
   - Could be used also in continous recording and spot

measurements of the solar and scattered radiation and the reflected solar radiation (albedo) which is usually used in field of Agrometeorology , and Forest Science,

- Proven also in strictly meteorological network.

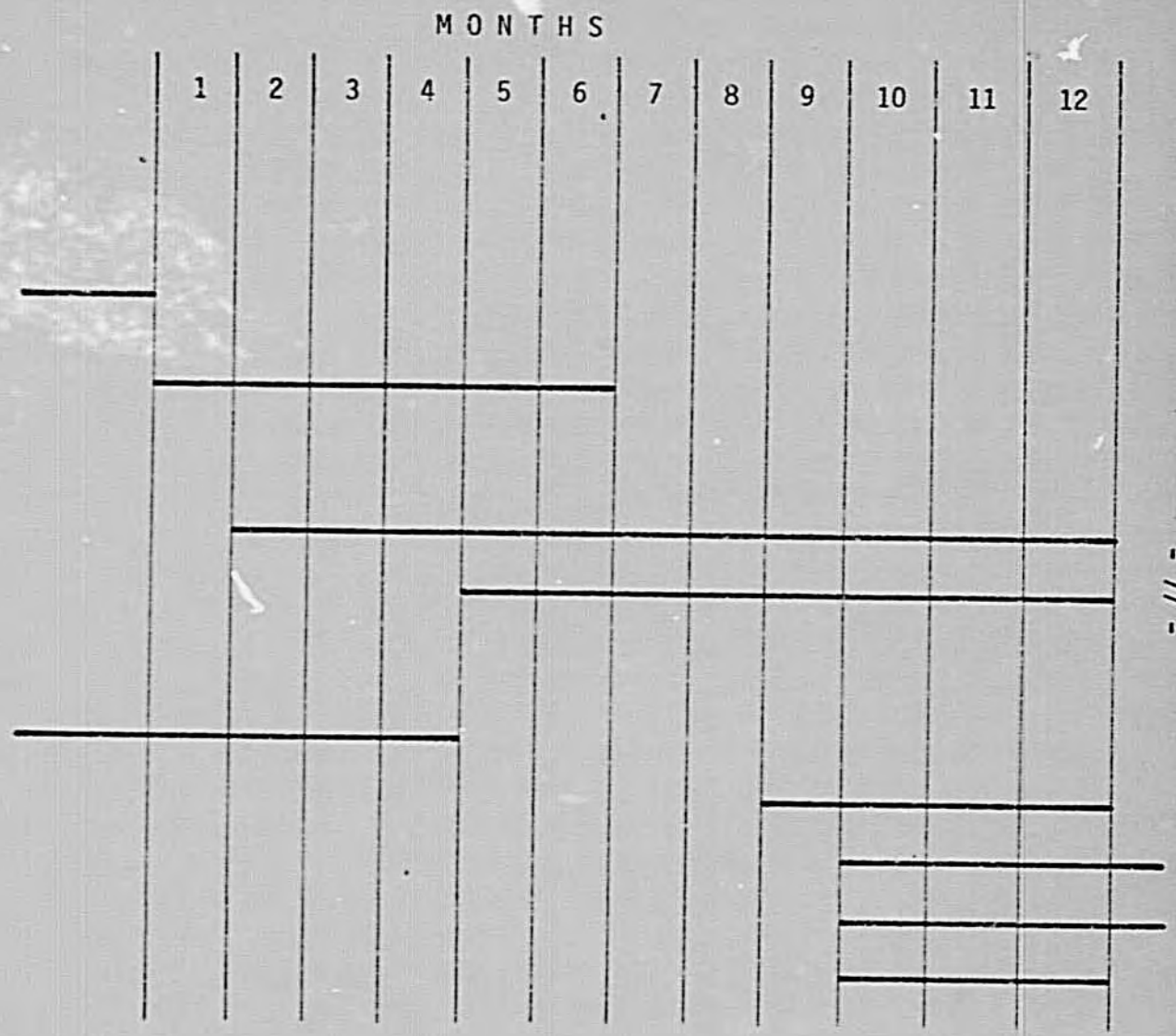
2. Normal Incidence Pyrheliometer Model NIP, Eppley (3)
   - For measurement of the direct solar component (only) received on a surface perpendicular to the beam

3. Strip Chart Recorder, 2 Pen, Multi-span speed, Hp 7128A Module 17501A (3)
   - Is used with the meter sensor
   - Records total radiation and sunshine duration in the graph

4. Campbell Stokes Sunshine Recorder (20)
   - Burning glass Sunshine recorder
   - Records the duration of bright sunshine
   - Is used to obtain the total time that the sunshine is not obstructed by the clouds.

After having calibrated all the equipment, it will be installed in synoptic or primary climatological stations operated by the PAGASA. The recorded data in the form of charts will be compiled for each month in each of the stations and sent to the National Weather Data Office for processing and analysis. They will then be published in usable form. The PAGASA's existing 1130 IBM and Nova Computer Systems will be used in the processing.

SCHEDULE OF ACTIVITIES



A. Expansion & upgrading of existing solar/wind station network in the Philippines

1. Procurement of equipment

2. Installation and calibration of new equipments

B. Collection & Processing of solar/wind data

1. Observation and collection

2. Processing

C. Analysis & Evaluation of Solar/Wind Data

1. Programming

2. Computerization

3. Mapping & Analysis

4. Evaluation

D. Preparation of Report

Financial Plan Summary

		TOTAL	PAGASA	B E D	USAID
I.	Personnel Services	₱ 49,200	₱ 49,200	₱ -	₱ -
II.	Maintenance and other Operating Expenses	185,000	170,000	15,000	-
III.	Equipment & Furniture	1,959,336	807,000	-	1,152,336
IV.	Capital Outlay	120,000	120,000	-	-
V.	Special Purposes	64,975	25,000	39,975	-
	TOTAL	₱2,378,511	₱1,171,200	₱ 54,975	₱1,152,336

Line-Item Budget

	TOTAL	PAGASA	B E D	USAID
I. Personnel Services				
1. Salaries	₱ 39,600	₱ 39,600	₱ -	₱ -
2. Wages (for two (2) laborers for the installation of equipment	9,600	9,600	-	-
Sub-Total	₱ 42,200	₱ 49,200	₱ -	₱ -
II. Maintenance and other Operating Expenses				
1. Travel	₱ 100,000	₱ 100,000	₱ -	₱ -
2. Supplies & Materials	35,000	35,000	-	-
3. Sundries	20,000	20,000	-	-
4. Contingencies	30,000	15,000	15,000	-
Sub-Total	₱ 185,000	₱ 170,000	₱15,000	₱ -
III. Equipment and Furniture Cost				
1. Equipment Cost	₱1,952,336	₱ 800,000	₱ -	₱1,152,336
2. Furnitture	7,000	7,000	-	-
Sub-Total	₱1,959,336	₱ 807,000	₱ -	₱1,152,336
VI. Capital Outlay	₱ 120,000	₱ 120,000	-	-
V. Special Purposes				
1. Local Consultancy	₱ 39,975	₱ -	₱39,975	₱ -
2. BED Usage and Facilities	25,000	25,000	-	-
Sub-Total	₱ 64,975	₱ 25,000	₱39,975	₱ -
GRAND TOTAL	₱2,378,511	₱1,171,200	₱54,978	₱1,152,336

Equipment Requirement

(For the installation of wind/solar stations at the following 12 places: Fort Bonifacio, Basco, Batac, Isabela, Guiuan, Coron, Virac, Dumaguete, Masbate, Romblon, Musuan and Bugsok)

NO.	QTY.	I T E M	COST (U.S. $) Unit	TOTAL
1	2 units	Eppley Pyranometer (B & W) Model 8848	600	1,200
2	1 unit	Eppley Shadow Band Stand Model SBS	700	700
3	2 sets	Eppley Integrator/Printer Model 411-6140	1,800	3,600
4	1 unit	Campbel Stokes Sunshine Recorder	400	400
5	1 unit	Planimeter Casella W 6014*	125	125
6	5 boxes	Printing Paper	55	275
7	2 rolls	Ribbon	49	98
8	1 unit	Combined Wind Direction & Speed Indicator W 1404, KPH mains drive 220 V/60 Hz	2,000	2,000
9	1 unit	Electrical Recorder for Wind Indicator W 1760 Mains drive projecting case	2,000	2,000
10	1 set	Metal Cabinets for two Indicator W 1406	216	216
11	4 units	Power Supply Batteries	67.5	67.5
12	30 meters	5-core cable	2	60
13	30 meters	2-core cable	0.8	0.8
14	1 unit	Invester	260	260
15	1 unit	Wind Mast	680	680
16	5 sets	Roll Chart for Recorder W 1784	53	265
17		Other supplies: bottles of ink filler W 1790,spare pen nozzle W 1792, cleaning out pump		85
			For one Station	$12,258.00 U.S.

Equipment Requirement

. . . . . .

*For Main Office only

Total Cost for 12 Stations with the planimeter only for the Main Office: [(12,258 - 125) x 12] + 125. . . . . .$ 145,721.00

Total Cost for freight and handling including insurance. 10,000.00

Grand Total. . . . . .$ 155,721.00

or at an exchange rate of 7.4 pesos per one dollar. . .₱1,152,335.40

4. INFORMATION AND PROMOTIONAL PROGRAMS

A preliminary proposal that outlines the activities and their respective financial allocations for this subproject is under revision. As supportive to Nonconventional Energy activities, it will to disseminate information on the availability and utilization of various nonconventional energy resources.

Workshops, conferences and rural extension seminars will be conducted by scientists and technical experts in several key provinces. A nonconventional energy sources slide show will be produced to form part of the program. Greater public awareness and acceptance of alternative energy sources will involve not only the publication of brochures, pamphlets and other information materials, but media advertising as well. The program will encourage basic research and demonstration of applicable technology by giving assistance to deserving educational institutions and rural service projects. To further demonstrate systems in which technologies have proven to be viable, more equipment will be acquired and installed at the Solarlab to augment its existing public display.

To help carry out the objective of the program, USAID donated two Jeep Cherokees to BED. The vehicles will prove to be valuable in providing transportation for those involved in conducting rural education on nonconventional energy.

Also in line with the information program, our library (BED Data Bank) has received its first batch order of articles and books procured with AID grand funding:

DOCUMENT NO.	TITLE
AD/A-034 871/4SL	International Symposium on Wind Energy Systems. Held at Cambridge Univ., 7-9 September 1976.
BNL - 50532	1985 Technical coefficients for energy technologies. Dec. 76, 32 p.
BNL - 50608	Input-output capital coefficients for energy technologies. Dec. 76, 32 p.
BNWL-SA-5893	Addition of powdered activated carbon to anaerobic digesters: Effects on Methane production. July 76. 7 p.
COO-2900-5	Fast production of methane by anaerobic digestion. Quarterly report, May 24, 1976. Aug. 23, 1976.
COO-2917-3 (v.2)	Biological conversion of organic refuse to methane. Final report. Nov. 76. 109 p.
N74-15748/8	Method of calculation of Annual Overall Efficiency of modern wind-power plants. Feb. 74. 13 p.
N74-21682/1	Wind Electric Power Station. Apr. 74. 14 p.
N74-22704/2	Workshop Proceedings: Photovoltaic conversion of solar energy for terrestial applications, vol. 1: Working group and panel reports. 1973. 117 p.
N74-22705/9	Workshop Proceedings: Photovoltaic conversion of solar energy for terrestial applications, vol. 2: Invited papers, 1973.
N75-13383/5SL	Solar power generating systems as sources of non-polluting energy (Power generation in space and power generation on the ground). 14 p. 1974.
N76-28653/3SL	Solar Cell.s July 1976. 17 p.
PB-231 149/6	Proceedings of the Bioconversion Energy Research Conference held at Massachussetts Univ., Amherst on 25-26 June 1978. 129 p.
PB-231 176/9	Reclamation of energy from organic waste. Final Report. March 74. 143 p.
PB-234 565/0	Research applied to solar-thermal power systems. Chemical vapor deposition research for fabrication of solar energy convertors. Jan. 74 95 p.

DOCUMENT NO.	TITLE
PB-237 042/PTG	Design and construction of a residential solar heating and cooling heating and cooling systems. 1974. 233 p.
PB-238 563/1SL	Fuel gas production from solid waste. 31 July 1974. 77 p.
PB-243 351/4SL	Potential for solid waste as an energy source in Texas. Final report. Nov. 74. 128 p.
PB-243 909/9SL	Development of an electrical generator and electrolysis cell for a wind energy conversion system. 10 July 75. 280 p.
PB-245 203/5SL	Energy use and climate. Possible effects of using solar energy instead of stored energy. Apr. 75. 47 p.
PB-245 609/3SL	A survey of the possible use of wind power in Thailand and the Philippines. Nov. 74. 143 p.
PB-259 000/PTG	Integrated energy vocabulary. 459 p.
PB-260 763/8SL	An evaluation of the use of agricultural residues as an energy feedstock, vol. 1. July 76. 164 p.
PB-260 835/4SL	A western gerional energy development study: Economics, vol. 1. SRI Energy Model results Final report.
PB-265 125/5SL	Inventory of energy research and development: 1973-1975, vol. 1, Serial U.
PB-265 704/7SL	Report of the national planning conference on the commercial development of the oceans, Held at Warrenton, Virginia, June 9-11, 1976. Vol. 2. Program elements.
PB-265 705/4SL	Report of the National Planning Conference on the commercial development of the oceans, Held at Warrenton, Virginia, June 9-11, 1976.
PB-267 210/3SL	Research on the application of solar energy to the food drying industry.
PB-275 658/3SL	Windmill power for city people.

DOCUMENT NO.	TITLE
LA-6637-C	Passive SolarHeating and Cooling Conference and Workshop Proceedings May 18-19, 1976 Albuquerque, New Mexico.
MBI-1957 (vol. 1)	Systems Study of Fuels from Sugarcane, Sweet Sorghum and Sugar Beets.
BMI-1957 A (vol. 4)	Systems Study of Fuels from Sugarcane, Sweet Sorghum, Sugar Beets, and Corn, Volume IV: Corn Agriculture, Task 77, Final report.

SOLAR and ENERGY-RELATED PERIODICALS
(With annual overseas subscription costs)

1. INSIDE DOE
McGraw Hill Inc.
1221 Avenue of the Americas
New York, N.Y. 10020
$300

2. PEOPLE AND ENERGY
Citizens Energy Project
1413 K St. NW
8th Fl.
Washington, D.C. 20005
$19.00

3. SANDIA SCIENCE NEWS
Public Information Division 3161
Sandia Laboratories
Box 5800
Albuquerque, N Mex 87185
F r e e

4. NOT MAN APART
Friends of the Earth
124 Spear Street
San Francisco, CA 9410S
$15.00

5. SOLAR BULLETIN
National Solar Heating and
Cooling Information Center
P.O. Box 1607
Rockville, MD 20850
Free

6. THE SUN TIMES
The Solar Lobby
1028 Connecticut Avenue NW
Room 1100
Washington, DC 20036
$15.00

7. THE ENERGY DAILY
300 National Press Bldg.
Washington, D.C. 20045
$500

SOLAR and ENERGY-RELATED PERIODICALS

8. SOLAR AGE
Solar Vision Inc.
Church Hill
Harrisville, NH 03450
$26

9. ENERGY AND EDUCATION
National Science Teachers Asso.
1742 Connecticut Avenue, NW
Washington, D.C. 20009
Free

10. SOLAR ENERGY INTELLIGENCE REPORT
Business Publishers, Inc.
P.O. Box 1067
Silver Spring, MD 20910
#105/year

11. DEPARTMENT OF ENERGY INFORMATION
Weekly Announcements
Office of Public Affairs
Washington, D.C. 20585
Free

12. SOLAR BULLETIN
National Solar Heating and
Cooling Information Center
P.O. Box 1607
Rockville, MD 20850
Free

13. ENERGY Abstracts
NTIS
Springfield, VA 22161
$75

14. BIOMASS DIGEST
P.O. Box 1304
2337 Lemoine Avenue
Fort Lee, NJ 07024
$99

15. WIND ENERGY REPORT
P.O. Box 14
Rockville Centre, NY 11571
$75.00

SOLAR and ENERGY-RELATED PERIODICALS

16. SCIENCE
AAAS
1515 Massachusetts Avenue, NW
Washington, D.C. 20009
$95

17. SOLAR PRODUCTS SPECIFICATIONS GUIDE
Solar Age
Box 4934
Manchester, N.H. 03108
$120

18. BUSINESS WEEK
P.O.Box 506
Hightstown, NJ 08520
$20+

19. EPA Journal
Superintendent of Documents
US GPO
Washington, D.C. 20402
$12.50

20. CASCADE
Box 1492
Eugene, OR 97440
$10

21. ALTERNATIVE SOURCES OF ENERGY
Route 2
Milaca, Minn. 56353
$10

22. G E O
60 E 65th Street
N. Y., N.Y. 10022
unknown cost

23. THE BULLETIN OF THE ATOMIC SCIENTISTS
1020 E 58th Street
Chicago, Ill. 60637
$18

24. NRDC Newsletter
122 E 42nd Street
New York, N. Y. 10017
$15

SOLAR and ENERGY-RELATED PERIODICALS

25. SELF-RELIANCE
1717 18th Street NW
Washington, D.C. 20009
$6

26. NATIONAL SCIENCE FOUNDATION BULLETIN
1800 G St. NW
Washington, D.C. 20550
Free

27. ENVIRONMENT
4000 Albermarle St., NW
Washington, D.C. 20016
$16.75

28. WOOD ENERGY INSTITUTE BULLETIN
P.O. Box 800
Camden, Maine 04843
$30

29. RESOURCE REPORT
Environmental Policy Center
317 Pennsylvania Avenue, SE
Washington, D.C. 20003
$25

30. ENVIRONMENTAL REPORTER
Bureau of National Affairs, Inc.
Washington, D.C. 20037
$512

31. Solar Engineering Publishers, Inc.
8435 N. Stemmons Freeway
Suite 880
Dallas, Texas 75247
$15

32. THE NEW YORK TIMES
Mail Subscription Department
P.O. Box 5792, Church St. Station
New York, N.Y. 10242

$197.40 for Weekday and Sunday

33. FOREIGN AFFAIRS
P.O. Box 1891
Baltimore, Md. 21203
$14

SOLAR and ENERGY-RELATED PERIODICALS

34. WIND PUBLISHING CORPORATION
104 South Village Avenue
Rockville Centre, NY 11570
(P.O. Box 14, 11571)
$95

35. INTERNATIONAL HERALD TRIBUNE
21, Rue de Berri
75380 Paris Cedex 08, France
$195

36. JOURNAL OF THE NEW ZEALAND TREE CROP ASSOC.
Mr. D. J. Davies
Crop Research Div., D.S.I.R.
Lincoln, Canterbury
New Zealand
$6

37. R A I N
2270 NW Irving
Portland, Oregon 97210
(overseas price unknown-less than $20)

38. ENERGY REPORTER
Bureau of National Affairs, Inc.
Washington, D.C. 20037
$512

39. SOFT ENERGY NOTES
Friends of the Earth
124 Spear Street
San Francisco, CA 94105
$120

40. Biomass Energy Institute Bulletin
P.O. Box 129
Postal Station "C"
Winnipeg, Manitoba
Canada R3M 3S7
$15

SOLAR and ENERGY-RELATED PERIODICALS

41. Smithsonian
Membership Data Center
P.O. Box 2801
Boulder, CO 80321
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