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ANNEX I

WOOD–FIRED POWER PLANTS SUBPROJECT

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WOOD-FIRED POWER PLANTS SUBPROJECT

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ANNEX I

WOOD-FIRED POWER PLANTS

I. BACKGROUND

The Philippines has imported about 80 million barrels of oil annually at a cost of about $2.5 billion per year over the past several years.[1/] Paying for oil imports now consumes a major share of export earnings. The country cannot afford economic growth at these energy prices since growth means increased energy consumption. Nor, can it afford to continue using its foreign exchange earnings to pay for as much oil as is now imported, much less to pay for the increased amounts required as the economy and population grow. Recognizing this reality, the Government of the Philippines (GOP) has placed top priority on the development of alternative energy sources. While there has been some significant progress, it will be the mid to late-eighties before major structural shifts are fully evident.

A major component of the new GOP energy program is development of alternative, renewable sources of fuel for electricity generation which substitute for and are additive to existing systems which are 70% (down from 84%) dependent on imported oil. A major program objective is to reduce electricity generation from oil to 25% by 1987 and 18% by 1990. The Philippines has significant renewable energy sources for this program, although not always in a readily useable form or conveniently located. Included among these indigenous renewable resources are geothermal fields (the Philippines will be the world's major producer by mid-decade), macro and mini-hydro resources and wood-fired power plants.

In 1979 as a first major step in developing biomass-based energy resources, the GOP initiated itsd Wood-Fired Power Plant Program to be implemented by the National Electrification Administration (NEA). The program objective is to develop 2,000 MW of electricity by the year 2000, to provide approximately 20% of projected electricity requirements nationwide. By 1987, some 70 wood-fired power plants are expected to be operating nationwide producing about 200 MW.[2/] The plants will be

1/ The 80 million barrels of oil makes up about 83% of commercial energy needs and is consumed as follows: about 45% for transportation, some 23% for electrical generation, about 4% for lighting and related users, and 28% directly by industry. Industrial users consume the largest share of electricity generated with oil. This heavy dependency on oil is a result of past investment decisions based on earlier low costs of fossil fuels.

2/ As of March 1982, the NEA has ordered equipment for 17 power plants, has performed 15 feasibility studies, has signed 14 loan agreements with electric cooperatives, and has signed 13 A&E services contracts and 6 construction contracts for power plant civil works.

fueled with wood produced from more than 70,000 hectares of tree farms developed specifically to supply these power plants.[1/] The first wood-fired power plants (using Leucaena leucocephala (ipil-ipil), and other fast-rotation species for fuel) are on order and will be in operation by mid-1982.

Total potential for energy production from biomass in this area is estimated at more than 50,000 MW. This estimate is considered conservative because tree farm and conversion technologies and experience continue to evolve. Equally important benefits from implementation of well-designed biomass programs are: (1) reduction of foreign exchange requirements for imported oil; (2) employment generation for the rural poor and unemployed; and (3) reversing the serious environmental degradation currently taking place in the nation's uplands.

During the first phase of the program, emphasis will be placed on improving forestry management techniques and developing well-defined institutional procedures adaptable to a variety of situations. Analyses to improve conversion technology will take place simultaneously. In addition, the GOP has earmarked funds for the development of a training center in Pangasinan Province to provide training in tree farm development and management and power plant operations and maintenance to project personnel as well as to participants from other developing countries.

This subproject of the AID-assisted Rural Energy Development Project focuses on wood-fired electricity generating power plants. It will support three units of the broader GOP Wood-Fired Power Plant Program being implemented by the NEA. AID will finance the offshore procurement of power plant equipment for three 5 MW units--(boilers, turbine and generators) and A&E services. The three subproject sites are in Negros Occidental, Bohol and Panay provinces in the Visayas.

II. SUBPROJECT DESCRIPTION

A. General

An underlying assumption of the Philippine commitment to reducing dependence upon imported oil, as well as augmenting energy availability, is that increased and available supplies at affordable prices are critical to efforts to promote rural development. In the context of GOP development programs, increased energy production is required to meet development needs in the rural sector, not merely meeting subsistence needs. If development is to accelerate, energy availability must be expanded to meet increasing demands for shaft power and process heat.

1/ As of March 1982, NEA and the electric cooperatives have identified 72 tree farm sites encompassing more than 84,000 hectares. They have organized and registered 272 Tree Farmers Associations (TFAs) consisting of 2,993 farmer members. To date, the TFAs have planted 9,173 hectares of fast-growing trees.

A basic premise of the GOP rural energy development program is that technically, economically, and financially viable alternatives do exist and can be developed for the rural areas and parts of the urban industrial sectors. Many of these alternatives are based on renewable resources.

Among the alternatives available, the GOP has concluded that biomass-based energy (relatively clean, renewable and domestic) can be an alternative to oil for some applications in the rural, electric, industrial and transportation sectors. The GOP estimates that its potential biomass capacity is larger than total current energy consumption. While the government is aware that technologies for the economic and convenient development of this potential are not thoroughly developed, it feels it is essential that programs be initiated as rapidly as feasible to start developing this potential. The GOP Wood-Fired Power Plant Program is one of these efforts. Under this program, trees will be grown on large tree farms using fast-growing species and employing crop management systems. Upon harvest, the trees will be transported to a power plant, cut and fed into a boiler to run a steam turbine generator.

The wood-fired power plant model involves two distinct, but integrally related, rural institutions:

- Tree Farmers Associations (TFAs), responsible for growing, harvesting and supplying adequate quantities of wood to satellite collection points on a timely basis;

- Rural Electric Cooperatives (RECs), responsible for transporting wood to the power plant, operating and maintaining the power plant, and distributing electricity to consumers/members. The cooperatives are also responsible for organizing and developing the tree farmers associations.

The rural electric cooperatives are constituted as independent, consumer-owned legal entities that can apply for and obtain legal rights to use government lands for reforestation under Presidential Decree 705 and Executive Order No, 725. (See Appendix B, Legal Rights and Protections.) Tree farm land will be secured through long-term leases (25 years, automatically renewable for an additional 25 years, with token rental payments of ₱0.50/ha/yr). The Administrator of the NEA is legally empowered (Presidential Decree 269 as amended by PD 1645) to organize and incorporate TFAs for the purpose of establishing energy tree farms. Electric cooperatives subdivide the tree farm areas among associations. Each association is made up of approximately 10-15 members and will have exclusive use of a minimum of 100 hectares for a similar 25-year period, renewable for another 25 years. A standard tree farm area for a 5 MW power plant will be 1,800 to 2,000 hectares. Title to the land will remain with the government as part of the public domain. However, the trees will be owned by the TFAs.

In the selection of association members, the electric cooperatives give preference to marginal upland farmers and other unemployed/ underemployed farm laborers in the vicinity who voluntarily join and commit themselves to plant and harvest trees and sell wood. The associations are kept small for ease of management, maximum income growth, and to encourage participatory action among relatives, neighbors and friends. (See Section II, B., 1., Energy Tree Farm below, and Appendix C, Tree Farmers Associations). These associations are an integral part of the wood-fired power plant system and receive supporting services from the electric cooperatives and NEA as described below.

The electric cooperatives guarantee a market for the wood produced. This guarantee is built into the loan agreement along with an agreed upon price. The price is renegotiated each year. The wood is delivered to pick-up points within the tree farms, and the cooperative is responsible for transport to the power plant.

In the past, ownership and control of a power plant has been shared by NEA and the RECs. It is the intent of NEA in this new program that ownership and control of the power plant be held jointly by the rural electric cooperative (a majority share), the tree farmers associations and the NEA. In this arrangement, the farmers will have an interest in the successful operation of the power plant. The form of the power plant organization and the means for allowing joint ownership will be determined in 1982 when the first of the wood-fired power plants begin operation. A simple system of accounting for power plant operations which the farmers can understand has been developed and will be instituted.

NEA furnishes financing to the electric cooperatives for establishing the power plants and energy tree farms. The cooperatives relend NEA-supplied funds to the tree farmers associations for the development of their farms during the first four years of the program.

Land use planning will follow multiple use concepts to the extent possible, considering site conditions and the need to guarantee deliveries of wood required by power plants. Wherever terrain and soil conditions permit, crop and forage production will be encouraged to meet farm family food requirements. The use of backyard gardens and intercropping on the tree farms is encouraged and practiced.

The primary goal is fuel production for power plants. In view of present and projected costs of oil-based energy, preliminary economic studies indicate that fast-rotation trees can be a profitable crop in upland areas. However, economic benefits, near- and long-term, to participating farmers are also a priority GOP objective of the program. To help support the long-term benefits, NEA's reforestation policies include the interplanting of slower-growing, higher value fruit, nut and even some lumber species between firewood trees.

B. Detailed Description

The wood-fired power plant complex consists of two interdependent parts: (1) the energy tree farm, and (2) the power plant. Figure 1 gives a plan view of a typical project site. An illustrative tree farm area is 1,800-2,000 hectares, a size easily capable of producing the wood needed for a 5 MW power plant. The wood transport system is the minimum needed to move the required wood (average 100 metric tons per day) the 5 to 7 kilometers maximum from the harvesting site to the power plant. Although variations will exist to accommodate site-specific situations, the details below serve to describe the most common circumstances in which the two parts exist and operate.

1. Energy Tree Farm

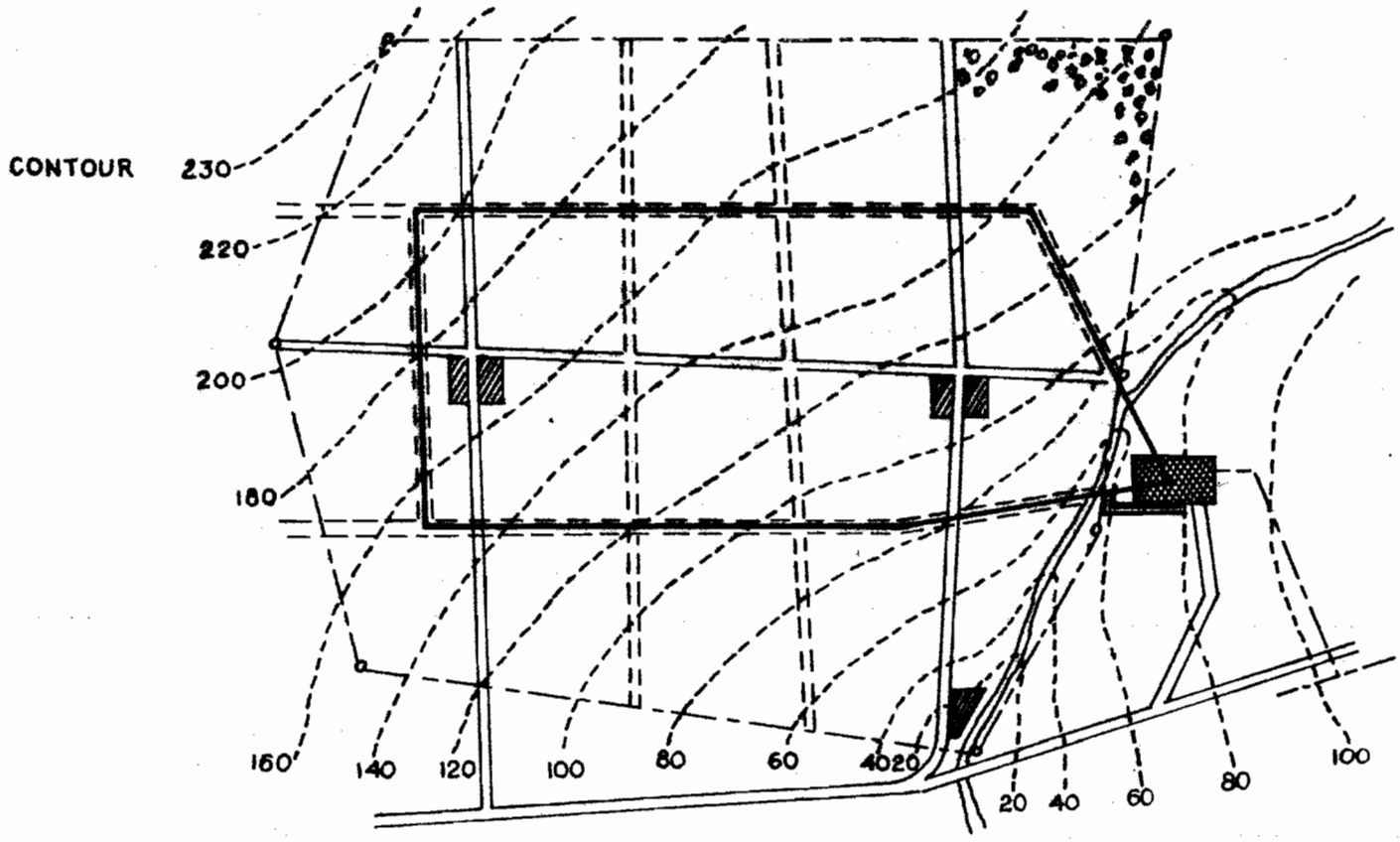
a. Background

This section describes procedures and methods followed by upland farmers planting fast-growing trees in this program. Fuelwood production is the principal livelihood activity of these farmers.

Systems and practices discussed in this section should be characterized as general descriptions, not as specifically prescribed technologies. As conditions vary between and even within tree farm sites, production method flexibility must always be applied. Because these variations exist, many tree farm development alternatives emerge. For example:

- which fields should be directly seeded and where should seedlings be used instead?
- would ringweeding be better than strip brushing?
- should existing vegetation be removed because it competes or left standing because it enhances establishment of trees and protection of the soil?
- is fertilizer required, what type and at what rate?

Differences in soil, terrain, annual rainfall patterns and social factors add to this illustrative list. Appropriate operational decisions sensitive to these variations will be made at the operational level under this subproject. The important decisions that determine the degree of success in operations such as tree farming are invariably based on common sense and existing farming practices used in the area, rather than on sophisticated technologies. Experience in tree farms established to date shows that farmers rely on general knowledge and past experience in cultivating the upland areas. Adaptations are



MAJOR PHYSICAL COMPONENTS

1,800-2,000Has — TREE FARM

— ROAD NETWORK

— FIREBREAKS

— FARMERS & EMPLOYEES HOUSING

— WOOD TRANSPORT FACILITIES

— POWER PLANT

— COOLING WATER SYSTEM & R.O.W.

— WATER SOURCE, STREAM

— POWER LINE & R.O.W.

SCHEMATIC DIAGRAM
WOOD-FIRED POWER PLANT
PROJECT SITE

FIGURE 1

often associated with interaction with other farmers.[1] The following paragraphs describe tree farming activities within this broad framework of variables, alternatives and farmer capabilities.

b. Procedures

Tree farming in this program is implemented by rural electric cooperatives supported by NEA.[2]. The rural electric cooperatives identify denuded or otherwise underutilized public (i.e. government owned) lands[3] suitable for reforestation with fast-growing trees. They represent farmers and apply for long term leases covering these lands. NEA facilitates approval of leases at the national level (Manila). Lease contracts are signed with the Ministry of Natural Resources (MNR) which exercises legal jurisdiction over public lands.

Site selection criteria include the following:

- soil pH ranging from 5.5 to 8.5
- terrain from level up to 60-70% gradient
- elevation below 500 meters
- good drainage
- annual rainfall from 2000-2500 MM
- availability of a water source to support the power plant.

The tree farm is divided into 18-20 modules of 100 ha. each. One module is owned and operated by the electric cooperative as a reserve supply and the other modules are operated by tree farmers associations. From 10-15 farm families group themselves into tree farmers associations to supply wood to the power plant. The boundaries of these 100 hectare modules are surveyed and clearly marked and farmers begin tree farm establishment. Ideally, each module is planted and harvested at the rate of 25 hectares per year for four years.

1/ A separate $3 million ESF/GOP funded Project Design technical assistance project will provide consultancy for tree farm establishment, cultivation, maintenance, harvesting, species selection and yield prediction; See Appendix D.

2/ Administrative arrangements are discussed in Section III, G.

3/ One-sixth of the Philippines or 5,000,000 hectares are classified as critically denuded areas. These lands are predominantly non-productive *Imperata* grasslands; i.e. dominated by (*Imperata cylindrica*), talahib (*Saccharum spontaneum*) and other grass species.

c. Methodology

1) Clearing/Land Preparation/Planting

NEA has experimented with different planting systems, and direct seeding has given the best results at the lowest cost. The systems described below generally refer to direct seeding methods. On sites requiring seedlings, the bare-root and the potted seedlings methods will be practiced. Lands are cleared and planting rows laid out. Land preparation requirements are sensitive to planting systems, vegetative cover prior to clearing, soil characteristics, and species to be planted.

A primary objective of land preparation is to reduce competition from weeds during the first stages of tree growth. Vegetative materials are removed from one meter surrounding the planting spot, before it is cultivated and planted. Seeds are pre-treated by soaking to hasten germination and innoculated with rhizobium to help insure vigorous nodulation. Tree seeds or seedlings are best planted at the start of the rainy season.

Tree farms in this subproject will use *Leucaena leucocephala* (ipil-ipil) as the major legume species. This is principally because (1) seed supplies are assured, (2) potential yields are high, (3) *Leucaena* is easily established by direct seeding, and (4) leafmeal can provide additional farm income. Planting *Leucaena* helps rehabilitate the soil and precludes the need to use nitrogen fertilizer. While direct seeding of this species cannot be used in all instances, it is appropriate at the sites selected for this subproject. On fields requiring fertilizer or lime, it can be readily incorporated into land preparation/direct seeding operations. Where bare-root seedlings are used, the only modification would be to dig seedling holes.

Seed availability for other tested species is improving, particularly for nitrogen-fixing trees such as *Acacia auriculaeformis*, *Albizia falcataria*, *Acacia mangium*, *Casuarina equisetifolia* and others. Species choice options will increase over time.

2) Maintenance

Maintenance after planting is crucial in tree establishment, especially when direct-seeding is practiced. In this subproject, most maintenance will consist of ringweeding with the native blunt-ended machete, a standard farm tool. Weeding clears all competing vegetation for approximately 30 cm surrounding the new seedling. Cut and grubbed-out weeds are piled around the seedling and serve as mulch. Normally 3-4 ringweedings are required during the first year. As the tree grows larger, weeds are shaded out.

Maintenance activities described above can create gainful employment during the 3-4 year interim between planting and harvests. Labor-intensive maintenance systems help achieve this objective

whereas other methods (such as weed control by herbicides) would not. Relatively modest hand labor requirements and lower living costs in rural areas make labor intensive maintenance feasible. Other maintenance operations are fire prevention and construction of firebreaks by association members.

3) Harvesting[1/]

Trees (4 years old) at harvest time generally average between 15-30 centimeters (cm) at breast height and weigh approximately 20 kilograms (kgs). These sizes make it feasible to use (1) bow-saws and/or short-guidebar chainsaws for felling/topping operations, (2) hand stacking onto sleds (travois) and (3) skidding by animal power from field to log-deck. Log extraction is accomplished in this manner. Once wood is delivered to log decks it will be bundled and tagged. Payments to farmers for wood produced will be based on weight. From log deck to power plant, the appropriate materials handling systems will be selected on a site specific basis. In some instances, simple bullcarts may be sufficient. Trucks or trailers pulled by farm tractors would be needed in other locations. On many sites, the volume and very hilly terrain may make cable-based systems worth considering. These materials-handling decisions will be sensitive to local conditions and least-cost choices in all instances. All of these systems are currently used in the Philippines for various applications (e.g. log-hauling, coconut and sugar production, lime kilns). In some instances, combinations of these systems may give the best results.

4) Financing

Tree farming operations will be financed through crop loans up to ₱3,500 per hectare. These loans are extended progressively throughout the 4-year tree farm establishment phase. The loan provides funds for needed inputs--seeds, tools, fertilizer, and other inputs and pay for labor performed until earnings from harvested trees become available. Loan releases are based on tree farm accomplishments. Accomplishments are evaluated by technical staff from the electric cooperative and NEA. Field activities can be scheduled such that useful work is performed throughout the year.[2/] Releases can be staggered and paid out on a weekly or bi-weekly basis, similar to normal work-for-hire arrangements. Thus far, most TFAs associations in the broader GOP program have chosen to operate in this manner. However, no fixed procedure is prescribed, and as long as the work is accomplished loan releases are made. Thus, in the initial 4 years of tree farm development, farmers have the option to allocate their time either partially or complete-

1/ Current plans call for hiring casual labor to assist the TFA members in harvesting. These labor costs are included in the economic and financial analyses.

2/ For example: January-April - maintain firebreaks, clear land; May-August - plant, weed, replant; September-December - weed.

ly to tree farming. For additional income, farmers are encouraged to plant annual crops such as rice, corn, sweet potatoes and vegetables within the tree farm while the trees are still young. Once harvests begin, crop loans are paid over a span of 12 years by deducting a percentage of wood sales prior to payment to tree farmers associations. The electric cooperative buys the wood at a guaranteed price, ex-log landings (i.e. farm gate).

2. Power Plants

The technology for generating electricity from wood is well developed and power plants are widely used in many developed and developing countries throughout the world. The plants proposed for this subproject will have a generating capacity of 5 MW, and will be used to satisfy base loads. The plants will also have an additional 25% cogenerating capability for industrial processing. The plant operation (see Figure 2 for Plant Process Flow) follows the basic steam cycle. The fuel, in this case roundwood logs, is introduced into a boiler. Steam is produced as a result of direct combustion of the wood in the furnace portion of the boiler. Steam, slightly superheated, is allowed to expand through a turbine. The rotary motion of the turbine by means of direct coupling with a generator is then transformed into electrical energy. The steam, at low pressure and temperature, is condensed in a shell and tube type heat exchanger. The heat exchanger is customarily referred to as the condenser. Cooling water, usually pumped from a nearby body of water such as river or lake, is passed through one side of the heat exchanger and thus provides the thermo-dynamic low temperature reservoir. The spent steam water is pumped back into the boiler and reused. In some cases it is passed through a feedwater heater prior to being reheated in the boiler. Other ancillary equipment is also required for plant operation. This would include such items as conveyors for fuel loading and ash removal, various pumps, and controls for maintenance of combustion temperatures, steam pressure and temperature, and power output.[1/] Since the plants will be used to satisfy base loads, problems related with load fluctuations will be avoided.

When the plant is designed for other application in addition to electricity generation, i.e., cogeneration, the turbine is equipped with steam extraction ports. This allows for the steam to be withdrawn at various pressures and temperatures for use in different applications. In order to maintain the rated power output the boiler must be sized accordingly larger.

For a wood-fired plant in the Philippines, a tree farm using fast-growing trees such as ipil-ipil will be established at the power plant site. The size of the trees at the time of harvesting will be such that they can be directly fired as roundwood after being cut to

1/ See Appendix E for a detailed description of fuel properties, fuel requirements, equipment operation, costs and suppliers.

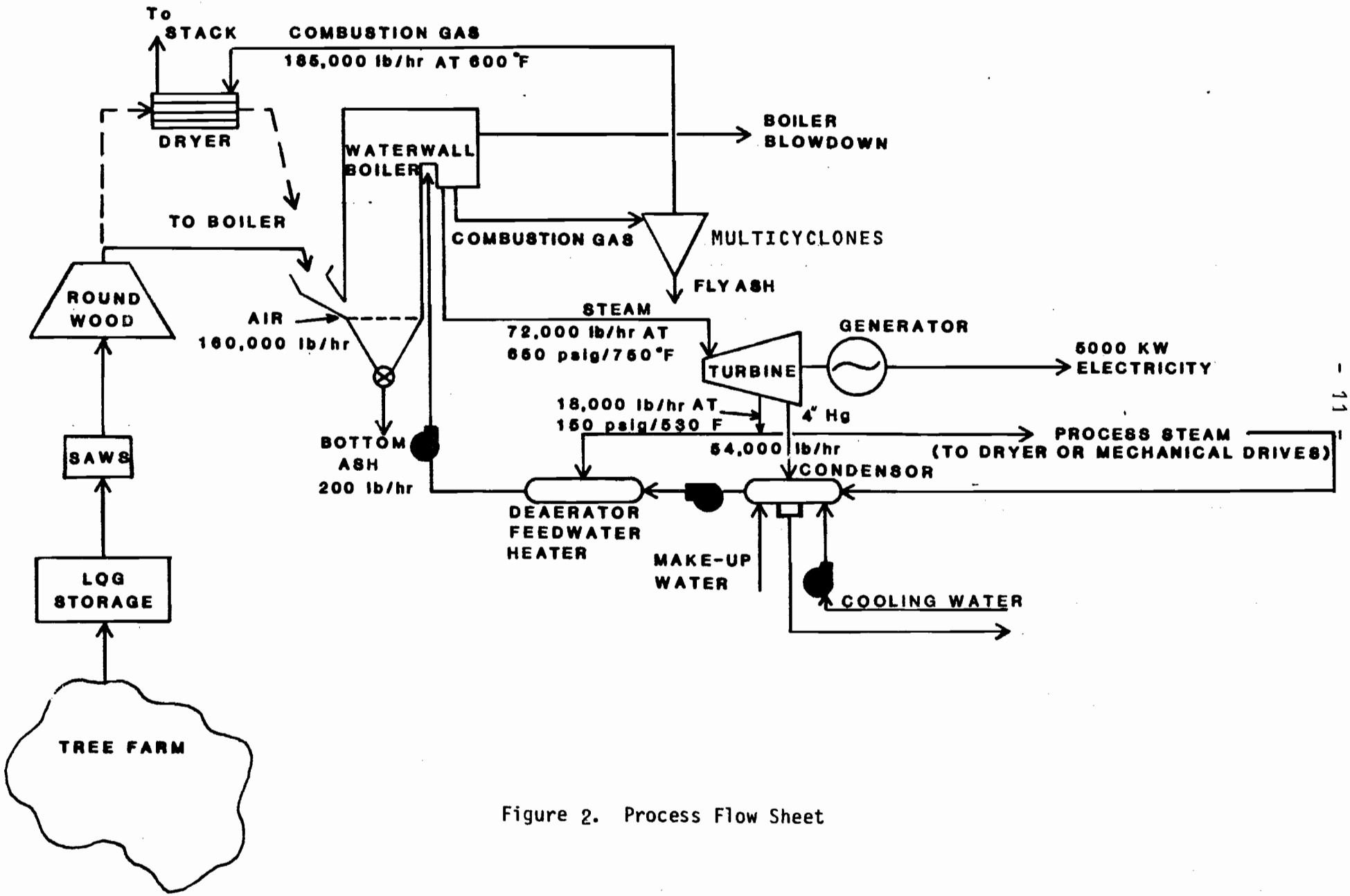


Figure 2. Process Flow Sheet

suitable lengths. The use of woodchips has also been considered. Because of their size, woodchips have the advantage of reducing combusting thermal mass in the furnace and thus increasing the furnace's responsiveness to sudden load changes. However, given current in-country conditions, and the fact that the plants will operate in a base load mode, roundwood is preferred over woodchips.1/

The discharges from the plant include air emissions resulting from the combustion process, ash, cooling water, and boiler blow down. Air emissions, which in this case are principally particulates, can be controlled with multicyclone separators. Ash is inert and in some cases can be applied to the land. Cooling water is generally discharged at a temperature which is five to ten degrees warmer than the incoming stream. Typically, the flow rate required would be at least an order of magnitude lower during most of the year than that in the receiving body of water so that damage to aquatic species would not be a problem.2/. The small amount of boiler blow down may be discharged with the cooling water. Other technical details will be determined during specific detailed engineering design by a contracted A&E firm.

C. AID Participation

AID participation in the Wood-Fired Power Plant Subproject will support the larger GOP program described earlier by funding three 5 MW power plants to be located in the Visayas area of the Philippines.3/

1/ Roundwood will be used instead of chips since chippers increase plant costs by 15-18%, energy consumption and operating complexity as well as maintenance requirements. Preparing and stoking roundwood is labor-intensive, easily learned and commonly practiced in the Philippines.

2/ During the dry season at the Bohol Site (Inabanga River), the river flow is reduced by a factor of five for approximately three months of the year. The plant cooling requirements can be satisfied by adding an approximately 10^6 gallon cooling pond. This pond size, determined by overall energy balance considerations, will increase the civil works cost of the project by about 1.5%. A cooling pond has been selected over a cooling tower because of its cost effectiveness, simplicity of operation and the reduction of foreign exchange costs involved if an imported cooling tower were used.

3/ In discussions in July-August 1981, AID and the MAC Secretariat reached an agreement with the NEA that power plants funded under the subproject would be placed in the Visayas because of the power needs of the area and because of the improved project economics of avoiding placement on the Luzon grid. Subsequent action by the National Cabinet placed complete responsibility for developing the Wood-Fired Power Plant Program with NEA (it had earlier been split between NEA and the National Power Corporation (NPC)), and increased the number of wood-fired power plants to be placed in the Visayas, while reducing the number for Luzon. This action offered a greater choice of sites outside of Luzon than existed before and demonstrated the GOP's plans to promote a greater use of wood-fired plants in the area. The sites selected for this subproject are in Bohol, Negros Occidental and Iloilo provinces.

Regions VI and VIII in the Visayas are two of the focus Regions of AID's assistance strategy. In addition to helping address the Philippine energy problem by developing indigenous renewable energy resources, the subproject will generate productive employment for upland farmers who are among those identified as being extremely poor and will help reverse environmental degradation through tree farms. The costs to be covered include: (a) offshore procurement of fuelwood processing equipment, boilers and controls, steam turbo-generators, condenser/cooling water, pumps, boiler feedwater treatment equipment, piping and electrical switchgear, and transportation and insurance; and (b) contracting an A&E firm to assist and advise NEA and cooperatives to analyze and develop plant specifications, write and issue an Invitation For Bid (IFB), and assist NEA and AID in reviewing bid documents and selecting suppliers of power plants and other hardware.

Additionally, but under a separately funded ESF project, Project Design, AID is providing $2.0 million to the NEA and FSDC to further develop their technical capability to implement their rural energy/ reforestation activities. NEA and FSDC are contributing an additional $1.0 million peso equivalent to technical assistance activities. The technical assistance includes: applied research to develop and modify tree farm models which are appropriate to site-specific variables (including: species selection and seed/seedling development; yield response; pest and diseases advisory services; transport system review; fuelwood production cost analyses; cogeneration possiblities; and potential uses of wood biomass derived energy); assisting in the expansion and further development of the technical unit responsible for the program--the Dendro-Thermal Development Office;1/ provide central office and field staff training; improve conversion technologies, as appropriate; developing a library and information dissemination program; and limited commodities, e.g., vehicles, tools and training aids.

1/ Recommendations of the recent Washington PP design team to inject specific skills and procedures into this office in order to help the TFAs Associations in developing, maintaining and operating the energy tree farms, have been incorporated into the TA.

Total Subproject Costs
($000)

		Source		
		AID/ESF	GOP	Total
A.	AID Funding			
	1. Imported Funding	9,000[1/]	-	9,000
B.	NEA Contribution			
	1. Civil Works		2,079	2,079
	2. Local Equipment		234	234
	3. Tree Farms & Transport		7,830	7,830
	4. A & E, Local		564	564
	5. Contigencies/Escalation		1,866	1,866
	Total	9,000	12,573	21,573

This assistance, to start by August 1982, will be carried out by Filipino and American professionals. While the project is nationwide, the consultants will be readily available to focus their efforts on the three tree farm sites supporting the power plants funded under the ESF program.

Another possible AID involvement in this program is through the S&T Bureau's centrally funded "Bioenergy Systems and Technology Project" (936-5709). The Mission has identified two areas in which this project could be of assistance: (1) analysis of NEA's experience and preparation of relevant procedural and program guidelines for other developing countries to follow in setting up similar programs of their own; (2) curriculum and course work development for NEA's international wood-fired power plant training center.

III. DETAILED SUBPROJECT ANALYSIS

A. Technical Feasibility

The wood-fired power plant subproject combines two existing technologies into a new package. The technical aspects of each part of the power plant complex are briefly discussed below.

1. Energy Tree Farm

Planting fuelwood trees could be characterized as reforestation in its least sophisticated form. The process of establishing fuelwood farms includes operations that are common to all tree farming systems (i.e. preparation of seeds or seedlings, clearing the land, planting the trees, weeding and protection). These operations are simplified if the objective is merely to grow wood that can be burned or converted to char-

1/ Payable in foreign exchange.

coal. For hundreds of years, traditional Filipino farmers have planted many crops which require more care and greater technical expertise than fuelwood trees (e.g., bananas, fruit trees and coconuts). Consequently, implementing the reforestation component of this program should not require a greater degree of technical skills than most Filipino farmers currently possess or can easily learn.[1/] With adequate incentive and other benefits, Filipino farmers have shown they are willing and eager to learn. Tree planting should not be an exception to this rule.

a. Planting Systems

The tree farmers have established most of their existing tree farms[2/] using the direct seeding method. Foresters generally frown on this practice because it requires intensive maintenance. The traditional system is to raise seedlings in a nursery and out-plant when these are from 30-50 cm. high. By comparison, in direct seeding the new seedling is only one cm high, and may have to compete with aggressive weeds. Regular weeding is necessary and labor inputs are high. Consequently, most foresters previously consulted by NEA advised against direct seeding.

However, experience over the past two years has proven that direct seeding is feasible. The intensive weeding that foresters try to avoid has been turned into an employment opportunity under these programs. Regular weeding and farm maintenance provides steady employment and income during the four-year development period. Thus, a socio-economic need has influenced decisions regarding technical procedures used.

Direct seeding, however, is not used in all instances. Some plantings have followed the bare-root method, especially on cogon covered fields (Imperata cylindrica). Bare-root planting is a standard reforestation procedure for trees that can be grown in this manner. Ipil-ipil is one of these, but many other trees are also planted as bare-root seedlings (e.g., rubber, coffee, pines and Gmelina arborea).

The planting systems used in this subproject have proven to be technically feasible.

b. Species Choice

Plantations established so far have focused on Leucaena leucocephala (ipil-ipil). Some TFAs and NEA foresters have started

1/ The success of these programs will probably depend as much on managerial and administrative competence; the ability to assure a timely flow of the materials farmers must have (tools, seeds, fertilizer, and money) in order to apply the technical expertise they already possess. This point is addressed in Section III, G. (Administrative Feasibility).

2/ 9,173 ha. planted as of March 1982.

varietal adaptability test plantings of other trees. This will continue and increase as more varieties become available and as a situation requires. As Leucaena is still the dominant species, it is important to examine the wisdom of this choice.

Leucaena is a legume. When properly innoculated or planted on lands already containing active nitrogen-fixing bacteria (Rhizobia), legumes do not normally require applications of expensive nitrogenous fertilizers. From this perspective Leucaena is an appropriate species for the generally nitrogen-deficient marginal lands now being converted to energy farms. However, nitrogen is not the only element required for healthy plants. Phosporus deficiencies are common in the tropics and without sufficient levels of phosporus, biological nitrogen fixation is impeded. To address this problem project budgets earmark funds for NPK fertilizers in the first year of plantation operations. NPK fertilizers usually contain some sulphur, which Leucaena also needs, although not in large quantities. Recommended fertilization levels (approximately 15 gms/seedling) are sufficient to induce good starting growth and rhizobial activity on most soils.

In subsequent years, Leucaena should perform well on elements that its deep root systems extract from the subsoil, plus biologically-fixed nitrogen. Nonetheless, problem soils do exist and these kinds of problems cannot usually be solved independently by small-scale farmers. In cases such as this, the TFA calls on the electric cooperative or NEA to provide direct assistance or arrange for outside experts from government or private organizations. By mid-1982, consultants who will participate in program implementation under a separate technical assistance effort will also provide the expertise needed to address this concern. Experience to date has shown that tree farmers and electric cooperatives have sufficient motivation to invest additional efforts and financial resources in response to specific problems of this nature. Consequently, there is no reason to expect that this technical concern will not continue to be addressed.

Another characteristics of Leucaena is its intolerance of acidic soils. Prudent selection of tree farm sites to avoid acidic conditions is important. Alternatively, lime application is a relatively simple and inexpensive process that can be included in normal land preparation/planting operations. Other fast-growing/nitrogen fixing/acid-tolerant trees are found in the Philippines, and seed procurement has become more organized. This area is also included in the technical assistance effort mentioned earlier. Acacia auriculaeformis, Acacia mangium, Albizia falcataria and Casuarina equisetifolia are of particular interest and NEA has started initial plantings. Species selection and testing will increase as the technical assistance effort gets underway. In the meantime, careful site selection to avoid acidic areas is the most practical course. Considering the large amount of land available (estimated 5 million ha.) and the relatively small land requirements of this subproject (approximately 6,000 hectares) for tree farms in the

Visayas, or the broader NEA program countrywide (approximately 70,000 hectares) the choice of good sites is not a constraint.

c. Monocultures

Concerns have been expressed on this issue. There is some fear that diseases could either wipe out or seriously damage tree farms. In this regard, Leucaena has survived for centuries in the Philippines. No serious pests or diseases have been recorded except weevils which attack seeds, not the wood. Furthermore, in an operational sense, it is very difficult to establish a tree monoculture in the tropics. Those who have attempted to do so can attest to this. Recent tree farm site visits by NEA and AID technical teams have revealed that even where Leucaena was the only tree planted, many other species sprouted from natural seed dispersal. Fast-growing pioneer species such as Trema cannabina, Muntingia calabura and others are particularly prevalent, and can be identified at weeding time and left untouched. Additionally, current plans and budgets encourage inter-planting of other useful species such as fruit trees and potential timber trees. These factors and increased availability of other nitrogen-fixing fuelwood species mitigate against undue concerns regarding monoculture plantings.

Soil erosion concerns have also been voiced in connection with discussions on monocultures. This is a valid concern during early years of tree farm development. At the dense spacings currently being implemented, sheet erosion may occur on steep sites. However, in later years after harvests begin, twigs and branches left in the field will speed up detritus/humus accumulation and substantially decrease any potential erosion. Simple, economical erosion control measures can and have been put in motion by farmers associations.

For example, at Burgos, Ilocos Sur, contour planting has been started. Contoured hedgerows of closely planted stems that break rainfall run-off is probably the most economical erosion control measure to apply. NEA Dendro-Thermal Development Office personnel are aware of the problem and erosion control technology has been incorporated into NEA's ongoing training seminars. Consultants hired under the Technical Assistance Project will also strengthen NEA's ability to respond to this concern.

d. Nutrient Removal

Nutrient removal is related to long-range sustainability, and is an issue which can only be speculated on at present. It should be pointed out that fuelwood has been harvested from existing Leucaena stands for decades on mountains adjacent to the University of the Philippines at Los Banos (UPLB) College of Forestry with no reported decrease in yields. A similar experience is apparent throughout most of the Pacific Trust Territories. There, Leucaena is considered an obnoxious weed that keeps growing despite repeated cutting, burning and even bulldozing. Notwithstanding these examples, it will be useful to

monitor nutrient removal and the effects of subsequent harvests over time. These research activities will be supported under the complementary technical assistance effort. Fuelwood farms will be a definite improvement on the predominantly grassy wastelands to be used in this subproject. Currently, these grasslands are burned each dry season. On these marginal lands, nutrient loss, erosion, siltation of lowlands and reservoirs are ongoing negative ecological realities. Tree farming will substantially improve land use.

e. Harvesting

The hand labor and animal methods proposed for stump-to-log landing operations appear sound. Cut trees will be small, light and easy to skid, compared to the much larger logs that carabaos have traditionally have been used for. Felling and topping with bowsaws, short-guidebar chainsaws and bolos are standard operations in the Philippines.

From log landing to power plant several systems are planned. These range from bullcarts to trucks, tractor-drawn trailers and/or cableways. These methods are all technically feasible. Private firms/operations have used these systems for many years and modified them to conform to a variety of conditions. There have been no serious problems training rural Filipinos to operate trucks, trailers, farm tractors or cable-logging systems. The issues to address are therefore primarily economic; in other words which are the most economical and reliable given site-specific considerations.

Most farmers are unfamiliar with planning harvest systems on large tree farms. The tree farmers and electric cooperatives will be assisted by the Technical Assistance Project plus the UPLB College of Forestry and the Forest Research Institute (FORI).

NEA has made extensive use of resource persons from UPLB, FORI and the private sector in training programs conducted for this program over the last two years, and will continue to tap the large pool of competent individuals in the Philippines to help assure that appropriate expertise is available to help tree farmers.

f. Yields

Leucaena yields after four years of growth vary according to site. Furthermore, predictions on yields reported by various experts also show a wide variation. However, a growth and yield range of 25 MT/yr (100 MT/ha/harvest) to 40 MT/ha/yr (160 MT/ha/harvest) is considered conservative.1/ The range is based upon growth measurement

1/ Growth and yield reports vary by country, site and management inputs, and reports of 30 to 50 MT/ha are not uncommon.

studies conducted in the Philippines and elsewhere, and, more specifically, conservative projections at the sites identified for this subproject. An analysis of fuel requirements for electricity generation, including using the power plant's cogeneration capabilities, indicate that even the lower growth figure (25 MT/ha/yr) will be sufficient to meet plant needs.

Because of the timing of this subproject, the tree farms will be in their early fourth year of growth when the power plants are ready for their trial runs. To meet fuel requirements, the electric cooperatives can harvest existing native stands at each site. These stands will be replanted as part of the tree farm.

A detailed discussion of yields and fuel requirements appears in Appendix E.

2. Power Plants

The technical feasibility of wood-fired power plants has been demonstrated for a number of years and is well-established throughout the world. Solid fuels (wood and coal) used to be the major sources of fuel for electricity generation. However, these fuels were displaced, in many countries, by natural gas and oil.

Because of the uncertainty of oil and natural gas supplies, there has been a renewed interest in using wood as a fuel. Until recently, the principal areas of its application were in the forest products and sugar cane processing industries where the majority of the energy is derived from the direct combustion of biomass. Further, because these power plants are comparatively small in size and consist of standard components, they are well suited to supplying the electricity needs of developing countries, particularly in rural areas.

Essentially, a wood-fired power plant consists of standard components. These include the furnace and boiler, the turbine-generator unit, the condenser, appropriate conveyors for fuel feeding and ash removal, and air pollution control equipment. In addition, a standard control system is used to monitor such parameters as the power output, combustion temperature, steam pressure and temperature, cooling water flow and temperature and others. Wood-fired boilers are larger than comparable gas or oil units because more combustion air is needed for solid fuels. The combustion units, namely the furnace, are generally equipped with fixed grates which further eliminate the problems associated with maintaining moving grates or fluidized bed systems. The air emissions resulting from wood combustion consists primarily of particulates which are controlled with multicyclone separators considered a well-established technology.

By the time the power plants for this subproject arrive, the NEA will have more than 20 such plants on line. The operations personnel

for this project will have received formal classroom training and on-the-job training before being assigned to these plants. In addition, specific equipment orientation and lessons in operational procedures will be provided by manufacturers.

The wood-fired power plant subproject is considered technically feasible.

B. Economic Feasibility: Analysis I

An economic feasibility analysis of the wood-fired power plants was undertaken through the costing of the fuel cycle under consideration, and its comparison with alternative fuel cycles, in particular diesel-fueled plants.

The steam generator process used here produces electricity using wood as the fuel. In this case, the fuel system starts with reforested land from which "raw" energy fuelwood is harvested. The fuelwood is transported to the generating site and then burned in the form of small logs approximately 3" to 4" in diameter and 12" to 18" long. The rest of the cycle uses the heat of combustion to produce steam which in turn generates electricity via a steam turbine. The economics of each individual stage of the fuel cycle will be presented, with the economic comparison based on the relative cost of generating electricity using wood versus diesel fuel.

The basic fuel will be produced on tree farm modules that the National Electrification Administration (NEA) is in the process of developing. Tables 1-4 (all tables are in Appendix F) present the estimated economic costs of producing "raw" energy on a 100 ha. module. These costs are dominated by expenditures for unskilled labor, based on a daily wage rate of ₱12 paid by the tree farmers association to the farmers. The economic cost will first be treated as equal to this labor cost, but since during much of the year the laborers have little opportunity for other employment,1/ subsequent discussion will examine the implication of shadow pricing this labor to reflect its low opportunity cost. Based on an exchange rate of ₱8 to $1 and interest rate of 20%, the raw energy cost is $0.74/MBTU at landing.

Estimated economic costs include a considerable farmer profit margin2/ based on the agreed contract price between NEA and the tree farmers association. This price reflects market prices for fuelwood prevalent in the project area. NEA must pay at or near the market rate to lessen the temptation for farmers to sell to consumers directly and not

1/ Labor demand for tree farming largely does not coincide with periods of heavy labor demand for subsistence agriculture.

2/ Generally, the farmer is expected to achieve a larger financial margin as his costs will not be capitalized to reflect economic worth, but rather the financial terms of the loans provided by NEA to the TFAs.

to the cooperative. This margin substantially raises family income, which will also be augmented by income earned from inter-cropping agricultural crops.

A primary benefit of the NEA system is that the farmer and not the middleman profits. In most of the Philippine fuelwood and charcoal market, much of the difference between the sum of direct and indirect production costs and the market price to consumers goes to traders and other middlemen who primarily bear the cost of transport and the value of their own time and effort.

Including the cost of transport to the generation site, effective cost per kwh is $0.015 as shown in Table 2. Table 3 presents the capital and annual cost excluding fuel for a 5-MW generation plant. The plant is assumed to operate 5,520 hours per year at about 30% overall thermal efficiency. Approximately 1 MW will be consumed to run the power plant and auxiliary equipment in addition to transformer and transmission efficiency losses assumed to be 5% and 7% respectively (see Table 5a, Appendix G (Financial Tables)). At a rate of exchange of ₱8 = $1, and a 20% interest rate and a capital recovery factor of .202119 (25 years), the annual capital cost of generation is $0.028/kwh, the annual non-capital costs adds only another $0.004/kwh, with an additional $0.015/kwh for wood transport costs. To this must be added the fuel costs of some $0.011/kwh based on the raw wood cost of $0.74/MBTU.

Total costs of generating electricity are presented in Table 4, where they are compared with the costs of diesel-based electricity. Diesel-based electricity costs can vary dramatically. Smaller units not only have higher unit capital costs, but they also have lower thermal efficiencies, and therefore produce less electricity per MBTU of diesel fuel. The Table presents a range of costs for producing electricity with diesel fuel as well as an average cost. The average cost, based on international prices for diesel, will be the basis for the comparison. These costs have been conservatively estimated, based on larger units of about the same size range as the wood-fired unit. However, most importantly, the fuel cost estimate is also conservative for the following reasons: First, future oil costs relative to other costs will probably rise as discussed below, and the cost in Table 4 does not consider this factor. Second, the economic cost of $8.50/MBTU for diesel may not adequately reflect real local transport, storage and handling costs. Last, and most importantly, the heat rate used of 10,000 Btu/kwh is the nominal rate assigned generally by manufacturers. Experience in the Philippines and elsewhere indicate that in long run operation, this increases as much as 20% or more. While analogous arguments can be made regarding the wood-fired system, the problem is usually not as severe. The net result of this could easily make the relative gap in economic costs another 1-2¢/kwh in favor of wood-fueled power plants.

Offsetting this issue somewhat is the question of load factor. The analysis presented in the tables assumes 5,520 hours/year operation. While these hours may be high in many rural situations, it will not be

the case with these units, which will serve to meet base load requirements. However, it is useful to examine the implication of a significantly lower load factor reflecting a figure of 4,000 hrs/year. In effect, this increases the economic cost of capital items by 38% and also is more labor intensive. Revising the figures in Table 4 would result in an effective diesel cost of about $0.132/kwh and a wood-fired cost of about $0.077/kwh, so that even under decreased loads wood still looks very attractive.

This analysis has assumed that diesel is the most attractive alternative at the subproject sites. In the Visayas, there may well be site-specific areas in which small hydro is a more viable alternative than wood-fired or diesel power plants. Although mini-hydro is more capital intensive it is often very attractive on a long term basis because of its low operating costs.

It is useful to examine the implications of alternative economic assumptions. If there is a shadow value of ₱10 = $1, then the capital cost of wood-fired plants will decrease from $0.03/kwh to about $0.02/kwh, reducing the total cost to $0.05/kwh. But, by comparison, diesel-based electricity is import intensive in both fuel cost and generation, so the comparative cost of the diesel would be about $0.147 which makes the relative attractiveness of the wood-fired alternative very impressive.

Increasing the opportunity cost of capital can be examined, using a 25% interest rate which affects the capital items, primarily the generation cost. Based on Table 4, the capital costs of wood-fired system which are now about $0.04/kwh at 25% interest rate, is within the range of the capital cost of diesel generation plant. This comparison decreases the relative attractiveness of wood versus diesel, but not significantly.

A critical issue in this scheme is the yield of wood on the plantation. The discussion above is based on an annual increment of 25 MT/ha/yr and while this is well in tune with results elsewhere it is useful to examine the implications of markedly lower yields.

There are two different assumptions that can be made about the effect of lower yields. In the first case, the effective costs of raw energy stay at about $0.74/MBTU because the farmer's margin drops significantly and labor costs decrease to a limited extent reflecting lower harvest costs on a per hectare basis. This is deemed the most likely scenario if in fact the margins are reflective of the market value of these raw energy Btus and the comparative cost of other energy forms. If the scenario holds, there is no change in the relative economics of using wood to generate electricity, just a change in the farmer's margin.

An alternative but less likely scenario, stemming from lower yields, is that farmer's margins are preserved and raw energy costs increase. But even if the effective price per kilowatt hour is increased by 20%

perhaps because of yields as low as 20 MT/ha/yr, the fuel cost component would only be $0.0127/kwh and wood-based electricity would give a total cost of about $0.06/kwh which is still much less than diesel. But the more likely scenario, stemming from lower yields, would be lower farmer's margin.

As discussed earlier, a large percentage of the raw fuel cost goes to labor. If the opportunity value shadow price of much of this labor is low, that is, in the slack agricultural season the labor value is zero, then the true economic cost of the fuel is not $0.74/MBTU but perhaps some $0.25 lower or about $0.50/MBTU making the economic attractive ness of wood-fired systems still stronger.

C. Economic Feasibility: Analysis II

A standard economic feasibility analysis was conducted comparing the total initial and annual costs of the wood-fired power plant and its tree farm with the expected benefits. The benefits were estimated as the foreign exchange cost of diesel fuel required to produce the same amount of electricity. Shadow prices were used to approximate the low opportunity cost of labor (-50% of nominal costs) in the labor-surplus economy, reflecting the high rate of underemployment in rural areas, and the true peso value of foreign exchange (+25%), which is considerably higher than the current exchange rate.

The results of the basic analysis as presented in Table 5, indicate the economic internal rate of return (IRR) on the investment would be 29%, while the economic benefit/cost(B/C) ratio would be 1.6 at 20% discount and 2.1 at 15% discount. These indicators are well above the economic feasibility threshold.

A sensitivity analysis to test the effects of possible underestimation of costs and overestimation of projected benefits was conducted by increasing all costs 20% and reducing the benefit stream by 25%. The latter simulates the reduction of crude oil prices from the current $34 per barrel to $25.50 on the world market. Table 6 indicates that in this "worst-case" scenario the IRR drops from 29 to 20%, while the B/C ratios drop to 1.0 at the higher 20% rate of discount and to 1.3 at 15% discount. Thus if the opportunity cost of capital is held to be 20% in real terms and the "worst case" scenario occurs, this subproject would be at the feasibility threshold. At the more plausible discount rate of 15%, however, it would still be economically attractive.

A second sensitivity analysis was conducted to see how dependent the economic feasibility indicators are on the shadow price assumptions. Using nominal cost and benefit estimates only, with no shadow pricing of labor or foreign exchange, the IRR still achieves a healthy 25% level and the B/C ratio remains a strong 1.3 at 20% discount, 1.7 at 15% (Table 7).

These results show that the economic feasibility of the project is fairly robust and not overly dependent either on cost and benefit pricing accuracy or on the shadow price assumptions.

D. Financial Feasibility

The wood-fired power plant subproject includes developing 6,000 hectares of tree farms at an estimated cost of $3,390,000 and the construction of three 5 MW power plants at an estimated cost of $18,183,000. The total cost of this subproject is $21,573,000, of which AID will cover $9,000,000 (the foreign exchange costs of the power plants). The GOP will cover the local currency costs totalling the dollar equivalent to $12,573,000. This section analyses the costs and returns of (1) the farmers for a 100 hectare module tree farm, and (2) to NEA for a 5 MW wood-fired power plant.

1. Tree Farm

Tree farms for the wood-fired power plant program are developed on 100 hectare modules. Each module is operated by a Tree Farmers Association (TFA) composed of 10-15 members. The wood is sold to electric cooperative power plants at a common farm gate price of ₱65.00/ton ($8.12). Each module is developed over a period of four years; one-fourth (25 ha.) is planted each year. Ipil-ipil, or other similar fast-growing species, is planted at one-meter intervals, or 10,000 trees per hectare. Trees are harvested in four-year cycles, and new trunks grow from coppices which resprout from the stumps after each harvest. Thus, there are no costs incurred in replanting.

The development cost of each module is $56,500 over four years or $1,130,000 per 2,000 ha. tree farm.[1/] A breakdown of costs per module is shown in Tables 1, 2, and 3, Appendix G. The annual operating expenses for each TFA after Year 4 will be for farm supplies and transportation.

In this program, the TFAs are given four year crop loans of $565 per hectare. Loans are released through the electric cooperative in accordance with work accomplished on the tree farms. The loan consists of cash advances for labor inputs (planting, weeding, trimming) and non-cash (i.e., in kind) advances of silvicultural inputs such as farm tools, seeds, and fertilizers. The loan is for 12 years at 12% interest with a 4-year grace period. The annual amortization per TFA is $10,375 (₱83,000) beginning Year 5.

In the initial project years, members of the TFA derive income from cash advances for the labor they provide while planting and maintaining their respective modules. Miscellaneous income is earned from the sales of other crops. Once harvesting starts, the bulk of farmer

1/ This excludes capital expenditures for road construction and transport equipment and systems, plus organizational and administrative costs--general costs which are borne by the electric cooperatives.

income will come from wood sales. For purposes of comparison, sensitivity analyses based on growth figures of 25 MT/ha/yr and 40 MT/ha/yr (or a 100 ton and a 160 ton yield/ha/harvest respectively) and two association sizes, i.e., 10 and 15 members have been prepared.

It is important to understand when reviewing Tables 1, 2, and 3 that there is a relatively high degree of unemployment and underemployment within the population sector from which the tree farmers will be selected. As a result of full-time employment in developing the tree farms, they and their families will be able to earn that portion of the loan proceeds designated for reimbursement to association members for labor during the initial four years of the project, and at the same time continue earning from subsistence farming efforts. The earnings projected in Tables 2 and 3 are based solely on the sale of harvested wood and are fully additional to existing sources of income.

It should also be kept in mind that this analysis assumes that the wood-fired power plant will operate at 5,520 hrs/yr (60% of capacity) and at that rate will require the full annual harvest based on a growth rate of 25 MT/ha/yr. In fact, it is reasonable to anticipate that the tree farms will provide something between 25 MT/ha/yr annual growth and 40 MT/ha/yr annual growth. Since the farmers will be required to sell only 25 MT/ha/yr to the electric cooperative, production in excess of 25 MT may be (1) sold to the electric cooperatives if the plant operates at more than 5,520 hrs/yr, (2) left in place and sold in 7-8 years for lumber at significantly higher prices, or (3) sold for charcoal production. In addition, the tables do not include income projections for the leaves of the ipil-ipil which can be sold as leafmeal at $62.50/ton (₱500/8). Based on the current market situation, annual leaf sales could total 1-2 tons/ha beginning in Year 5.

Table 1 summarizes the cost of establishing a 100 hectare module with a projected escalation factor of 10% compounded annually. Tables 2 and 3 summarize the cash inflows/outflows and the resulting net cash inflow to a TFA for a 25-year period. Since the net cash inflow will be fully distributed to the members these tables may be used as an income statement and balance sheet. While Table 2 projects the cash flow based on an average growth of 25 MT/ha/yr, Table 3 is based on an average growth of 40 MT. The only difference between the two tables is the projected wood sales in Years 5-25 and the resultant net cash inflow to the TFA.

The bottom line for the TFA and its individual members as shown in Tables 2 and 3 is converted to dollars and shown below:

PROJECTED RESOURCE FLOW
(in dollars)
25 MT/HA/YR

	Year 1	Year 2	Year 3	Year 4	Years 5-12	Years 13-25
Net Cash Inflow to TFA	7,200	7,238	7,238	9,113	7,438	17,812
To individual member						
10 members	720	724	724	911	744	1,781
15 members	480	482	482	608	496	1,188

PROJECTED RESOURCE FLOW
(in dollars)
40 MT/HA/YR

	Year 1	Year 2	Year 3	Year 4	Years 5-12	Years 12-25
Net cash inflow to TFA	7,200	7,238	7,238	9,113	19,625	30,000
To Individual member						
10 members	720	724	724	911	1,963	3,000
15 members	480	482	482	608	1,308	2,000

Cash generations from wood sales as projected in Tables 2 and 3 fully cover both operational costs and annual loan amortizations and leave enough cash for distribution to members to increase their average annual income by a minimum of 2.5 times. This is calculated by taking the high side of the average upland farmers' income range ($125-187 annually) and dividing it into the lowest of the above projections ($480 /$187). Based on these projections the project is financially sound and provides adequate incentives to the TFA members to ensure their properly implementing the project.

2. Wood-Fired Power Plant

The initial investment required for building a 5 MW power plant is $6,061,000, approximately 50% of which is in foreign exchange. (See Table 4, Appendix G for detailed project cost breakdown.) The foreign exchange component is to be financed through a loan from NEA to the electric cooperatives, with $3,016,000[1/] payable in 25 years at 9.75%[2/] interest rate.

1/ An estimated $125,000 is also being provided under this program to provide procurement advisory services to assist and advise NEA and the cooperatives in purchasing the three power plants. Services include analyzing and developing plant specifications, writing and issuing an IFB, and assisting NEA and AID in reviewing bid documents and selecting suppliers of power plants and other hardware.

2/ This is a 9% interest being charged to NEA by the GOP which NEA passes on to the electric cooperative, plus a .75% service charge.

Financial projections for 25 years for a wood-fired power plant project, including the income and cash flow statements, cost breakdown per kwh, and balance sheet are shown in Tables 5a-e, and 6a-e. Where costs are expressed in Philippine currency, a conversion rate of 8 pesos equals one U.S. dollar has been used. Construction costs are based on those currently in effect in the Philippines. The costs for major pieces of equipment are based on prevailing prices obtained from United States equipment suppliers. An escalation allowance of 10% compounded annually is included.

The financial analyses are based on fuelwood having moisture contents of 34% and 40% and corresponding heating values of 5,000 and 4,515 Btu/lb. The total annual net energy produced by the plant is calculated to be 21,946 MWH. The plant is scheduled to operate 5,520 hrs/yr., with a 90% generating efficiency, 93% distribution efficiency, and a 30% overall thermal efficiency.

The major operating expense items are: woodfuel purchased from the tree farmers associations, equipment depreciation and interest charges. Based on a fuelwood moisture content of 34%, the annual operating expense in Year 1 is expected to reach $1,063,375 (₱8,507,000/8) or an average of $0.0475 (₱0.38) kwh; while the operating expense for a 40% moisture content is $1,086,375 (₱8,691,000/8) or an average of $0.04875 (₱0.39) as shown in Tables 5d and 6d respectively.

These costs compare favorably with the average rates charged by electric cooperatives to their customers in 1980, see Table 7. This table shows that the average power rates per kwh charged by cooperatives located in Central Visayas and Eastern Visayas, (the proposed locations of the three 5 MW wood-fired power plants) are $0.10 (₱0.80) and $0.12 (₱0.96) respectively. These rates range from 2.05 to 2.52 times the Year 1 estimated kwh costs of the wood-fired 5 MW power plants. However, since we have used 1981 and 1982 costs in our projections in Tables 5-6 this comparison is relevant.

The principal reason these 1980 average actual power rates charged by the cooperatives are over twice the estimated cost of producing wood-fired energy is that substantially all of the cooperative power is purchased from the National Power Corporation, the major portion of which is produced from imported fuel. Note that the hydro-power in Northern Mindanao had an average rate of only $0.05375 (₱0.43). The wood-fired power plants offer to (1) be an effective substitute for more expensive, imported oil-based power, (2) enable the electric cooperative to produce and distribute energy at a rate lower than existing oil-based power plants are charging, and (3) provide the electric cooperatives with a much greater profit margin than most have experienced to date.

At the end of the economic life of the project (25 years), the accumulated net earnings of the power plant fired with wood at 34% mois-

ture content, would be $7,749,750 (₱61,998,000); and $7,708,375 (₱61,667,000) for a 40% woodfuel moisture content. Cash balance would amount to $9,355,000 (₱74,840,000) and $9,313,625 (₱74,509,000) for a 34% and 40% woodfuel moisture content respectively. The average annual profit margin is about 15% which assures the recovery of investment within the economic life of the project. Cash generated from operations covers loan repayments (interest plus principal) 1.6 times and cash generations are greatest during the first 15 years of the project, when loan repayments are the lightest. The project will also have adequate earnings and cash generations to maintain and replace the transport infrastructure and other equipment as needed. Major replacement expenses are projected every 10 years in the tables.

The potential contribution of the three wood-fired power plants at 5 MW capacity each at the macro-economic level will be to reduce fuel oil imports by about 110 thousand barrels of oil equivalent per year or approximately $3,740,000 in terms of foreign exchange savings (at $34 per barrel). This calculation has not been factored into the financial analysis tables.

E. Social Soundness Analysis

1. Beneficiaries

Direct beneficiaries of this subproject fall in three categories. First, are the 600 families who will grow fuelwood trees for use in the three wood-fired power plants. Nearly all of these beneficiaries are landless and poor.[1/] They are generally subsistence farmers involved in rainfed (usually swidden i.e., slash-and-burn) agriculture on marginal uplands; most supplement their incomes as agricultural laborers on lowland paddy fields and plantations. These farmers are among the most impoverished in the rural Philippines. Second, are the 250 people who will receive employment in the three new power plants. Third, are the 73,000 current customers, both businesses and households, of the three rural electric cooperatives participating in this subproject who will benefit from lower energy costs.

Indirect beneficiaries include: (a) casual agricultural laborers who will be employed during periods of peak labor demand on the tree farms; (b) future customers who will benefit from expanded electrification and lower energy costs, and (c) unemployed and underemployed rural people who will gain employment in rural small-scale industries which should begin to develop and expand as the wood-fired power plants begin producing low-cost, reliable electricity.

1/ Definition and analysis of rural poverty is presented in CDSS documents for years 1982, 1983, and 1984.

2. Socio-Cultural Feasibility

The project is feasible within the existing socio-cultural context of the rural Philippines. Farmer participation in the project is voluntary and shifts in subsistence orientation--from subsistence rainfed agriculture to fuelwood production--will be gradual and should entail virtually no risks. Organizational requirements for production of fuelwood while different are compatible with cultural norms and local social structure. Further, a moderate flow of income and assured access to land should provide sufficient incentives for farmers to join and work within these organizations.

a. Socio-Economic Change

Farmers involved in rainfed and swidden agriculture on lands to be selected for tree farms will shift their primary subsistence orientation from field crop cultivation to fuelwood production. This reorientation, however, will be gradual over the initial four or five years and will entail only minor adjustments. Farmers will be encouraged to intercrop during the first year or two of each planting, to cultivate backyard gardens, to farm designated areas which have not yet been planted to trees or on lands not suitable for fuelwood species (e.g., lowlying areas), and even to farm in areas outside the tree farm. Once production is underway and harvesting begins, however, typical households will probably confine their agricultural activity to backyard gardening and inter-cropping between tree lines. This should not be surprising given that earnings from fuelwood production will be 3-4 times their current income. Some farmers may have already made considerable labor investments into the area they are farming (such as terraces or bunding), and may not wish to change their situation. In such cases, they will not be required to join the tree farmers association.

b. Risk

Participation in fuelwood production is voluntary and risk is minimal. Farmers will receive monthly incomes in the form of production loans during the years prior to the first harvest. Loans will be amortized at moderate interest rates from sales revenue of fuelwood, starting at the end of Year 4 and continuing for 8 years. Force majeure conditions will be in effect over the course of the loan. For example, if a natural disaster curtails or limits fuelwood production, an adjustment to amortization schedules will be negotiated. In addition, as mentioned above, farmers will be allowed to continue farming and gardening. Most important, their fuelwood will have a guaranteed market, assuring them of continued high incomes in the future.

c. Group Viability

Because production of trees and conversion to energy will be undertaken primarily by small groups of farmers rather than individuals, group viability is critical. Modern Philippine society cannot be

characterized as communal,[1] but cooperation among villagers, or bayanihan, is pervasive. Bayanihan refers to the mutual help given by members of a community during times of planting and harvesting, constructing homes, roads and bridges, moving a house from one lot to another, and preparing for a fiesta, party or other occasions calling for outside assistance. This cooperative spirit has already been successfully tapped in forming irrigation associations, establishing cooperatives, and organizing upland farmers for integrated rainfed resources development. Bayanihan should serve as a strong foundation for group viability in this project as well.

The most important factor contributing to long-term viability and success of the organizations, however, is that membership results in steady employment, relatively higher income, and assured access to land. These benefits are not obtainable outside the group, and thus there will be strong incentive for members to work for the success of the group.

Other factors contributing to long-term viability are: (1) group tasks and functions are relatively simple and focus on a single common goal; (2) most tasks are agricultural and are similar to those performed in rainfed agriculture (e.g., clearing, plowing or digging, planting, and weeding); (3) membership is small and will be comprised of neighbors, friends or kin; and, (4) organizational structure is simple and members' voting rights are guaranteed.

A final noteworthy point is that beyond general guidelines and by-laws for incorporation, the organizational form of specific farmer associations is flexible. On the nearly 30 tree farms already established by the NEA, careful attention is being given to discovering the types of organizational structure best suited for given socio-economic environmental situations. No single form will likely serve all the varied contexts. A multi-disciplinary team is already examining the determinants of differential success on several existing farms. The latter findings, plus careful monitoring of the associations formed for the three power plants under this subproject, will yield firmly grounded guidelines regarding the best-suited organizational formats for given contexts, tasks, and environments.

3. Spread Effects

The major spread effect of this project is entailed within NEA's plan to construct 70 wood-fired power plants by 1987. Seventy plants will result in employment and access to land for approximately 14,000 families. Although the power plants will receive their wood supplies primarily from tree lots established by the NEA, and thus will not

1/ Pre-Hispanic Philippine society was characterized by agricultural communities comprised of small groups of related families who owned, farmed, and shared in harvests communally.

provide a market for other producers, individuals or small groups of farmers might be encouraged by the project's success to undertake part-time, casual production of fuelwood species on their farms and around their homes. In addition to providing a modest supplemental income through local sale of firewood, the trees can provide shade, check erosion, serve as living fences, replenish the soil with nitrogen (if ipil-ipil or similar leguminous trees are planted), provide leaf fodder, and supply the family with firewood for its own consumption.

A different type of spread effect is the positive impact the project will have on the unemployment problem on sugar plantations. With depressed world prices for sugar, unemployment rates have soared. Many of the part-time, casual laborers on these plantations are upland agriculturists who seek work during the slack periods on their own farms. Those joining the TFAs will be so involved in tree farming, intercropping, and tending their household gardens, and later harvesting, that they will no longer seek additional employment. This will reduce the over-supply of agricultural laborers on the plantations, and thus allow many landless and near landless living in the lower elevations, who were previously competing with the uplanders for these scarce plantation laborer jobs, to have greater opportunity for employment.

4. Equity

This subproject should have a positive impact on problems of low income and rural unemployment. Target beneficiaries are primarily landless subsistence farmers who will receive higher incomes (by a factor of 3-4) and obtain long-term access to land.

Significantly, positive benefits of this subproject do not entail major negative socio-economic consequences. Areas selected for tree farms will be sparsely populated, the ideal being a 100 hectare area settled and farmed by 10-15 families. Most of the nearly 30 tree farms already established by the NEA follow the latter densities. In general, the settlement pattern in these sites has been a cluster of 3 to 4 households of kin for every 20 to 30 hectares. Families doing more or less settled agriculture, generally reside along a dirt track or road; those doing shifting agriculture have their houses in the scrub jungle, close to their present farms. No movement of people is required. Membership in the tree farmers association is voluntary and those not wishing to join will be allowed to continue farming, though they will be prohibited from engaging in shifting agriculture within the tree farm once it is completely planted to fuelwood species.1/

The only negative impact of the project is that some upland farmers will eventually be denied access to land which was previously

1/ It is expected that farmers who have not made significant changes to the area they farm, such as terraces and bunding, will eventually either join the association or move off the tree farm altogether once their current farms begin decreasing in fertility.

available to them for farming. Unless equally accessible land is readily available elsewhere, these farmers are bound to feel a loss. Moreover, given the existing situation of too many people on too little land, any restriction of land will result in greater pressure on other land, with consequent shortened fallow, increased erosion, and generalized environmental degradation.

Fortunately, however, given the NEA policy of preferring areas where population densities are low, the number of farmers denied access to lands by the establishement of tree farms should be small. Further, it is expected that a number of jobs generated by this project--constructing the power plants and surrounding infrastructure, running the power plant, and assisting on the tree farms during periods of peak labor demand--will, in many ways, compensate for any negative effects of the subproject. It should be noted that a number of observers (e.g., Gelia Castillo) have suggested that since upland farmers are marginal--only 26% of their incomes are derived from their own farms--that the best way to improve their lot is by enhancing off-farm and non-farm employment opportunities. Employment generated by this project, beyond that provided to the direct beneficiaries, will thus in general benefit upland farmers who lose access to previously available land.

5. Women in Development

As determined in Philippine attitudinal studies, the ideal role of men is "family provider" and the ideal role for women is "caring for the family and the household". Both sexes overwhelmingly hold these perceptions. In activities such as fuelwood production, where participants are families rather than individuals, both men and women are likely to be fully involved. Given the cultural norm that men undertake manual and physically exerting tasks, men will likely assume land clearing, digging, felling trees, and similar tasks; women will likely be more involved in planting, weeding, mulching, trimming and stacking of cut wood. While farm activities thus complement each other, men and women can be expected to share equally in decision making, financial management, and record keeping.1/ Women will continue to take responsibility for backyard gardens.

Although women are able and will be encouraged to participate in the project activities, their involvement will not be demanding and should not interfere with daily household routines. Tree farms will generally be located near residential areas, and it should be relatively easy for a woman to fit several hours of work on the tree farm into her

1/ Women in general have a strong, often controlling in certain household decisions, particularly in regard to financial matters. Experience in their projects where households rather than individuals participate indicates that women will at least share equally in decision making, financial management and record keeping.

weekly schedule if she chooses.[1/] Household tasks are generally re-allocated and rescheduled when the need arises, and it is culturally expected that Filipino males will share in such tasks as caring for children, cooking, washing clothes and dishes, and cleaning house, especially if their wives are employed.

Women will gain most as indirect beneficiaries in the project. As holder of the purse-strings and major decision maker in the disposal of household income, women will receive significant savings through reductions of fuel and power expense. This extra discretional income will likely be spent on food and other daily requirements which should contribute to the improved well-being of the household. In addition, women can expect to obtain additional employment, particularly as expanded electrification stimulates the development of rural small-scale industry and manufacturing.

While the project allows and encourages a good deal of female participation and provides a number of employment opportunities, not all rural women will be equally eager to participate. Many, in keeping with the previously mentioned ideal role for women, may choose not to work outside the home. In most rural societies, increased income results in a shift from household (chiefly female and child) labor to hired labor. The increased incomes that are expected under this project should have a similar consequence, freeing the rural Filipina, if she chooses, to concentrate on her role of caring for the family and the household.

F. Environmental Impact Analysis (EIA)

1. Tree Farm

On the whole, the change from present vegetation and land use to energy tree farm development making optimal use of nitrogen-fixing, fast-growing species will have a predominantly positive impact on the environment. Whatever negative influences result from this change can either be easily corrrected or are outweighed by the significant positive influences.

The above conclusion holds true for all three sites in this subproject. In spite of the variations in site factors and conditions, the study team concluded that the introduction of ipil-ipil into these areas will have far more favorable environmental effects than the present land uses.

1/ While nearly half of all females are housekeepers, nearly 60% of the women in the labor force are engaged in agricultural work, either on the household farm or as off-farm agricultural laborers. This proportion is even larger among the poorer rural households. Work that women will perform on the tree farm and in project-related agricultural activities (e.g., intercropping and gardening) is very similar to their present agricultural activities.

The adverse impacts predicted are: (a) increased soil erosion because of soil disturbance during site preparation, planting and road construction, and (b) possible entry of pests like rats because of the concentration of available food provided by the new plants. The first impact takes effect immediately following the rainy season, but is short-term. The second impact is also short-term and can be mitigated by proper cultural practices.

The team also felt that the heavy rainfall, the allelopathic effect of ipil-ipil on the underbrush, and the rapid decomposition of ipil-ipil litter could tend to induce sheet erosion in the long term. However, this is counteracted by the effective rainfall interception provided by the tree canopy and increased infiltration resulting from the inter-weaving root system.

Among the very favorable impacts of energy tree farm developments are: (a) improved microclimatic conditions such as stabilized soil temperature and moisture because of the higher and close canopy structure, and (b) increased primary biomass especially wood resulting from the reforestation of degraded areas with fast-growing trees. Significant environmental impacts are expected to result from this program, contributing to a greatly improved ecological balance.

2. Power Plant.

A wood-fired power plant in the 5 MW range will have a relatively minor if not insignificant adverse impact on the surrounding environment. This issue will be considered in terms of the interaction with the surrounding air, water and land. In general, the impact can be seen from the fact that the major pollutants in a typical combustion process are the oxides of nitrogen and sulfur as well as particulates and ash. Wood is essentially a sulfur-free fuel and oxides of nitrogen can be controlled in the combustion process. The majority of particulates can be removed with multicyclone separator while the bottom ash can be disposed on the tree farm land.

The firing of wood in a boiler can result in the emission of particulates and traces of carbon monoxide, sulfur, nitrogen oxides and hydrocarbons. The relatively small amounts of hydrocarbons discharged to the atmosphere in a remote area should not cause any significant health or air pollution problems.

Emissions of particulate matter have the potential to cause the greatest impact on ambient air quality. Multicyclones are incorporated into the system design to reduce air emissions below the significant threshold. Control efficiencies as high as 99.9% have been noted with achievements generally between 90-99% in conventional practice. Most likely, with these controls, particulate emissions on the order of 30 lb./hr will be achieved.

Sulfur dioxide emissions are directly related to the fuel-bound sulfur content and the rate of fuel combustion. Since wood contains virtually no sulfur, SO_x emissions will be insignificant.

Oxides of nitrogen emissions are determined basically by flame temperature and fuel-bound nitrogen content. The data indicate that nitrogen emissions may range from 0.2 to 1.2 pounds per million Btu heat input.

There is a possibility that some minor amount of water soluble extractives such as tannins could be produced or liquid effluents in the run-off from the fuel storage pile. This would only happen if the moisture content of the pile was in excess of 60%. These effluents could cause small discharges of biological oxygen demand (BOD) and color. As the fuel in the proposed subproject will be stored as roundwood and not chips, the likelihood of any discharge being formed is very small. Further, if any effluent was formed it would be of a sufficiently small magnitude so as to have a negligible effect on any potable or irrigation water supplies.

The solid waste associated with wood combustion includes bottom ash from the boiler plus residues collected in the air pollution control system. Unlike the wastes from coal combustion, those from wood do not contain significant quantities of hazardous or toxic materials.

In a typical wood-fired power plant, noise emissions result from fuel unloading, conveying, and storage pile maintenance, fuel size reduction processes, the operation of the boiler equipment (e.g., the forced draft and induced draft fans), and the transport and disposal of the residual ash. Of these sources, the particle size reduction systems are the most significant noise emitters.

In this subproject fuel preparation will not involve major size reduction and simple gangsaws will be used, thus greatly reducing noise levels. Noise from other sources can be kept to a minimum by using proper engineering principles.

The complete EIA for this project is contained in Appendix K.

G. Administrative Feasibility

This subproject is being implemented by an existing, highly successful institution. The National Electrification Administration (NEA) and its associated rural electric cooperatives have, in the past 10 years, extended electric distribution lines to over 1,600,000 new customers.1/

Currently the NEA budget runs at ₱1 billion per year and will climb to almost double that by 1983. NEA provides financing, policy

1/ AID has financed over $90 million in the NEA rural electrification program since 1969.

guidance, technical assistance and leadership for the rural electrification, mini-hydro and dendro-thermal programs.

In the rural electrification project, the most mature of the three, new house connections are being made at the rate of 1,200 per day, every day of the year. This involves simultaneous construction in over 100 locations nationwide with the handling of about ₱1,200,000 worth of supplies and equipment daily. A logistical apparatus exists which enables the NEA to ship required materials to the 100 plus locations on a dozen different islands while still maintaining very low construction costs. To date total program expenditures have averaged less than $200 per connection, a figure judged to be quite low by world standards.

There are now about 115 electric cooperatives managing systems serving 2,000 to 45,000 customers. The average system services 15,000 to 25,000 customers. These cooperatives have planned and managed their systems from their inception. A typical cooperative has about 150 employees and an income of over ₱1 million per month. Typically a cooperative has been expanding its lines at the rate of about 5,000 new customers per year.

Each cooperative has also been assigned the task of developing its own electric power resources, either through the installation of mini-hydro or wood-fired power plants, or both. Although relatively new, considerable progress has been made in these programs because NEA and the cooperatives are applying the same drive as they have to all of their efforts, plus they have gained extensive experience and skill in logistics. Over 30 tree farms have been established. Seventeen British and French power plant units are on order and the first units have started to arrive. An additional eleven units are under negotiation with the Japanese. (See Appendix I, Program Summaries.) By the time the U.S. supplied equipment arrives, at least twenty power plants will be fully operational. Three mini-hydro power plants are in operation and two more are under construction.

The tenor of the above is that this project will be melded into established institutions which have a proven track record. The project will add only a modest increment to the work load of the institutions and therefore there should be no significant administrative problems.

In terms of formal administrative arrangements the NEA has established a Dendro-Thermal Development Office (DTDO) the head of which reports directly to the NEA Administrator. (See Appendix J, DTDO Functions.) The DTDO currently has a staff of about 60 persons with a variety of engineering, financial, agricultural and administrative skills. By 1983 the staff size is expected to total 120. This office allocates sites to the cooperatives, assists in land leases, arranges procurement of equipment, and establishes general guidelines for tree farm development and power plant operations. The office works very closely with the cooperatives in development of the dendro complex. It also coordinates with supporting groups such as FORI, BFD, MHS and consultants.

Once the DTDO and a cooperative reach agreement in principle for the establishment of a wood-fired power plant the responsibility for project implementation becomes that of the cooperative. The cooperative establishes a Dendro-Coordinator's Office, typically of 5 to 6 persons. This office along with the cooperative general manager handles project administration and relations with the tree farmers associations directly. Thus, there is close and direct cooperative involvement in tree farm development and in the farmers institutional evolution.

The cooperative receives a loan from the NEA for tree farm implementation. In turn the cooperative relends this money to the tree farmers associations. In lending to the cooperatives, NEA adds a 3/4% service fee to the loan terms (See Financial Analysis). The cooperative administers the loan and disbursements are made to associations partly in-kind and partly in-cash on a work accomplished basis. The cooperatives collect loan payments by withholding a percentage of the cash due the association at wood sales time. In short, the farmer never has to brace himself for returning money for loan payments as all the money he receives from the cooperative and association is net of debt servicing.

The cooperative dendro coordinator's office performs a technical assistance and liaison role for the farmers. The office generally has a staff of six or more foresters/agriculturists, engineers and management supervisors to help on farming methods and to trouble-shoot problems that may arise. Preference in hiring is given to graduates of local colleges and universities who are familiar with the region's agricultural practices and conditions, the dialect, the people and have retained rural oriented attitudes and interests. If problems occur beyond the cooperatives expertise the coordinators office can request directly or through the NEA, assistance from U.P. Los Banos, BFD, FORI or other resource agencies.

As tree farm development progresses, the task at hand changes from one of strictly farming to farming and engineering. NEA has certified seven local A&E firms as knowledgeable in the rural electrification area. The cooperative enters into a contract with one of these firms to provide the technical services required in planning and constructing the transport system and the power plant.

The NEA's DTDO provides technical backstopping for the cooperative in evaluating and reviewing the A&E firm's work. The A&E firm prepares, designs and supervises construction. The construction can be done through a combination of force account and contract work. In addition, the DTDO will receive considerable technical assistance from a separately implemented project, as described under Section II, C, "AID Participation," and Appendix D.

These administrative arrangements are derived from the experience gained during the 10 years of the rural electrification program. They are well tested and provide an effective mechanism for project execution.

In addition, the Forest Research Institute (FORI) conducts continuous research studies of ipil-ipil (Leucaena leucocephala) and other tree species with high calorific value which can be grown in the tree farms. FORI supports the program by providing the latest and most advanced findings regarding seed technology, plant growth, thermal efficiency and agro-forestry.

Experts from FORI extend technical assistance by acting as speakers in various seminars on plantation management and development conducted under the program for the in-depth training of project agriculturists and foresters. The experts continue their research activities into the tree farms by making periodic field visits and observation tours of different project sites. The program benefits greatly by these project assessments and recommendations which are submitted to NEA. The Institute maintains a wide range of reference books and publications about forestry and the NEA staff has liberal access to them. In addition, NEA continues to develop its own library and information system.

As mentioned above, the NEA Dendro Thermal Program is initiated through close coordination with the BFD. Most of the project sites developed by NEA are foothill lands that are under the jurisdiction of BFD.

Technical assistance is rendered by conducting the relocation surveys that determine the definite areas to be converted into wood-fired power plant project sites and the identification of project boundaries. BFD geodetic surveyors handle the subdivision of tree farm sites into different modules to be cultivated by the tree farmers associations. The foresters of the bureau conduct inventories of existing trees within the project areas for possible interim fuelwood supply during initial power plant operations.

In general, BFD's involvement does not end here. It extends from the pre-establishment of tree farms through project implemention. Bureau foresters, on a voluntary basis instruct farmers on better and more efficient methods of farming and nursery establishment. Forest rangers assist farmers in the physical maintenance and patrolling of tree farms. Forestry assistance is also provided by the American Peace Corps which has 10 volunteers assigned to the NEA program.

Soil surveys and soil development recommendations are performed and made by the Bureau of Soil Services.

In summary, the administrative arrangements for the subproject are strong and fully compatible with successful implementation of the subproject.

Figure 3 outlines the intra-organizational support and operations loop.

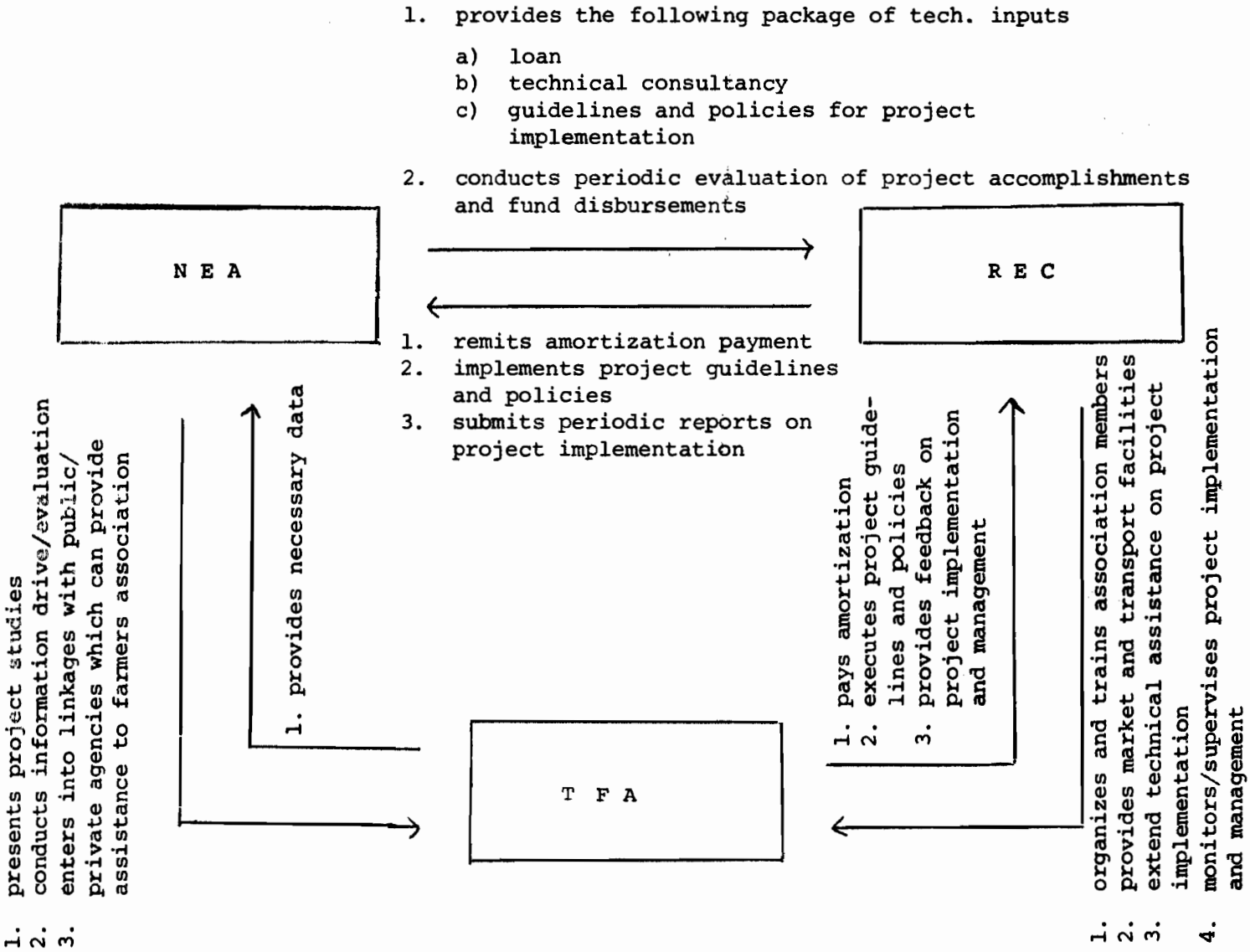


Figure 3

Support and Operations Loop

IV. FINANCIAL PLAN

This section discusses the financial plan for the three wood-fired power plants. Overall economic and financial aspects of the subproject at the farmer, association, power plant and national levels are addressed in Section III, B, C and D; Economic and Financial Feasibility.

A. Project Obligations

Following is an estimated obligation schedule for the purchase of three 5 MW power plants:

	($000)				
	FY 82	FY 83	FY 84	FY 85	Total
AID Grant (obligation)	7,000	2,000	-	-	9,000

The AID obligation will be used to purchase required imported hardware from the U.S. and U.S. source procurement services. In order for the NEA to initiate the offshore procurement, funds must be obligated by the donor. Accordingly, the AID portion of the project is proposed for obligation in late FY 82. Procurement will take place in FY 83 with plant delivery and payment in late FY 84 or early FY 85.

B. Disbursement Schedule

The proposed $9.0 million grant will be disbursed during the third and fourth year period. The GOP contribution indirect support to the project will be $12.573 million, peso equivalent. It will be spread over four years through the first harvest and initial plant operation. The project disbursement schedule follows:

($000)

	YEAR				
	1982	1983	1984	1985	Total
Tree farm Costs 1/ (Table 1)	669	722	795	1204	3,390
Power Plants (Table 8)					
GOP portion 1/	740	1932	3,381	3130	9,183
AID portion 2/	-	-	8,100	900	9,000
	1,409	2,654	12,276	5,234	21,573

1/ Payable in local currency and funded by the GOP.

2/ Payable in dollars and funded by AID.

The AID grant funds are being used to cover the costs of: (1) offshore procurement of fuelwood processing equipment, boilers and controls, steam turbo-generators, condenser/cooling water pumps, boiler feedwater treatment equipment, piping and electrical switchgear, and transportation and insurance; and (2) contracting an A&E firm to assist and advise NEA and the three electric cooperatives to analyze and develop plant specifications, write and issue an Invitation for Bid (IFB), and assist NEA, MHS and AID in reviewing bid documents and selecting suppliers of power plants and other hardware.

The NEA contribution will finance the costs of: (1) development and construction of civil works at the power plant sites; (2) development and operation of the tree farms through the first harvest, including the transportation infrastructure; (3) local purchase of electrical and mechanical equipment to complete the power plant; and (4) local A&E services, initial plant operating capital and miscellaneous needs.

C. Disbursement Procedures

U.S. equipment and materials imports and U.S. consultants (A&E) will follow normal AID disbursement procedures using either a direct letter of commitment or the letter of commitment/letter of credit procedure. A 10% retention will be used for equipment imports.

V. IMPLEMENTATION PLAN

This section covers implementation considerations for the AID financed portion of the wood-fired power plant project. Administrative feasibility questions relevant to the subproject are discussed in Section III, G.

A. Implementation Schedule

	Project Month
Obligation	0
Conditions Precedent	2
RFP Issued for A&E Firm (for procurement services)	2
Selection of A&E Firm	5
Site Appraisals and Design Specifications, IFB Preparation Completed	9
Review and Selection of Vendors	13
Award of Contracts	14
Start Equipment Production	16
Equipment Shipped	34
Equipment Arrival	36
Plant Civil Work Completed	36
Plant Assembly Completed	39
Commercial Operation	42

B. Project Management System

NEA - The U.S. A&E consultants to this subproject will be assigned to the NEA Dendro-Thermal Development Office (DTDO), from which they will assist and advise NEA, the electric cooperatives, the MAC Secretariat and AID in selecting the AID-funded equipment to be procured in this subproject. AID will work with NEA and the MAC Secretariat in implementing the subproject consistent with AID agreed to procedures and will monitor the use of AID-financed resources.

MAC Secretariat - The Secretariat will manage this subproject in coordination with NEA and AID. The Secretariat will review the A&E consultants' recommendations for equipment purchases and authorize NEA to proceed with procurement. The Secretariat will have primary responsibility for monitoring implementation. The Secretariat is currently developing its monitoring capabilities, and will be fully qualified to monitor and report on physical progress by the time the power plant equipment arrives and is installed. The Livelihood Support Fund officer will serve as the GOP responsible subproject officer and as a counterpart to the AID subproject officer.

AID - AID will monitor the subproject, provide appropriate AID approvals, and participate in progress assessments as well as evaluations.

C. Contracting/Procurement

1. Responsible Agency

All equipment purchases under this subproject will be the responsibility of the National Electrification Administration (NEA). NEA has demonstrated the requisite capability to undertake offshore and local procurement within AID regulatory strictures under previous AID loans. Technical assistance and advice in procurement procedures will be furnished by AID as needed.

2. Method of Procurement

Offshore procurement will be accomplished in accordance with AID regulations and good commercial practice. Specifically, NEA plans to contract with a U.S. A&E firm which will be assigned to work with the NEA Dendro-Thermal Development Office. This firm will be charged with assisting in developing specifications to be included in an IFB to purchase the necessary equipment to construct the power plants. The A&E firm will also assist NEA in evaluation of bidders' responses and selection of suppliers. All contracts resulting from the IFB will be reviewed and approved by AID prior to award.

3. Source/Origin of Procurements

The authorized source/origin of offshore commodities for this

subproject is AID Geographic Code 000. No need for procurement source or origin waiver is anticipated at this time. NEA will purchase from the U.S. fuelwood processing equipment, boilers and controls, steam turbo-generators, condenser/cooling water pumps, boiler feedwater treatment equipment, piping and electrical switch gear. If local purchases are required, they will be confined to small value items to support construction.

4. Payment Procedures

Payment to suppliers for offshore commodities will be accomplished by commercial letters of credit or AID direct letters of commitment, whichever is most feasible and advantageous to NEA.

5. Shipment

All equipment will be shipped on American, Philippine or Code 941 flag vessels and will comply with the 50-50 shipping requirements of the Foreign Assistance Act(FAA).

6. Marking

NEA is aware of AID marking requirements and will ensure that all equipment financed by AID will be properly marked. Conspicuous signs indicating the AID involvement in the subproject will additionally be placed outside the completed plants.

TABLE OF ASSUMPTIONS

I. Tree Farm

Growth and Yield of Ipil-Ipil for Fuelwood

	Particulars	Poor Sites	Fair Sites	Good Sites	Excellent Sites
1.	Average site index (m.)	7 (acidic soils)	10 (slightly acidic)	13 (near neutral)	16 (neutral soils)
2.	Approx. distribution	50%	30%	15%	5%
3.	Yield after 4 yr. (cu.m./ha.) (minimum input, large materials)	Reject as Ipil-Ipil plantation site!	69.8	125.9	227.0
4.	Yield after 4 yr. (cu.m./ha.) (minimum input, including small materials)		76.8	138.5	249.7
5.	Yield in t./ha. (at 0.60 specific gravity)		46.1	83.1	149.8
6.	Yield after 4 yr. (t./ha.) (at prescribed cultural mgt.)		101.4 (120% increase)	157.9 (90% increase)	209.7 (40% increase)
7.	Growth per year (t./ha.yr.)		25.3	39.5	52.4

Notes

1. Site index in meters refers to the total height that dominant and co-dominant trees are capable of attaining in 5 years.

2. Approximate distribution of sites among grassland areas and other potential plantation areas; ideal ipil-ipil site would be neutral soils, 500 m. elevation or lower, adequate rainfall and fertility.

3. Estimates based on yield table from plot data collected all over the country; plots at no or minimum inputs and only large materials utilized (over 5 cm. in diameter).

4. Yield including small usable materials (about 10% of item (3)).

5. Yield in t/ha. if specific gravity is 0.60.

6. Yield attainment if plantation is properly cared for, i.e., liming to correct acidity, cultivation, fertilizer application, regular weeding and crop protection. Estimated response (conservative) provided in parenthesis.

7. Item 6 divided by 4 years. Growth, refers to the increase in tree dimensions or to the increase in stand measures over a period of time.

a. Heating value of Ipil-Ipil at 34% moisture content — 5,000 Btu/lb.

b. Heating value of Ipil-Ipil at 40% moisture content — 4,515 Btu/lb.

c. Total yield/harvest for a 25MT/ha/yr growth

Yield/hectare/harvest = growth per ha/yr x no. of years

= 25 MT/ha/yr x 4 years

= 200 MT/harvest

Yield of a 100-hectare module

100 MT/ha. x 25 has. = 2,500 MT

At specific gravity = 0.60

100 MT ÷ 0.60 = 160 cu.m./ha.

$160 \frac{\text{cu.m.}}{\text{has.}} \times 25 \text{ has.} = 4{,}000 \text{ cu.m.}$

d. Total yield/harvest for a 40 MT/ha/yr. growth

Yield/hectare/harvest = 40 MT/ha/yr.

x 4 years = 160 MT/ha.

At specific gravity = 0.60

$= \frac{160 \text{ MT/ha.}}{0.60} = 260 \text{ cu.m./ha.}$

Yield of a 100-hectare module

= 260 cu.m./ha x 25 = 6,500 cu.m.

e. 1 barrel of oil = 6×10^6 Btu

$18{,}300 \frac{\text{Btu}}{\text{lb.}} \times 7.81 \frac{\text{lbs}}{\text{gallon}} \times 42 \frac{\text{gallons}}{\text{Bbl.}} = 6.00 \times 10^6 \frac{\text{Btu}}{\text{Bbl}}$

f. 25 MT of wood = 46 Bbls. of oil

100 MT of wood = 184 Bbls. of oil

II. 5.0 MW Wood-Fired Power Plant

a.	Average operating time	5,520 hrs/yr
b.	Transformer efficiency	95%
c.	Transmission efficiency	93%
d.	Overall thermal plant efficiency	30%
e.	Wood-Fired requirement per megawatt hour[1/]	1.04 MT
f.	Gross energy generated (5MW x 5520 hrs/yr)	27600 mwhr.
g.	Net energy transmitted (27600 x .90 x .93 x 95)	21946 mwhr.
h.	Price of wood fuel/MT (1983) $8.13 =	₱65.00
i.	Price of crude oil/barrel $34.00 =	₱272.00
j.	Annual foreign exchange savings per 5 MW wood-fired power plant $1,243,600 =	₱9,948,800

1/ 5 MW = 17 x 10^6 Btu/hr. @ 30% thermal efficiency,

57 x 10^6 Btu/hr. is required to achieve 5 MW output

$$\frac{57 \times 10^6 \text{ Btu/hr.}}{5{,}000 \text{ Btu/lb.}} = 11{,}400 \text{ lb/hr.} = 5.2 \text{ tons/hr.} = 1.04 \text{ MT/mwhr}$$

LEGAL RIGHTS AND PROTECTIONS OF THE FARMERS ASSOCIATION

This document is appended to the Project Paper in order to address the legal aspects of the questions raised in paragraphs 2 D(2) and (by extension) 3A of 1981 State cable 317473 which approved the PID for this Project.

The referenced paragraphs requested, among other things, a review of the legal rights and protections of the farmers associations with particular reference to their rights to lease and hold lands for tree farming use.

Such a review had already been performed prior to receiving State 317473, and the conclusion therefrom remains valid; i.e., the farmers associations do have legal rights and protections which are sustainable by the judicial courts of the Philippines and which appear adequate for purposes of AID financing requirements.

The tree farmers associations have been fostered and supported by the National Electrification Administration (NEA) under its charter. NEA was established in August 1973 by Presidential Decree (PD) 269 (as amended by PD 1645). The powers provided to NEA included the authorization and registration of cooperatives relating to the supply and use of electric power. NEA has used this authority to provide for the recognition and registration of power plant related tree farmers association.

The associations incorporate as legal corporate entities recognized by the law of the Philippines and are registered with NEA; making them legally established corporations under the laws of the Philippines having the rights and remedies associated therewith.

NEA has model articles of incorporation and model by-laws available to the farm groups with which it works. The guidelines explain the requirements and responsibilities associated with incorporation. The guidelines appear to be quite adequate for the purpose they fill.

In the view of the USAID Mission, the rights of the members of the associations we are assisting are established by law and may be protected by the judicial courts of the Philippines.

In the NEA program, the Rural Electric Cooperatives lease the public lands to be used by the farmers associations. The cooperatives will lease the land and the associations will own the trees to be sold to the cooperatives. The Government of the Philippines' responsibility for public land applicable to this discussion has been delegated to the Ministry of Natural Resources. Its Bureau of Lands administers Commonwealth Act No. 141, the Public Land Act; and its Bureau of Forest Development administers Presidential Decree No. 705, the Forestry Reform Code of the Philippines. Both laws provide for the lease of public lands (for agricultural purposes and for forestry purposes, respectively) for periods of 25 years, renewable for an additional 25 years. The provisions of each law specifically allow for such leases to be entered into with associations (corporations) of Philippine citizens, which the cooperatives (as well as the farmers associations) clearly are .

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Both the Bureau of Lands and the Bureau of Forest Development have promulgated regulations and rules applicable to leasing lands for purposes which include the development of the type of tree farms we will be assisting. The Bureau of Lands has actually issued a "Primer" on the leasing of such lands which explains in considerable detail the steps to be taken in order to lease public land. Similarly NEA has guidelines relevant to leasing public land and on the assistance it can provide in this regard.

Further, the President has issued Executive Order 725 as the official Government policy directive encouraging and facilitating the establishment of tree plantations. This executive order reiterates the provision of an initial twenty-five year lease and additionally provides for the "automatic" renewal thereof for an additional period of twenty-five years at the option of the lessor (providing the lessee has complied with terms of the lease).

A sample lease published by the Ministry of Natural Resources is attached. Other documents, laws and decrees referred to herein are on file in the Office of the AID/Manila Regional Legal Advisor.

Republic of the Philippines
Ministry of Natural Resources
Office of the Minister
Diliman, Quezon City

INDUSTRIAL TREE PLANTATION LEASE AGREEMENT NO._____

OF

_____
(Name of Lessee)

_____
(Location of Area)

This AGREEMENT, made and entered into by and between:

The MINISTRY OF NATURAL RESOURCES, for and in behalf of the Republic of the Philippines, hereinafter referred to as the LESSOR, and_____ _____with residence and postal address at _____ hereinafter referred to as the LESSEE:

WITNESSETH, THAT:

WHEREAS, the establishment of industrial tree plantations is encouraged as Government policy to accelerate the country's reforestation efforts which shall promote ecological balance and assure an adequate wood supply to meet local and foreign demand;

WHEREAS, P.D. 705, P.D. 1559, and other existing laws, rules and regulations provide for incentives to qualified developers and operators of industrial tree plantations;

WHEREAS, the LESSOR and the LESSEE are desirous of entering into this Industrial Tree Plantation Agreement;

NOW, THEREFORE, for and in consideration of the foregoing premises, the LESSOR, as Minister of Natural Resources and by virtue of the Authority of Presidential Decree No. 705, as amended by Presidential Decree No. 1559, otherwise known as the Revised Forestry Code of the Philippines, hereby leases to the LESSEE _____hectares of public forest land covering a period of twenty-five (25) years to expire on _____, automatically renewable for another twenty-five (25) years, which land is located at Sitio/s _____

Barrio/s _____, Municipality/ties of _____
_____, Province of _____,
Philippines, the description and boundaries of which are shown in the attached sketch which forms part of this Lease Agreement.

This Lease Agreement shall be for the planting of trees to supply the requirement of existing and proposed wood processing, energy plants and other related industries subject to the following terms and conditions:

1. The LESSEE agree to plant and raise in the area covered under this Lease Agreement trees for the production of saw timber, pulpwood, etc., and other crops suitable for energy generation or for other government sponsored development projects if found viable.

2. The planting of dipterocarp or primary trees of commercial value and raising of secondary crops shall be confined within the perimeter of the parcel of land described herein. The LESSEE shall conserve and preserve the monuments and other landmarks indicating corners and outlines along the boundaries and within the confines of the area covered by this Agreement.

3. The area subject of this Lease Agreement is a public forest land and does not include areas already declared as A&D lands or private lands and any such lands shall be excluded from the boundaries of the ITP leased area.

4. The LESSOR reserves the right to permit, if public interest requires the opening of such portions of the area under lease for logging, mining, and other public rights-of-way, which shall not be more than _____meters wide; Provided, That the person or entity granted the right-of-way shall pay the LESSEE a reasonable compensation for any damage to improvements, if any, occasioned by such opening.

5. No rental shall be collected during the first ____years from the date of issuance of the lease; Provided, That from the _____to the _____year, the annual rental shall be _____per hectare; and thereafter, and until the expiration of the lease, the annual rental shall be _____per hectare; Provided Further, That if the area be declared/certified as long denuded by the Director of Forest Development, duly approved by the Minister of Natural Resources, the LESSEE shall be entitled to exemption from payment of rentals for the full term of the Lease Agreement.

6. All operation and planting of agricultural crops, forest crops, in harmonized combination with the raising of animals, shall follow such rules and regulations that may be issued by the Bureau of Forest Development;

Provided, That precautionary measures shall be instituted to minimize surface run-off, soil erosion, and other land imbalance. Non-compliance with such rules and regulations shall be sufficient ground for the cancellation of this Lease Agreement.

7. If the LESSEE does not utilize the area leased herein for the purpose for which the lease is granted, or fails to comply with the terms and spirit hereof within one (1) year after the signing of the Agreement, then this Lease Agreement may be cancelled by the LESSOR, except for causes beyond the control of the LESSEE.

8. The LESSEE shall improve and plant at least _____ of the area herein granted within three (3) years from the execution of this Agreement; _____ of the area within five (5) years; _____ of the area within seven (7) years; and the balance of the entire area within _____; otherwise, a more realistic plan shall be submitted, giving details on budget, cash flow, and timetable of development within the capabilities of the LESSEE, subject to approval by the LESSOR; Provided, However, That the LESSEE shall always maintain the area forested, which shall be planted with trees immediately after they are cut; otherwise the LESSOR may reduce the area granted, commensurate with the capability of the LESSEE to improve and make use of the area, or cancel the lease for cause and forfeit the bond deposit.

9. As a guaranty for the faithful performance of the conditions of this Agreement, the LESSEE shall furnish or deposit a bond in the amount of _____ (₱ _____), if cash or other acceptable government securities, and an additional twenty-five percent (25%) more than the amount herein provided, if by a surety. The LESSEE agrees that the said bond shall, upon his failure to fulfill all and singular the conditions and requirements herein set forth or made part hereof, be retained and/or forfeited in favor of the Republic of the Philippines to be applied, as much as practicable, for the satisfaction of the obligations assumed hereunder; and the LESSEE further agrees that should the sureties on the bond delivered herewith or any bond delivered herewith or any bond delivered thereafter in connection with this Agreement become unsatisfactory to the LESSOR, the LESSEE shall, within thirty (30) days from receipt of notice or demand, furnish a new bond with sureties solvent and satisfactory to the LESSOR.

10. The LESSEE shall do all in his power to prevent and suppress fires in the area under this Agreement or other areas immediately adjacent thereto, and to place his employees or workers under the direction of Foresters or other authorized agents of the Director of Forest Development, whenever required for the purpose of putting out or preventing forest fires.

11. The LESSEE shall be responsible for the protection and conservation of forest growth in the area under lease and shall cooperate with the Bureau of Forest Development in the protection of forest areas immediately adjacent thereto.

12. The cutting, gathering, or protection of trees, naturally growing in the area of lease shall be regulated by the BFD. For this purpose, all dipterocarp and endangered tree species inside inadequately-stocked areas shall not be cut except when so authorized in accordance with BFD rules and regulations.

13. The LESSEE shall not assign or sub-lease the leased area or any portion thereof, neither shall the LESSEE encumber the leased area, in whole or in part, to any lending entity for the purpose of securing credit financing, without the prior approval of the LESSOR.

14. Upon expiration of this Agreement or on its termination when public interest demands, all permanent improvements on the area shall remain on the plantation, but the LESSEE shall be entitled to fair compensation for such improvements introduced by the LESSEE on the leased area in an amount to be determined by a third party appraiser mutually acceptable to both parties. The compensation for the standing trees shall be their market value at the expiration date of the lease, using the following formula, to wit:

$$V = \sum_{i=1}^{n} V_i$$

$$V_i = \frac{P_i Q_i}{(1+4)^t}$$

Where:

V	=	Total amount of compensation for standing trees
V_i	=	Value of standing trees for specific timber/wood products at the expiration date of the lease
i	=	Particular type of timber/wood products expected from the industrial tree plantation

n = Number of types of timber/wood products expected from the industrial tree plantation

P_i = Price of specific timber/wood products, based on the standing trees, the expiration date of the lease

Q_i, t = Expected harvest upon maturity of trees

t = Years to harvest from expiration date of the lease

r = Interest rate prevailing at the expiration date of the lease

The LESSEE shall be entitled to compensation for permanent infrastructure introduced by the LESSEE, based on their fair market value as of the expiration date. The LESSEE may remove the temporary or semi-permanent structures, unless the LESSOR opts to retain them by paying their fair market value as of the expiration date. The value of the improvements shall be finally determined by the appraiser mutually accepted by both parties.

15. In the event of violation by the LESSEE or his authorized agents of any provisions of P.D. 705 and P.D. 1559 governing the protection of the trees in the lease area, or of the terms and conditions of the lease agreement; and the event that after due warning by the LESSOR to the LESSEE, the latter fails within a reasonable time, which time shall not exceed three (3) months, to stop the violation referred to; or in the event that the LESSEE or his agents or other persons operating under this Lease Agreement, commit and act tending to influence a forest officer, to induce him directly or indirectly to violate existing rules and/or regulations, then this Agreement may be cancelled by the LESSOR without the right of compensation under the immediately preceding paragraph.

16. To insure normal balance of forest cover, the LESSEE shall submit a development program for the leased area for the approval of the LESSOR which shall form part of this contract upon its approval. No revision shall be made on such program without the mutual consent of both parties.

17. The LESSEE is required to submit on or before the 30th day of January of each year an annual report ot the LESSOR, showing, among others, the number of hectares developed during the year, species, planted, survival rate at the

end of the year, number and size of nurseries established, kinds of seedlings raised, and other improvements introduced during the year. Quarterly progress reports shall be submitted to the BFD during the tenure of this Agreement.

18. The LESSEE shall not unnecessarily impede, obstruct or in any manner prevent the passage of legitimate licensees, lessees, permittees and/or other forest users and the public, by virtue of the lease herein granted.

19. After the final ground survey, the boundaries of the area covered by this Industrial Tree Plantation Lease Agreement shall not be altered or modified except when public interest demands.

20. In the process of development, the LESSEE shall strictly observe and/or implement all possible measures for the protection of watersheds and the environment to the effect that:

    a. No trees in the leased area shall be cut regardless of species, if found within 20 meters from edges or rivers or creeks of at least five (5) meters in width and of public roads.

       Open, denuded, brushlands, or inadequately stocked areas along stream channels below five (5) meters in width shall be planted with trees and may be harvested if included in the duly approved industrial tree plantation development plan.

    b. The LESSEE shall protect and conserve unique, rare, and endangered trees, plants and wildlife indentified under existing laws, rules, and regulations within the leased area.

    c. The LESSEE shall plant five (5) edible fruit tree species per hectare of the area under lease, to provide aid and comfort, and food for wildlife species.

    d. There should be at least sixty (60) surviving seedlings of suitable dipterocarp species per hectare of the area after three (3) years from the start of land development.

21. In the event that there are old growth forest, mossy forest and other prohibited portion within the area subject of this Lease of Agreement which may be discovered later that same shall be subjected to ground delimitation within sixty (60) days after discovery.

22. In the event that there shall be found later forest occupants within the area subject of this Lease which were already there before inspection of the area was made, the LESSEE shall within sixty (60) days upon discovery of such occupants submit a revised Industrial Tree Plantation (ITP) development plan to government with the reduced area which plan shall include, among others, an effective scheme for the management of such forest occupants consistent with the provision of P.D. 705, as amended and other policies, rules and regulations related thereto. If such occupants were proven to have been in the area before 19 May 1975, the LESSEE shall not disturb the occupancy until further instruction from the Director of Forest Development and priority shall be given to those forest occupants in the matter of implementation.

23. Construction of permanent infrastructures that are not necessary in the development of industrial tree plantation such as houses of concrete and strong materials is not allowed under this Lease.

24. The LESSEE shall coordinate/link up the development scheme with the Kilusang Kabuhayan at Kaunlaran (KKK) program of the New Republic.

Quezon City, Philippines
_____, 19_____

For and in behalf of the
Republic of the Philippines

_____ _____
Minister of Natural Resources (LESSEE)

WITNESSES: WITNESSES:

_____ _____

_____ _____

RECOMMENDED BY:

Director
Bureau of Forest Development

REPUBLIC OF THE PHILIPPINES)
) S.S.
QUEZON CITY)

In Quezon City, this _____day of _____, 19_____, before me a Notary Public for and in the said City, personally

Name	R.C. NO.	Date of Issue	Place of Issue

_____
Minister of Natural Resources
(LESSOR)

_____
(LESSEE)

known to me and to me known to be the same persons who executed the foregoing instrument and who acknowledged to me that the same is his free act and deed.

This document is an INDUSTRIAL TREE PLANTATION LEASE AGREEMENT NO. _____covering _____parcels of public forest land, consisting of eight (8) pages and each is signed by the LESSOR and his witnesses and bears my Notarial Seal.

Witness my hand and official seal, on the date and place first above written.

NOTARY PUBLIC

Doc. No. _____;
Page No. _____;
Book No. _____;
Series of 19_____.

TREE FARMERS ASSOCIATIONS 1/

Tree Farmers Associations are an integral part of the electric cooperatives responsible for meeting the fuel requirements of a coop's wood-fired power plant. Membership is voluntary; the group is small; the organization and management are simple and the purpose singular.

I. Organization

Preparatory Activities

Pre-organizational activities such as a site survey, soil analysis and the approval of the 25-50 year lease of the tree farm site are coordinated by the electric cooperatives established by the National Electrification Administration (NEA) in cooperation with officials from the local government, the Bureau of Forest Development, the Bureau of Lands and the Bureau of Soils.

After these arrangements are firmed up, the electric cooperative officials embark on an information drive and discuss the project with prospective beneficiaries covering project concepts, mechanics, by-laws, articles of incorporation, membership, criteria for selection of officers of the association, loan and repayment systems and obligations and other topics. Given this guidance, potential beneficiary leaders emerge and they, in turn, voluntarily initiate the formation of tree farmers associations.

Prospective beneficiaries are Filipino citizens who are residents or prospective residents of the community within and surrounding a project site. Association members are usually heads of families. They must indicate an ability and willingness to perform manual labor. Applicants with no stable means of livelihood are given preference. Being from the same community and social level, the applicants generally know each other.

Other interested applicants for association membership are asked to file application forms with the electric cooperative in case a tree farm is later expanded and additional members are required.

Organizing Process

The electric cooperative screens the applicants, and those who are qualified merge into groups of usually ten (10) members. Each group forms a separate and distinct farmers association, and is assigned more or less a 100-hectare module.

The members of the prospective association elect their officers who then constitute a board of directors. These officers are oriented and trained by the electric cooperative regarding their roles and responsibilities in relation to the association and the electric cooperative.

1/ For the Wood-fired Power Plant Subproject, an estimated 20 farmers associations were organized and other are in the process of organization as of February 1982.

The officers discuss, draft and move to adopt by-laws and articles of incorporation which are ratified by the association members. The process, though simple enough, takes time. The free exchange of ideas among officers and members is encouraged to promote clear understanding by the members of their responsibilities as well as privileges.

Registration

The prospective farmers association registers and files with the NEA its articles of incorporation, by-laws, a resolution approving the articles of incorporation and by-laws, a resolution requesting the electric cooperative to grant a loan financing the establishment of a tree plantation for the dendro-thermal project, and a resolution authorizing the president of the association to sign loan documents and other agreements in behalf of the association. The three resolutions must be agreed to by the members of the association.2/ The NEA then issues a Certificate of Registration signed by the NEA Administrator.

II. Management

Concept

Tree farmers associations are formed and organized by electric cooperatives to establish 100-hectare modules as the source of fuelwood to the wood-fired power plants. The associations operate as legally incorporated business enterprises engaged in tree farms for profit.

Association membership is usually limited to ten members to allow each member to earn as much as ₱5,790 per annum during the tree farm development phase, or about 25% higher than the average rural family income of ₱4,370 per annum; and considerably higher than the ₱1,000 average income of the upland unemployed and underemployed who comprise the group earn at present.

The NEA extends loans to the electric cooperatives, which are in turn relent to the associations as tree production loans.

The fuelwood produced by the associations will be purchased exclusively by the power plant of the electric cooperative at competitive market areas.

Training

The NEA, together with the electric cooperatives, offers training courses for farmers association leaders and members. These include short courses or seminars on (1) project orientation, (2) plantation establishment, (3) basic business practices such as simple accounting, and (4) how to conduct meetings and business.

Project-related special training courses are likewise designed and offered to the association to ensure effective and efficient administration and operation of the tree farms. Tree farm management training precedes the establishment of the associations. Moreover, retraining is provided as necessary to improve productivity.

2/ Experience to date indicates once organized, the member freely agreed to the resolutions.

Operations

The farmers association establishes the tree farm using guidelines set by the NEA, the realities of the site and their own experience often based on years of working on or near the site area. The NEA also provides guidelines on seed procurement, loan fund availment, adaptation and cultural practices for fruit-bearing and timber trees, accounting procedures, reporting systems, sample articles of incorporation, by-laws and association board resolutions pertaining to legal commitments, i.e., loan documents and other agreements of the association. These guidelines serve as operating aids for the farmers association in developing and managing their farm and group.

While NEA sets the tree plantation guidelines, the association members define the specific module management practices, i.e., individual tasks and assignments such as who does supervision, security patrolling, clearing, planting, weeding and harvesting. The members impose their own system of checks and balances to ensure that all members perform their respective functions.

Each module is developed following a four-year cycle. A quarter of the area is developed each year until the full 100 hectares is developed on the fourth year.

The farmers associations are supported by the electric cooperative through a staff complement composed of a dendro coordinator, in charge of overall supervision, an agriculturist, a forester, an agricultural aide, and an agro-forestry supervisor to handle tree farm development, an organization development specialist, and administrative support personnel. In addition, technical support is made available from NEA, another government agencies or consultants through NEA, as needed.

Evaluation

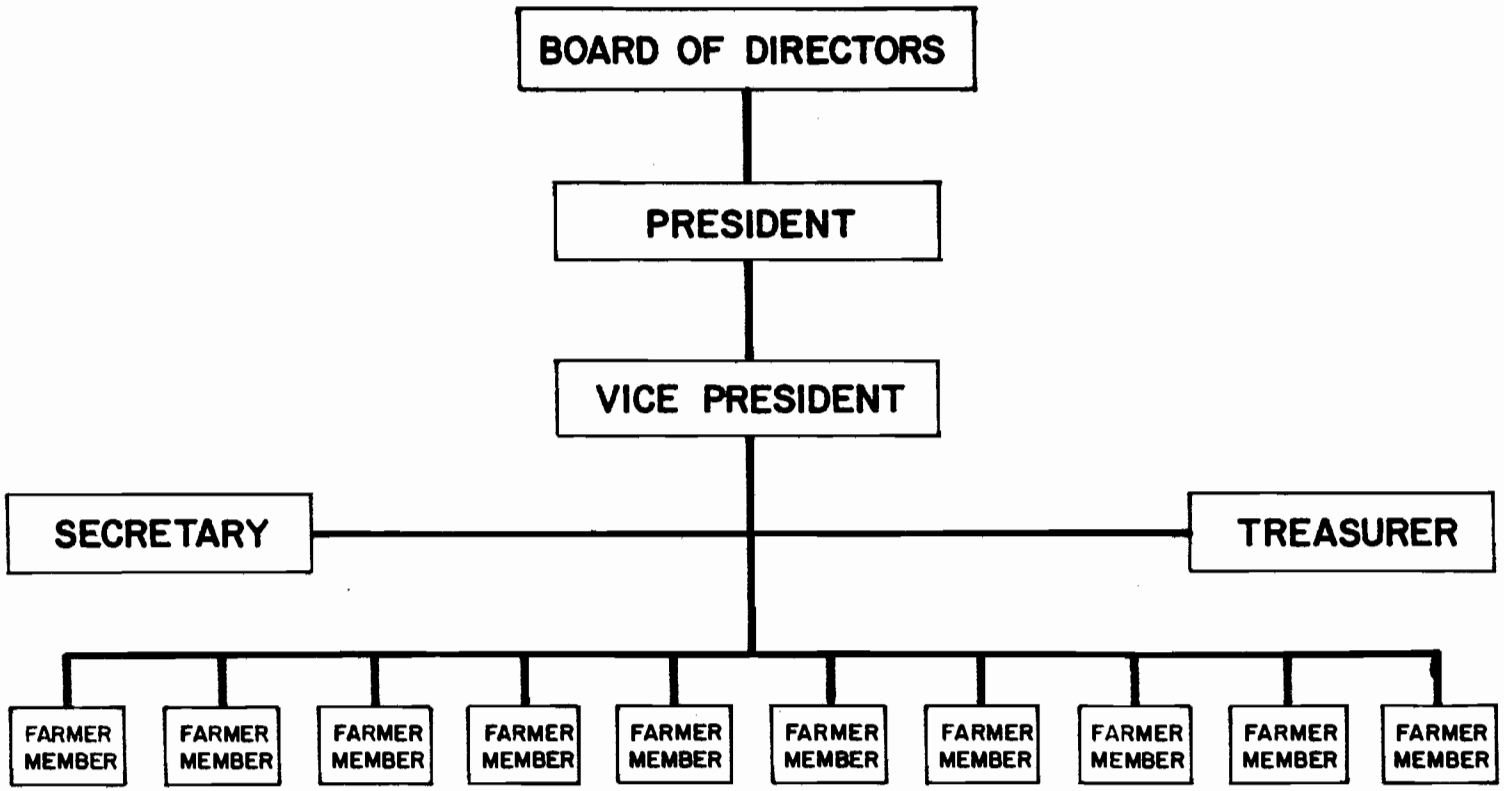
Twice a year, evaluation of the institutional development of farmers associations is conducted by NEA and/or the electric cooperatives. This serves to assess the performance of officers of the association and of the association as a whole.

A set of recommendations is then formulated and acted upon by concerned parties to improve their performance if necessary.

Benefits

On top of assistance in the form of training, organizational development, credit and marketing, the project provides several benefits to association members in the form of additional livelihood opportunities. The associations are encouraged to engage in intercropping, i.e., cash crops such as rice, sweet potato and corn for the short term, and timber and fruit trees for the long term on the tree farm site to augment the members' incomes. The program clearly provides employment to both the unemployed and the underemployed.

ORGANIZATIONAL STRUCTURE OF THE FARMERS ASSOCIATION



RURAL ENERGY/REFORESTATION TECHNICAL ASSISTANCE PROJECT
(Summary)

Project Objectives

The $3.0 million Rural Energy Technical Assistance Package will provide the NEA and FSDC energy-reforestation programs with technical assistance and research support. This support will enable the implementing agencies to modify and improve the implementation of these programs.

The project's overall objective is to accelerate the process of refining available knowledge and techniques in the production and use of wood biomass energy to achieve reliability in wood production, cost reductions and improvements in conversion processes and end-uses. In addition to direct support, the project's consultants will assist in upgrading the technical capability of the implementing agencies' expanding staffs.

This package is being implemented in close coordination with other national government agencies who are engaged in parallel efforts to develop energy tree farms, such as the Bureau of Forest Development, Ministry of Natural Resources.

Project Components/Description

The technical assistance package addresses several major areas supportive of and critical to wood-based projects. The project elements are:

Detailed

1. Species Selection and Seed/Seedlings Development

Tree farm development to date has been primarily sensitive to available materials. Fuelwood tree farm development has started on over 60 sites throughout the Philippines and additional locations will be chosen as NEA and FSDC expand their biomass-based energy programs. The objective of this effort is to expand species availability and to define the best species for prospective sites. Currently, fuelwood tree farm development has been restricted almost exclusively to ipil-ipil (*Leucaena leucocephala*), a fast-growing tree for which seeds are readily available.

There are pronounced differences in soil, slope and climatic conditions between and even within existing and future sites. Biomass production is enhanced when the right species is selected for the right site. Choosing what to plant is often complicated when developers are confronted with a need for species diversity.

Philippine plant propagation methods for producing tree seedling have focused on production of fruit orchard and reforestation (for timber) species. NEA/FSDC seed/seedling development programs can benefit from existing state-of-the-art accomplishments.

At the same time, it is recognized that nursery management linked to development of fuelwood tree farms, or backyard fuelwood lots for small-scale upland farmers has not been given much emphasis. Neither have the potentials of many promising, fast-growing fuelwood trees been exploited, or even

examined beyond the laboratory stage. It is to start to rectify this situation that this activity is planned.

To broaden the base of planting options, exploit the advantage of matching appropriate species to site, and help build diversity and stability into fuelwood tree farm projects, the contractor will develop and begin implementation of a seedling development program designed to:

a. Review known high yielding varieties and select 4 to 8 which appear promising for the Philippines.

b. Procure seeds and other planting materials for promising species appropriate for the several agro-climatic conditions found in Philippine fuelwood tree farm sites.

c. Conduct provenance and varietal trials under actual field conditions.

d. Establish propagation programs for the most promising species/varieties.

e. Organize and operate seed/seedling farms to multiply large quantities of planting materials from superior clones of proven species/varieties to produce usable quantities of seed/seedlings as rapidly as feasible.

f. Document results of the above-described activities and produce manuals that will help guide field-level implementors.

The contractor will be engaged to implement the activities described at two or three sites in different regions. This dispersal of research and provenance testing is designed to facilitate linking seed/seedling development to rapid application on fuelwood tree farms, woodlots and orchards throughout the country. Concurrently, this will expedite information feedback from the field to research centers and then to propagation/multiplication nurseries.

An important benefit will be development of an assured supply of planting materials in the quantity acquired to help make a large scale biomass-based energy program practical at the operational level. The contractor will manage this program for a 24 to 30 month time period.

2. Analysis of Yield Response

It is well known that trees give quite different yields under different situations. Soil type, cultivation regimes, time of planting and other factors all influence yield to some extent. However, as of yet, there is not a good understanding of how yields relate to these factors on fuelwood tree farms.

There are now at least 8,299 hectares of ipil-ipil plantings for fuelwood in over 60 different locations in a wide range of Philippine climatic zones. For these species, it is thus feasible to obtain extensive empirical data on growth under a wide variety of conditions.

The purpose of this proposed activity is to develop and provide a systematic documentation of yield response, while concurrently refining methodology and training personnel to continue these studies, post-project. The contractor

will coordinate the collection of data on yield in sample areas to be collected over an 18-20 month period, beginning as soon as possible in 1982.

Further data will be collected on factors which are believed to be causally related to yield. These data will include but not be limited to the following:

a. Soil characteristics to include acidity, mineral content, friability, depth, organic matter, etc.
b. Plant Spacing
c. Variety and seed source
d. Planting date relative to rainfall
e. Amount of rainfall
f. Fertilization
g. Weeding regimes
h. Slope of land
i. Intercropping

Data will be collected and the contractor will prepare interim analyses relating yield to the other data or items and report on findings in December 1982, June 1983, and December 1983. A final report at the end of the project will also be provided.

The analyses may involve the use of graphical displays, multiple regression, factor analysis and other appropriate statistical techniques to show what, if any, relationships exist between yield and the variables cited above. All data will be published as well as the statistical materials. The statistical analyses will have to be done on a computer of adequate capacity.

It is expected that the primary investigator will be a forestry or crop data analyst. A researcher with forestry/agricultural experience will provide consulting advice.

3. Transport System Review

Fuelwood tree farm development should be planned from the start with proper consideration given to forest engineering and materials handling concerns that will arise when harvests begin.

A major factor in the planning is what delivery system or combination of systems will be most appropriate to minimize wood handling and transport requirements.

For the NEA project, harvesting trees for fuel will mean moving large numbers of relatively small logs rapidly from field to plant. Depending on the terrain, a number of different transport systems may be considered. In relatively flat terrain where a road network could be constructed at a reasonable cost, trucking of whole stems and/or woodchips in combination with carabao skidding may be the most economical means of transport. However, in steep terrain, it is likely that some cableway system in connection with carabao skidding and/or portable cable yarders may require less energy, do less environmental damage and be an economically viable alternative to a road network. (While tree farm size and terrain may differ in the gasifier and charcoal programs, the lessons learned in the above studies and practices will still be directly applicable to these programs. This is particularly so in the expansion of the charcoal program.)

The contractor will study three typical sites picked to represent the range of differences in topographical variables existing at different sites, country-wide. The transport team will examine alternative transport and handling systems, and devise a conceptual level design and operational plan for each specified site to provide the lowest cost system. Alternatives to the least cost proposal will be briefly reported on with costs specified.

4. Analysis of Cogeneration

A steam-thermal power plant, particularly the low pressure systems envisioned, converts only a small part of the heat energy available to electricity. Large quantities of "waste" heat are thus available for other possible applications. Essentially free, heat is available for agro-processing purposes such as grain drying, wood shaping and drying and perhaps ice making and canning.

The contractor will make a study of excess heat availability for the various power plant types involved in the program. Based on brief marketing surveys, prefeasibility level studies will be provided for 3 to 4 possible cogeneration schemes.

5. Advanced Charcoal Production/High Energy Capture Technology

Traditional kilns offer a simple and relatively efficient method for charcoal making which is excellent for meeting most charcoal requirements in rural areas. More advanced techniques exist, however, which allow for greater volume production of charcoal and also make it possible to capture close to 85% of a feedstock's energy potential, including gas and oil, rather than the 50% which is captured through traditional charcoal production.

The contractor will provide a feasibility study of the application of more sophisticated charcoal production with an objective of maximum net energy capture. Preferred size range would be a capacity of 75-100 tons of feedstock per day. At least three U.S.-made systems with the desired characteristics are said to exist. These and any other relevant systems will be reviewed and one or more selected for a feasibility examination. It will be assumed that the compounds captured as a by-product of charcoal making will either be burned to generate electricity at site or processed for sale to other markets.

6. Gasifier Technology Development

The Philippines is moving rapidly in the field of biomass gasifier technology, especially for vehicular applications. At the same time, other nations have pursued their independent programs for several years. It is believed that Philippine gasifier development can be accelerated and strengthened by assuring access to the works of other leaders.

The contractor will review that experience and provide for an adaptation of relevant technology to Philippine conditions. It is proposed that the following activities be undertaken:

a. Possible gasifier applications in the Philippines will be reviewed.

b. Prefeasibility studies will be made on at least 3 to 4 common Philippine uses for which gasifiers appear most promising, but are not being tested in current projects.

c. Provision and testing of two small capacity, as simplified as feasible, gasifiers for application to ricemills or small electric generators.

7. A Review of Potential Future Uses of Wood Biomass Derived Energy

As noted earlier, biomass energy technology has remained relatively stagnant for the last thirty years. The applications suggested above use off-the-shelf technology which in large measure is unsophisticated. As fossil fuel becomes more costly and scarce, it seems highly likely that biomass will be an increasingly valuable energy source. It would be extremely useful to have a survey of probable important technological developments which may be expected to mature 5 to 10 years hence. Such information will help in formulating a program strategy for the adoption of more efficient technology.

The contractor will provide for a survey of probable medium-term developments. Such areas as follows will be examined among others:

a. high technology and wood thermal plants

b. gasification as a technique for efficient use of wood plantation products for generalized energy purposes

c. wood alcohol production

d. wood as chemical feedstock

e. wood pyrolysis as a means to capture maximum energy and to create more flexible fuels, such as wood oil and wood gas

8. Library and Information Development

It is important to have access to and to disseminate the most current technical information. The contractor will procure a modest library, about 500 reports and books, as representative of current biomass technology; and assist in improving current information systems.

FUEL AND EQUIPMENT

The GOP's wood-fired power plant program is a coordinated effort to restore denuded lands to a productive state through tree planting, using the trees to generate electric power, reducing the outflow of foreign exchange and generating jobs for the rural poor in the process.

This appendix describes the fuel (properties and yields) and the equipment (fuel requirements, type, costs and suppliers) used in this subproject. AID's participation in this subproject will include: (1) funding the offshore procurement of power plant equipment as indicated in the equipment costs list, and (2) contracting with an A&E firm to assist and advise NEA and coops to analyze and develop plant specifications, write and issue an IFB, and assist NEA and AID in reviewing bid documents and selecting suppliers of power plants and other hardware.

A. The Fuel

The fuel supply will consist primarily of *Leucaena leucocephala* which has been used for fuelwood and charcoal production in the Philippines for centuries. The trees are grown on tree farms adjacent to the power plants. Following are certain factors of this fast-growing tree that are germain to the operation of wood-fired power plants: namely its properties and yields.

Wood Properties

Leucaena has an uncommonly high density and calorific value for a fast-growing tree. The fiber dimensions are typically those of a hard wood but it is considered to be a medium hard wood. The wood is thin barked (on a dry weight basis, less than 8% is bark). The specific gravity varies between 0.54 to 0.70 for the Salvador and Hawaiian varieties respectively. Hawaiian type *Leucaena* strains because of their higher density make better firewood. In general, the wood is high in holocellulose (cellulose and hemicellulose) and low in silica, ash, lignin, and alcohol-benzene solubles.

In this project, the heating value is of particular importance. In general, it depends upon the species, the part of the tree (core, bark, etc.) and the moisture content. The upper limit of the heating value for bone dry wood is in the range of 7740 to 8600 Btu/lb. The ranges of heating values (oven dry) for two species of *Leucaena* have been reported as follows:

1. Hawaiian type - 8,300 to 8,400 Btu/lb
2. Salvador type - 7,500 to 8,300 Btu/lb

The following mathematical relationship has been proposed for calculating the heating value of wood as a function of the concentration of cellulose, hemicellulose and lignin:

$$HHV = (C)(7527) + (1-C)(11,479)$$

where HHV is the higher heating value (dry weight, ash-free basis) in Btu/lb and C is the fraction of cellulose and hemicellulose (holo-cellulose) in the wood. Some data reported for leucaena ranging in age from 1.5 to 6.0 years indicate

that the percentage of holocellulose and lignin is on the order of 72% and 23% respectively having an ash content of about 1 to 2%.

The effect of moisture content on the heating value can be determined from the following relationship:

$$NHV = HHV - 0.0114\ (HHV)\ (M)$$

where NHV is the net heating value (Btu/lb) and M is the percent of moisture content.

The HHV's for various moisture contents based on a HHV of 8,300 Btu/lb are presented in Table 1. Heating values of 4,515 and 5,000 Btu/lb were used to determine the fuel requirements for the power plant.

As a means of comparison, for readers more familiar with U.S. non-petroleum based fuels, the heating values and ash contents for various types of solid fuels and wastes are summarized in Table 2.

Table 1. Net Heating Value as a Function of Moisture Content
(HHV = 8,300 Btu/lb)

Moisture Content (%)	HHV (Btu/lb)
10	7354
30	5461
40	4515
50	3569

Table 2. Heating Values and Ash Contents of Selected Solid Fuels*

Materials	Heating Value (Btu/lb)	Ash (%)
Soft wood		
Douglas Fir	9050	0.8
Redwood	9040	0.2
Hard wood		
Hickory	8670	0.7
Poplar	8920	0.65
Coal		
Utah	14170	4.1
Wyoming	14410	13.8
Pittsburgh	13097	7.6
Bagasse	9140	11.3
Sawdust	5547 (30% moisture content)	
	3569 (50% moisture content)	

*These fuels were selected to provide reference points to readers who are not familiar with Leucaena.

Yields

A four-year Leucaena growing cycle is envisioned. The trees will be harvested when they are in the range of 9 to 13 cm. in diameter and about 6 to 8 meters high. The plan is to cut the trees and leave them in the field for three to four days with the leaves or tops in place for the purpose of enhancing drying. Later the tops will be removed, and the trunks cut into sections approximately two meters long or shorter lengths for transport to the plant for additional drying and firing.

Leucaena yields are expected to be 25 MT/ha/yr or 100 MT/ha at each harvest cycle (every 4 years). This figure is based upon growth measurement studies conducted at various sites in the Philippines and Hawaii, and conservative predictions of future average production at the sites identified for this subproject. An average specific gravity of 0.60 is used to express growth in terms of tonnage.

Table 3
Comparative Yield Data from Leucaena Tree Farms[1/]

Site	Basis		Cubic Meters/ha/yr	MT/ha/yr[2/]
FORI	Actual measurements		34.5	20.7
Canlubang	Actual measurements		58.1	34.8
Initao (MCC)	Actual measurements		36.3	21.8
Naawaan (MCC)	Actual measurements		51.8	31.08
Waimanalo (Hawaii)	Actual measurements		65.7	39.4
Kauai (Hawaii)	Actual measurements		56.1	33.6
Molokai (Hawaii)	Actual measurements		81.6	48.9
		Site		
	Consultant's Predictions	I	43	25.8
	Consultant's Predictions	II	42	25
	Consultant's Predictions	III	70	42

1/ See Appendix L for growth measurement study and MADECOR report of predicted yields.

2/ At average specific gravity of 0.60.

Table 4
Growth and Yield of Ipil-Ipil for Fuelwood[1/]

	Particulars	Poor Sites	Fair Sites	Good Sites	Excellent Sites
1.	Average site index (m)	7 (acidic soils)	10 (slightly acidic)	13 (near neutral)	16 (neutral soils)
2.	Approx. distribution	50%	30%	15%	5%
3.	Yield after 4 yrs (cu. m./ha) (minimum input, large materials)	Reject as Ipil-Ipil plantation site!	69.8	125.9	227.0
4.	Yield after 4 yrs (cu. m./ha) (minimum input, including small materials)		76.8	138.5	249.7
5.	Yield in ton/ha (at 0.60 specific gravity)		46.1	83.1	149.8
6.	Yield after 4 yrs (ton/ha) (at prescribed cultural mgt.)		101.4	157.9	209.7
			(120% increase)	(90% increase)	(40% increase)
7.	Growth per year (ton/ha/yr)		25.3	39.5	52.4

Notes:

1. Site index in meters refers to the total height that dominant and co-dominant trees are capable of attaining in 5 years.

2. Approximate distribution of sites among grassland areas and other potential plantation areas; ideal ipil-ipil site would be neutral soils, 500 m. elevation or lower, adequate rainfall and fertility.

3. Estimates based on yield table from plot data collected all over the country; plots at no or minimum inputs and only large materials utilized (over 5 cm. in diameter).

4. Yield including small usable materials (about 10% of item (3)).

5. Yield in ton/ha. if specific gravity is 0.60.

6. Yield attainment if plantation is properly cared for, i.e., liming to correct acidity, cultivation, fertilizer application, regular weeding and crop protection. Estimated response (conservative) provided in parenthesis.

7. Item 6 divided by 4 years. Growth, refers to the increase in tree dimensions or to the increase in stand measures over a period of time.

1/ Aspects of this table are discussed in Appendix L of this Annex.

Fuel Requirements

The following is a sensitivity analysis of fuel requirements using a range of 34% and 40% moisture content (M.C.). The assumptions used are a 5 MW plant operating at 30% overall plant efficiency and 100 MT/ha/harvest: 1/

(a) 34% moisture content = 5,000 Btu/lb
5 MW = 17×10^6 Btu/hr
at 30% overall efficiency, an input of 57×10^6 Btu/hr is required to obtain a 5 MW output.

If the heating value of wood is 5,000 Btu/lb, then the feed rate is:

$$\frac{57 \times 10^6 \text{ Btu/hr}}{5{,}000 \text{ Btu/lb}} = 11{,}400 \text{ lb/hr} = 5.7 \text{ tons/hr } (5.2 \text{ MT/hr})$$

(b) 40% moisture content = 4,515 Btu/lb
5 MW = 17×10^6 Btu/hr
at 30% overall efficiency, an input of 57×10^6 Btu/hr is required to obtain a 5 MW output.

If the heating value of wood is 4,515 Btu/lb, then the feed rate is:

$$\frac{57 \times 10^6 \text{ Btu/hr}}{4{,}515 \text{ Btu/lb}} = 12{,}600 \text{ lb/hr} = 6.3 \text{ tons/hr } (5.7 \text{ MT/hr})$$

1/ A moisture content of 50% (3,570 Btu/lb) is assumed for the harvested wood in the field 7-10 days after cutting. This equates to 40,296 MT per year from approximately 400 ha. Tree farm requirements range from 1,600 ha. without cogeneration to 2,000 ha. with cogeneration.

Assuming 5,520[1/] operating hours/yr, and an average yield of 100 MT/ha/harvest[2/] on plantations harvested once every four years, fuel requirements for a 5 MW ouput and the land areas needed to provide these requirements may be estimated as follows:

	Variables	
	Wood at 34% M.C. or 5,000 Btu/lb	Wood at 40% M.C. or 4,515 Btu/lb
MT/ hour	5.2	5.7
MT/ day	78.64	86.20
MT/ year	28,704	31,464

If the plant is designed for cogeneration with a 5 MW electrical output and 25% steam extraction, then enough fuel has to be provided for about 6.25 MW. Fuel requirements would therefore increase by approximately 25% and may be estimated as follows:

	Variables	
	Wood at 34% M.C. or 5,000 Btu/lb	Wood at 40% M.C. or 4,515 Btu/lb
MT/hour	6.5	7.1
MT/day	98.30	107.38
MT/year	35,880	39,192

B. The Plant Equipment

The basic equipment will be for wood processing (locally manufactured and purchased) and the major power plant components (offshore procurement financed by AID).

Fuel Processing

Much discussion has taken place between the NEA, AID and local and foreign engineers and boiler specialists concerning the form in which fuelwood will be used in this project; woodchips or roundwood. A strong consensus was reached favoring roundwood, for the following reasons: the Leucaena virtually has no bark; will be harvested at 9 to 13 cms. in diameter; has essentially no branches; and using roundwood is a known and practiced skill in the Philippines. Whereas the chipping equipment, especially if provided with dryers, can increase costs by 15-30%; and increases operating complexity and energy consumption as well as equipment maintenance.

1/ Based on NEA experience, thermal plants will operate at approximately 63% of capacity. This schedule provides sufficient downtime for regular maintenance to be performed; 365 days/yr x 24 hrs/day x 63% = 5,520 operating hours.

2/ Growth rate of 25 MT/ha/yr x harvest rotations every 4 yrs = 100 MT/ha/harvest.

The fuel processing consists of metering and a preparation stage. The metering is designed to keep the plant operating at the rated capacity. In fuel preparation, the wood will generally be stored on the site in about one to two meter lengths and a diameter of 9 to 13 cm. On the other hand it is possible that entire tree lengths may be stored, in which case a gang saw will be used to prepare appropriate length material (approximately 30 to 45 cm. long). Some splitting or hogging may be needed depending upon the type of boiler used or extent of drying desired. These practices are currently being used in the vicinity of one of the proposed sites by the sugar centrals. Funds have been included for fuelwood processing in the overall cost estimate in Table 5, No. 9.

Power Plant Equipment

A schematic diagram of the power plant is shown in Figure 1. The plant consists of the following steps: fuelwood is combusted in a waterwall boiler, the flue gas is passed into a multicyclone and then to a stack for dispersion into the atmosphere, electricity is generated with a steam turbine-generator set. At times in which cogeneration is used, about 18,000 lb/hr of steam would be extracted from the turbine at about 150 psig. The following is a discussion of the major pieces of equipment:

1. Waterwall Boiler

A number of systems are used for wood firing. In general, the pecularities lie in the combustion equipment. Solid fuels, which typically require a greater amount of combustion air than liquid or gaseous fuels, produce correspondingly larger amounts of flue gases. Consequently, larger boiler volumes are needed and provisions must be made for ash removal. The waterwall boiler consists of a furnace (combustion equipment) and an integral boiler with forced draft for supplying combustion air. A few systems that are appropriate for firing roundwood are discussed below.

Pile burning is perhaps the oldest method for combusting wood. The pile may stand on a grate or simply on a brick floor. Pile firing in a furnace provides stable and high combustion capacity with control being provided through the regulation of the combustion air. Essentially, the method is simple, reliable and inexpensive. With easily prepared controls such as proper feeding rates and loading systems, continuous fuel to maintain proper combustion temperatures will be available, and ash and carbon carry-over from overload will be avoided.

The grate system used in pile burning is either a simple fixed flat grate or a cone grate configuration which is better suited for fuels with higher moisture contents. Other mechanical flat grate configurations are dump, vibrating, reciprocating and travelling grates. It is recommended that grate systems that involve any type of motion not be used in this project. This is because the level of sophistication and hence operating and maintenance expense should be minimized. Furthermore, because wood has a relatively low ash content, moving grates are not necessary for ash removal.

Combustion air may be supplied to the boiler by forced or induced draft. The difference is in the location of the fan. If the fan is placed ahead of the furnace, the air stream is under positive pressure and the system is called induced draft. Combustion air is generally supplied through perforations in the grate. The combustion air cools the grate and protects it from potentially damaging high temperatures. Overfire and excess air, supplied to ensure adequate

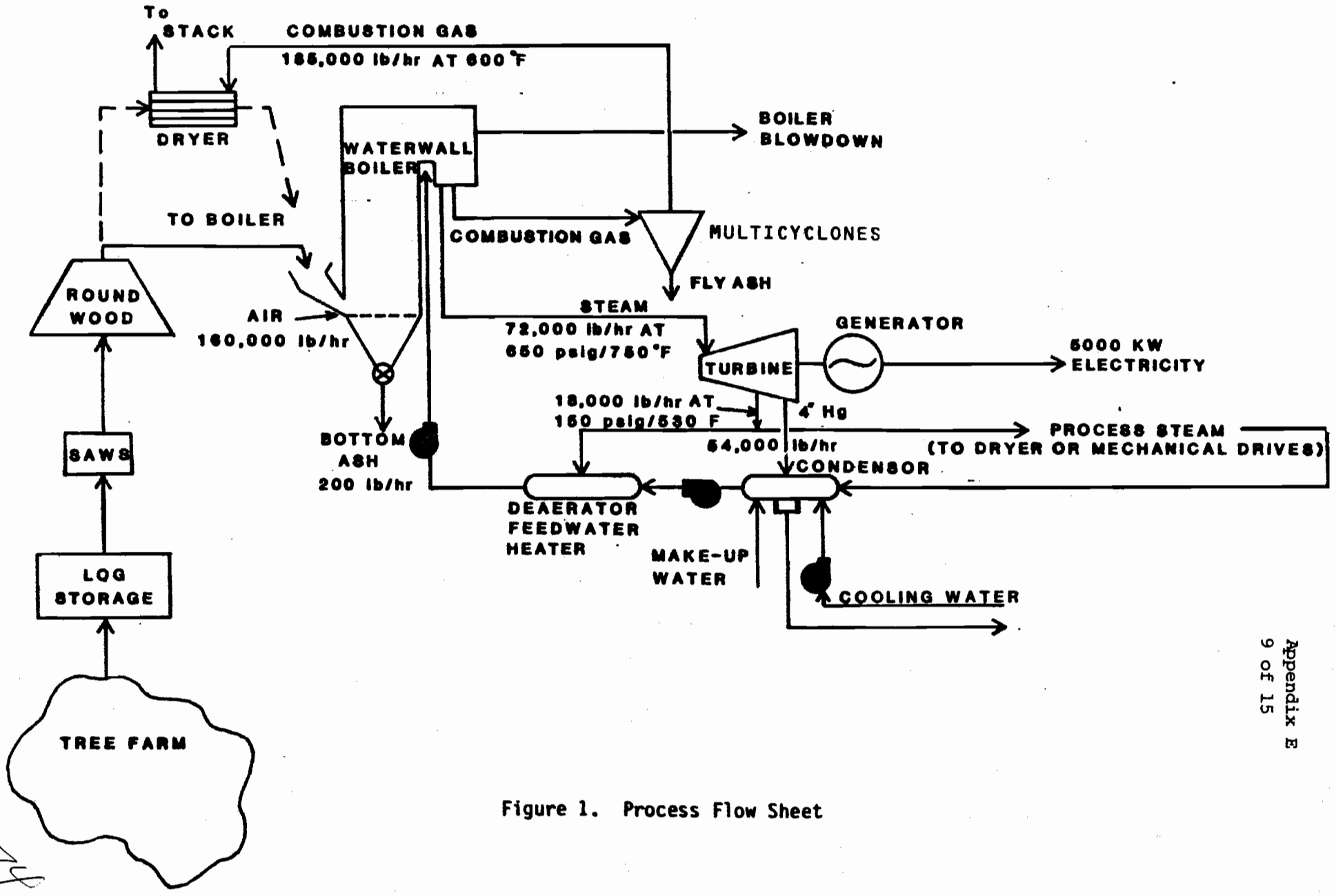


Figure 1. Process Flow Sheet

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turbulence and intimate fuel-air contact is introduced through the sidewalls of the boiler.

2. Turbine System

Typically, either back-pressure or condensing steam turbines are used. A back pressure turbine usually operates in the 1 MW to 100 MW range. However, in the case presented herein, an extraction-condensing steam turbine may be more appropriate because steam can be removed from the turbine at the pressure required by the process, and any excess steam produced is expanded and exhausted to a condenser. The turbine increases flexibility by allowing full utilization of boiler capacity for generation of power.

A 1 MW condensing steam turbine plant requires about 0.1 m^3/sec of cooling water. In a 5 MW case about 1800 m^3/hr of cooling water are needed. Some water treatment may be required. For example, depending upon local conditions, suspended particulates may have to be removed from the raw water. Chemical treatment may be required for any make-up water or feedwater.

3. Multicyclone Collector

Since the sulfur content of wood is low, the only air pollution control equipment needed in the combustion of wood is for the reduction of total suspended particulates. A number of control devices are currently in use. Cyclone separators are the most popular control equipment because they are the least expensive, the easiest to maintain, and can be reasonably efficient in collecting particulates. Multicyclones operate by forcing flue gases to pass through a helical pathway. Depending on the size of the particulates, the rate of gas flow and the length and diameter of the cyclone, particulates will separate from the gas stream as they hit the walls of the cyclone and fall to the bottom where they are collected. The collection efficiency of multicyclone systems varies considerably with particle size. Typical cyclone efficiency ranges from collecting particles greater than 40 microns in diameter with 99% efficiency, to collecting particles of 7 microns at 53% efficiency.

4. Other Equipment

In addition to the items described above, the plant will also include auxiliary equipment in terms of pumps, fans, and compressors. Instrumentation for controlling such items as combustion temperatures, water levels, steam pressure and temperature, turbine-generator speed and voltage, and other similar parameters are included as standard attachments to the major equipment.

Equipment Costs

The breakdown of costs, including a 10% escalation factor, for the power plant (i.e., the steam and electricity generation systems) are shown in Table 5. The installed cost of the plant is $3,016,000.

Site-specific cost items excluded from the estimate are costs for make-up water treatment and boiler feedwater treatment. Because each of the sites has available clear water it is felt these costs will be non-existent or negligible at most, and can be taken from built-in contingency funds.

Table 5. Installed Cost of a 5 MW Wood-Fired Power Plant

	Item	Equipment, $	Freight, $[a/]	Erection, $[b/]	Total, $
1.	Boiler and Controls[c/]	950,000	70,000	44,000	1,064,000
2.	Steam Turbine/Generator[d/]	1,200,000	50,000	20,000	1,270,000
3.	Electrical Switchgear	50,000	2,000	6,000	58,000
4.	Condensor and Cooling Water Pump	120,000	12,000	1,000	133,000
5.	Boiler Feedwater Treatment	50,000	6,000	5,000	61,000
6.	Spare Parts and Auxiliary Equipment	56,000	-	-	56,000
	Subtotals	2,426,000	140,000	76,000	2,642,000
	Contingencies				100,000
	Price Escalation				274,000
	Totals	2,426,000[1/]	140,000	76,000	3,016,000

a/ To Philippines.
b/ Includes vendor supervision.
c/ 70,000 lb/hr of steam at 650 psig/750°F.
d/ 5 MW electricity and 18,000 lb/hr of 150 psig/530°F steam.

1/ An estimated $125,000 is also being provided under this program to provide procurement advisory services to assist and advise NEA and the coops in purchasing the power plants. Services include analyzing and developing plant specifications, writing and issuing an IFB, and assisting NEA and AID in reviewing bid documents and selecting suppliers of power plants and other hardware.

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Equipment Availability

The availability of equipment is dependent on equipment type and vendor. Most of the low cost items can be obtained within two or three months while the relatively more expensive equipment (such as the boiler and turbine/generator) require a lead time of 12 to 18 months.

Project Scheduling

The estimated schedule of project implementation subsequent to the development of detailed engineering specifications is as follows:

Task	Months
Manufacturers' Design Work	2
Purchase of Equipment	14
Shipment of Equipment	2
Site Development	15
Equipment Installation	4
Shake-down	2

A project schedule broken down by task is shown in Figure 2.

Equipment Suppliers

A list of suppliers of power plant equipment appears below. The suppliers listed were those who provided actual cost information. Note: Other suppliers in each category were also contacted, but were reluctant to supply cost information without detailed formal quotation procedures.

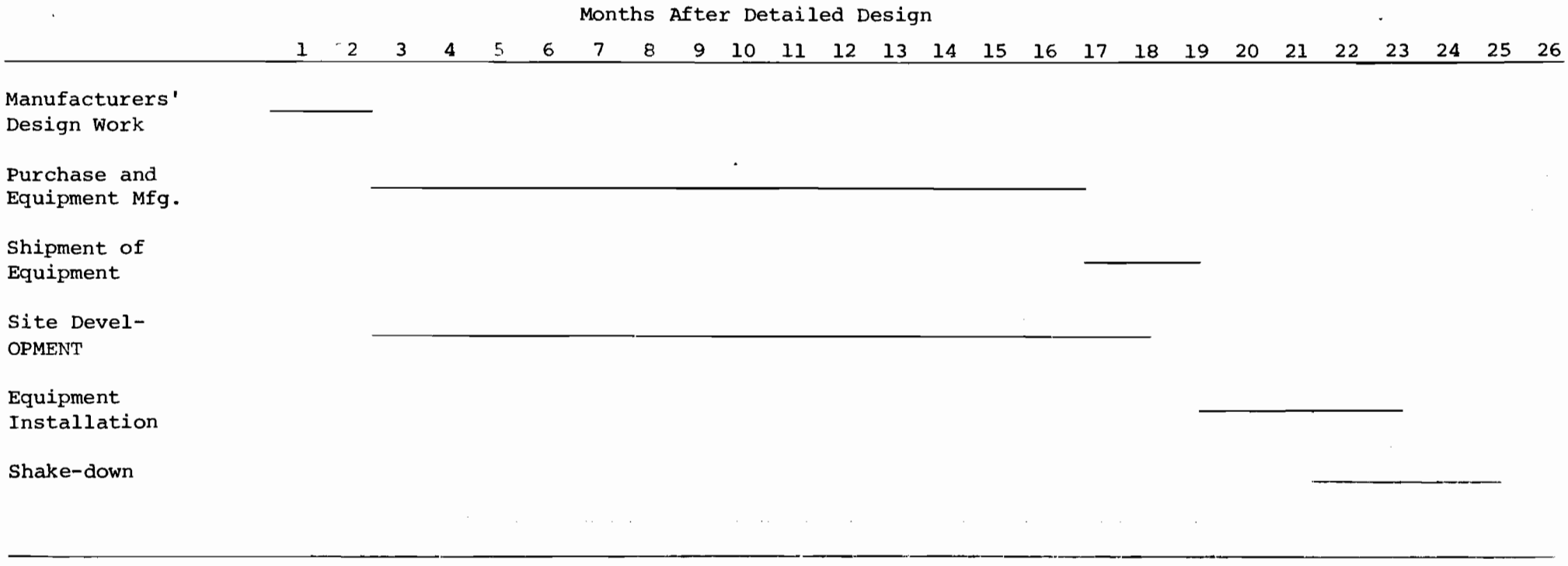

Figure 2. Estimated Project Schedule for (Constructing) a Wood-Fired Power Production Facility

BOILERS

E. Keller Company
238 West Street
Williamsport, PA 17701

(717) 326-3361

Erie City Boiler
1632 Union Street
San Francisco, CA 94123

(415) 771-3494

Foster Wheeler
10 S. Orange Avenue
Livingston, N.J.

(201) 533-1100

International Boiler Works
250 Birch Street
E. Straudsburg, PA 18301

(717) 421-5100

Wellons Inc.
P.O.Box 381
Sherwood, Oregon 97140

(503) 625-6131

TURBINE/GENERATORS

Turbo-Dyne Corporation
Coats Street
Wellsville, New York 14895

(716) 593-1234

The Trane Company
19782 MacArthur Blvd., Suite 220
Irvine, CA 92715

(714) 833-7816

Terry Turbines
Lamberton Road
Windsor, CT 06095

(203) 688-6211

Coppus Turbine Generator
344 Park Avenue
Worcester, MA 01610

(617) 756-8391

CONVEYOR BELTS

Conveyor Systems Inc.
6451 Main St.
Morton Grove, IL 60053

(312) 588-0200

FMC Corporation
Material Handling Systems Div.
Box 202
Colmer, PA 18915

(212) 822-0581

Mayfran International Div.
Fisher Industries
Box 43038
Cleveland, Ohio 44143

(216) 461-4100

CONDENSERS

Ecolaire Condenser
4340 Redwood Highway, Suite 226
San Rafael, CA 94903

(415) 472-6360

CONVEYOR BELTS

Radar Company Inc.
6005 N E 82
P.O. Box 20128
Portland, OR 97220

(503) 255-5330

Rexnord Inc.
Material Handling Division
Lebanon Road
Danville, KY 40422

(606) 236-9400

or locally manufactured

DRYERS

Stearns-Rober Mfg. Inc.
P.O. Box 5888
Denver, CO 80217

(303) 758-1122

EIMCO PMD Division
Envirotech Corporation
669 W. Second South St.
Salt Lake City, UT 84110

(801) 526-2123

Koppers Co. Inc.
Mineral Processing Systems Div.
P.O. Box 312
York, PA 17405

(717) 843-8671

M-E-C Company
Box 330
1402 W. Main
Neodesha, Kansas 66757

(316) 325-2673

Bethlehem Corporation
The Process Equipment Group
25 and Lenox Streets
Easton, PA 18042

(215) 258-7111

The Heil Co.
3000 W Montana St.
Milwaukee, WI 53201

(414) 647-3333

Louisville Drying Machinery
232 E. Main St.
Louisville, KY 40202

(502) 583-7646

ECONOMIC TABLES

Table 1

Power Plant Raw Fuelwood Energy Cost at Loading
(100 Hectare Module)

	Local (Peso)	Dollar Equivalent (₱8 = US$ 1)
A. Annual Direct Costs		
Unskilled labor	72,900	9,112
Silvicultural inputs	15,000	1,875
Total annual direct costs	87,900	10,987
B. Indirect Costs		Annualized Cost Capital recovery factor @ 20%
Initial investment costs		
Tools (4 yrs. life)	18,750	905
Roads (10 yrs. life)	48,000	1,431
Architecture & Engineering (2 yrs.)	4,200	125
Administrative (4 yrs.)	33,000	1,593
Total indirect costs	103,950	
Total annual indirect cost 1/		4,054
C. Farmer's Margin		5,271
Land 2/		
Total effective costs (a + b + c)		20,312
Costs/million BTU 3/		$0.74

1/ Annualized at 20% interest rate.
2/ As discussed in main body of text this is essentially zero.
3/ Harvesting will be managed on a 4-year rotation cycle with one hectare producing about 100 MT of wood per harvest. Only one fourth of the module or 25 hectares will be planted and harvested each year. Wood is assumed at 34% moisture content, 5000 $\frac{\text{Btu}}{\text{lb.}}$ 1 MT = 11 million BTU after drying and when entering the boiler. Effective cost/million Btu =

$$\frac{\$20{,}312}{25 \text{ MT/ha/yr.} \times 4 \text{ yrs.} \times 25 \text{ ha.} \times 11 \text{ Btu}} = \$0.74$$

Table 2

Transportation Costs

	Local (Peso)	Dollar Equivalent (₱8 = US$ 1)
Annual Direct Labor Costs		
Unskilled labor	159,231	19,904
Skilled labor	72,429	9,054
Total annual direct labor costs	231,660	28,958
Capital & Other Indirect Costs		Annualized cost capital Recovery factor at 20%
Initial investment costs		
Cableway	8,680,000	219,299
Transport equipment	2,200,000	55,583
Installation	600,000	15,159
Architect & Engineering	156,000	3,941
Total capital & other indirect costs	11,636,000	
Total annual capital & other indirect cost		293,982 1/
Effective total cost		322,940
Effective cost per kilowatt-hour		1.47¢ 2/

1/ Annualized at 20% interest rate and capital recovery factor at 25 years.
2/ Operation of the 5 MW wood-fired power plant is planned at 60% capacity or 5520 hours per year, calculated to generate 21,946,000 kilowatt-hours of net energy.

Table 3
Generation/Transmission/Wood Handling

	Local Peso	Dollar Equivalent ₱8 = US.$1
Annual Non-Capital Costs		
Maintenance/Utilities	242,000	30,250
Skilled Labor	278,217	34,777
Unskilled Labor	176,963	22,120
Overhead/Administrative	77,000	9,625
Total Annual Costs	774,180	96,772
Capital/Equipment Costs		Annualized cost capital recovery factor @ 20%
Initial Investment Costs		
Fuel Handling/Firing Generation	19,208,000	485,288
Site Development	960,000	24,254
Architecture & Engineering	1,049,000	26,503
Other Equipment	4,920,000	124,303
Total Capital/Equipment Costs	26,137,000	
Total Annual Capital/Equipment Cost 1/		660,348

Unit kilowatt hour (kwh) costs

$$\text{Annual non-capital costs} = \frac{\$96,772}{21.946 \times 10^6 \text{ kwh}} = .44¢/\text{kwh}$$

$$\text{Annual capital costs} = \frac{\$660,348}{21.946 \times 10^6 \text{ kwh}} = 3.01¢/\text{kwh}$$

1/ Annualized at 20% interest rate, capital recovery factor at 25 years.
2/ 21.946×10^6 kwh is net energy generated by 5 MW wood-fired power plant planned to operate at 60% capacity or 5,520 hours per year.

Table 4
Summary Comparative Cost
Cents per Kilowatt Hour (¢/kwh)

	Wood-Fired	Diesel 5/ Ranges	Diesel 6/ (Average)
Fuel 1/	1.06	6.0 -12.0	8.5
Non-Capital Cost 2/	.44		
Fuel Transport 3/	1.47		
Capital (Power Plant) 4/	3.01	2.75-4.3	2.9
Total	5.98	8.75-16.3	11.9

1/ Fuel requirement of the 5 MW power plant as shown in Appendix E page 6, is calculated to be 1.04 per megawatt hour, using wood at 34% moisture content with heating value of 5,000 Btu/lb. The power plant is planned to operate at 60% capacity or 5,520 hours per year. The computation of fuel cost at 1.06 cents is shown below. Selling price of wood is ₱65 per MT ($8.125).

1.04 MT/MWH x 5 MW x 5,520 HOURS/YEAR = 28,704 MT/YEAR

28,704 MT/YEAR x $8.125/MT = $233,220/YEAR

$$\text{Annual fuel cost} = \frac{\$233,220}{21.946 \times 10^6 \text{ kwh}} = 1.06¢$$

2/ Based on Table 3, Appendix F, Generation/Transmission/Wood Handling.
3/ Based on Table 2, Appendix B, Transportation Cost.
4/ Based on Table 3, Appendix F, Generation/Transmission/Wood Handling.
5/ Based on international costs. Assumes large unit, effective heat rate 10,000 Btu/kwh, diesel economic value $8.5/MBTU, 800 kw, 25 yr, 20% CRF, other operation and maintenance 3.5% capital annually.
6/ Estimates based on international prices for diesel, ranges of small to large units with capital costs $-1,000±/kw, the latter 750±/kw, heat rates vary considerably with large units.

Table 5 Wood-fired Power Plant and Tree Farm: Economic Benefit/Cost and Internal Rate of Return (IRR) Analysis (for 2000 has.) (₱1000, 1981 prices)

Year	Total Economic Proj. Cost 1/	Total Economic Benefits 2/	Present Value at 20% Discount Rate Costs	Present Value at 20% Discount Rate Benefits	Present Value at 15% Discount Rate Costs	Present Value at 15% Discount Rate Benefits	Net Undiscounted Benefits	P. V. of Net Benefits at 29.3% Discount Rate
0	100	-	100	-	100	-	- 100	- 100
1	1046	-	872	-	910	-	- 1046	- 809
2	31174	-	21648	-	23572	-	-31174	-18646
3	24318	-	14073	-	15990	-	-24318	-11249
4	2386	-	1151	-	1364	-	- 2386	- 854
5	1213	27275	2861 3/	64337 3/	4378 3/	98440 3/	26062	31679 3/
6	1213	27275	-	-			26062	
.	.	.					.	
.	.	.					.	
.	.	.					.	
25	1213	27275					26062	
TOTAL	84497	572775	40705	64337	46314	98440	488278	21

Benefit/Cost ratio at 20% rate of discount: 1.58; at 15% rate of discount: 2.13
Internal Rate of Return (IRR) = 29.3%
Net Present Value of Project at 20% rate of discount: ₱23.6 million ($2.8 million);
at 15% rate of discount: ₱52.1 million ($6.2 million).

1/ See Tables 8 and 9 for estimation of economic costs.
2/ Based on 21,946,000 kwh sold starting in year 5 priced at Diesel Central cost of 11.9 cents/kwh. Exchange rate used to convert to ₱ is 8.355 + 25% to reflect shadow foreign exchange rate. See Table 4 for derivation of Diesel Central Cost. Since diesel fuel is refined from crude oil in-country, the profits (revenues minus total costs) of the refineries should be deducted from the wholesale price as not representing Philippine economic costs avoided. These are a rather small percentage of the wholesale price of diesel, however, (no more than 2%, about half of which accrues to foreign owners) so ignoring them in these calculations does not result in a significant bias.
3/ PV of 21-year stream of constant costs or benefits beginning in year 5.

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Table 6 Wood-fired Power Plant and Tree Farm: Economic B/C and IRR[1/] Sensitivity Analysis -- With Costs Increased 20% and Benefits Reduced 25% (for 2000 has.) (₱1000, 1981 Prices)

Year	Total Economic Cost + 20%	Total Economic Benefits - 25%	Present Value at 20% Rate of Discount Costs	Present Value at 20% Rate of Discount Benefits	Present Value at 15% Rate of Discount Costs	Present Value at 15% Rate of Discount Benefits	Net Undiscounted Benefits	Net Present Value at 19.8% Rate of Discount
0	120		120		120		- 120	- 120
1	1255		1046		1091		- 1255	- 1048
2	37409		25978		28286		-37409	-26065
3	29182		16888		19188		-29182	-16972
4	2863		1381		1637		- 2863	- 1390
5	1456	20456	3434[2/]	48253[2/]	5255[2/]	73829[2/]	19000	45538[2/]
6	1456	20456					19000	
.	.	.					.	
.	.	.					.	
.	.	.					.	
25	1456	20456					19000	
TOTAL	101405	429576	48847	48253	55577	73829	328171	-57

Benefit/Cost Ratio: at 20% Discount: 0.99
at 15% Discount: 1.33

Net Present Value : at 20% Discount: -594
at 15% Discount: 18252

Internal Rate of Return (IRR): 19.8%

1/ See Table 5 for basic economic cost and benefit estimates.
2/ PV of 21-year stream of constant costs or benefits beginning in year 5.

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Table 7 Wood-fired Power Plant and Tree Farm: Economic B/C and IRR Sensitivity Analysis -- with No Shadow Pricing (₱1000, 1981 Prices)

Year	Total Nominal Costs 1/	Total Nominal Benefits 2/	Present Value at 20% Rate of Discount Costs	Present Value at 20% Rate of Discount Benefits	Present Value at 15% Rate of Discount Costs	Present Value at 15% Rate of Discount Benefits	Net Nominal Benefits	Net Present Value at 25.3% Rate of Discount
0	100		100		100		- 100	- 100
1	1622		1352		1410		- 1622	- 1294
2	25721		17862		19449		-25721	-16383
3	25953		15019		17065		-25953	-13193
4	3233		1559		1848		- 3233	- 1312
5	1474	21820	3477 3/	51470 3/	5320 3/	78752 3/	20346	32339 3/
6	1474	21820					20346	
.	.	.					.	
.	.	.					.	
.	.	.					.	
25	1474	21820					20346	
TOTAL	87583	458220	39369	51470	45192	78752	370637	58

Benefit/Cost Ratio: at 20% Discount: 1.31
at 15% Discount: 1.74

Net Present Value : at 20% Discount: 12,101 ($1.4 million)
at 15% Discount: 33,560 ($4.0 million)

Internal Rate of Return (IRR): 25.3%

1/ From Tables 8 and 9.
2/ See Table 5.
3/ PV of 21-year stream of constant costs or benefits beginning in year 5.

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Table 8 Economic Cost of Transport and Power Plant for Wood-Fired Power Plants (Serving 2000-Ha. Farms)
(₱1000, 1981 Prices)

Year	Initial Construction Costs: Foreign Exchange	Initial Construction Costs: Unskilled Labor	Initial Construction Costs: Other	Initial Construction Costs: Total	Annual Operations and Maintenance: Unskilled Labor	Annual Operations and Maintenance: Other	Annual Operations and Maintenance: Total	Nominal Cost Total	Total Economic Cost 1/: Foreign Exchange	Total Economic Cost 1/: Unskilled Labor	Total Economic Cost 1/: Other	Total Economic Cost 1/: Total
0												
1												
2	24128			24128				24128	30160			30160
3		2112	22248	24360				24360		1056	22248	23304
4			66 2/	66	248	526	774	840		124	592	716
5					248	526	774	774		124	526	650
6					248	526	774	774		124	526	650
7					248	526	774	774		124	526	650
8					248	526	774	774		124	526	650
9					248	526	774	774		124	526	650
10					248	526	774	774		124	526	650
11					248	526	774	774		124	526	650
12					248	526	774	774		124	526	650
13					248	526	774	774		124	526	650
14					248	526	774	774		124	526	650
15					248	526	774	774		124	526	650
16					248	526	774	774		124	526	650
17					248	526	774	774		124	526	650
18					248	526	774	774		124	526	650
19					248	526	774	774		124	526	650
20					248	526	774	774		124	526	650
21					248	526	774	774		124	526	650
22					248	526	774	774		124	526	650
23					248	526	774	774		124	526	650
24					248	526	774	774		124	526	650
25					248	526	774	774		124	526	650
TOTAL	24128	2112	22314	48554								

1/ With shadow prices applied to unskilled labor (-50%) and foreign exchange (+25%).
2/ Cost of wood for trial run (less harvesting cost of ₱15,000 included in Table).

USAID/P, OD/PE, 4/5/82

Table 9. Economic Cost of Tree Farms for Wood-Fired Power Plant, 20 Modules x 100 Ha. Each (2,000 ha.) (₱1000, 1981 Prices)

Year	Development Costs: Unskilled Labor	Development Costs: Other	Development Costs: Total	Annual Operations and Maintenance: Unskilled Labor	Annual Operations and Maintenance: Foreign Exchange	Annual Operations and Maintenance: Other	Annual Operations and Maintenance: Total	Nominal Cost Total	Total Economic Costs 7/: Unskilled Labor	Total Economic Costs 7/: Foreign Exchange	Total Economic Costs 7/: Other	Total Economic Costs 7/: Total
0		100 1/	100					100			100	100
1	1152 2/	470 4/	1622					1622	576		470	1046
2	1158 3/	435 4/	1593					1593	579		435	1014
3	1158 3/	435 4/	1593					1593	579		435	1014
4	1158 3/	735 4/	1893	350 5/	125 5/	25	500	2393	754	156	760	1670
5				400 5/	250 5/	50	700	700	200	313	50	563
6				400	250	50	700	700	200	313	50	563
7				400	250	50	700	700	200	313	50	563
8				400	250	50	700	700	200	313	50	563
9				400	250	50	700	700	200	313	50	563
10				400	250	50	700	700	200	313	50	563
11				400	250	50	700	700	200	313	50	563
12				400	250	50	700	700	200	313	50	563
13				400	250	50	700	700	200	313	50	563
14				400	250	50	700	700	200	313	50	563
15				400	250	50	700	700	200	313	50	563
16				400	250	50	700	700	200	313	50	563
17				400	250	50	700	700	200	313	50	563
18				400	250	50	700	700	200	313	50	563
19				400	250	50	700	700	200	313	50	563
20				400	250	50	700	700	200	313	50	563
21				400	250	50	700	700	200	313	50	563
22				400	250	50	700	700	200	313	50	563
23				400	250	50	700	700	200	313	50	563
24				400	250	50	700	700	200	313	50	563
25				400	250	50	700	700	200	313	50	563
Total	4626	2175	6801									

1/ Soil analysis and pre-planting costs from Table VI, Tapaz Dendro-Thermal Farmers' Association Feasibility Study.
2/ ₱450,000 for planting (excluding seeds and plastic bags).
3/ ₱672,000 for management and maintenance, ₱30,000 for planting permanent trees from Table VI, ibid.
₱456,000 for planting, ₱672,000 for management and maintenance, ₱30,000 for planting permanent trees, from Table VI, ibid.
4/ All other costs from Table VI, ibid.
5/ 2/3 of farm supplies from Table VIII x 20 + ₱300,000 for harvesting, ibid.
6/ Gasoline and oil from Table VIII x 20, ibid.
7/ With shadow prices applied to unskilled labor (-50%) and foreign exchange (+25%).

USAID/P, OD/PE, 4/5/82

FINANCIAL TABLES

Table 1
Wood-Fired Power Plant

Summary of Start Up Costs
Tree Farmers Association - 100 Hectare Module

	Year 1	Year 2	Year 3	Year 4	Total
Tree Farm Start-Up Costs					
Farm Supplies	₱23,490	₱21,740	₱ 21,740	₱ 36,740	₱103,710
Labor Costs	57,600	57,900	57,900	72,900	246,300
	81,090	79,640	79,640	109,640	350,010
Escalation Factor 10% Compounded	8,109	16,724	26,361	50,884	102,078
Total Start-Up Cost	₱89,199	₱96,364	₱106,001	₱160,524	₱452,088
Dollar Equivalent per 100 Ha. Module	$11,150	$12,040	$ 13,250	$ 20,060	$ 56,500
Dollar Equivalent for 6000 Hectares	$669,000	$722,400	$795,000	$1,203,600	$3,390,000

NOTE: All costs will be in local currency and will be funded by the GOP.

Table 2

Wood-Fired Power Plant

Projected Resource Flows
Tree Farmers Association - 100 Hectare Module
Estimated Growth 25 MT/HA/YR
(in Pesos)

	Year 1	Year 2	Year 3	Year 4	Years 5-12	Years 13-25
I. Inflows						
A. Loan Funds						
1. Cash	57,600	57,900	57,900	72,900 2/		
2. Farm Supplies	23,490	21,740	21,740	36,740		
Sub-total	81,090	79,640	79,640	109,640		
B. Wood Sales 6/					162,500	162,500
Total Inflows	81,090	79,640	79,640	109,640	162,500	162,500
II. Outflows						
A. Tree Farm Start-Up Costs 1/						
1. Nursery planting	7,750	6,000	6,000	6,000		
2. Permanent trees	3,500	3,500	3,500	3,500		
3. Fertilizer and pesticides	5,500	5,500	5,500	5,500		
4. Tools and equipment	3,750	3,750	3,750	18,750 4/		
5. Contingencies	2,990	2,990	2,990	2,990		
Sub-total	23,490	21,740	21,740	36,740		
B. Operating Expenses						
1. Farm Supplies					7,500	7,500
2. Transport					12,500	12,500
					20,000	20,000

Table 2

	Year 1	Year 2	Year 3	Year 4	Years 5-12	Years 13-25
C. Amortization of Loan					83,000 4/	
Total Outflows	23,490	21,740	21,740	46,740	103,000	20,000
Net Cash Balance to Tree Farmers Association	57,600	57,900	57,900	72,900	59,500	142,500
Net Cash per Member						
10 members	5,760	5,790	5,790	72,900	5,900	14,250
15 members	3,840	3,860	3,860	4,860	3,967	9,500

NOTE: All costs will be in local currency and will be funded by the GOP.

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Table 3

Wood-Fired Power Plant

Projected Resource Flows
Tree Farmers Association - 100 Hectare Module
Estimated Growth 40 MT/HA/YR
(in Pesos)

	Year 1	Year 2	Year 3	Year 4	Years 5-12	Years 13-25
I. Inflows						
A. Loan Funds						
1. Cash	57,600	57,900	57,900	72,900 2/		
2. Farm Supplies	23,490	21,740	21,740	36,740		
Sub-total	81,090	79,640	79,640	109,640		
B. Wood Sales 5/					260,000	260,000
Total Inflows	81,090	79,640	79,640	190,890	260,000	260,000
II. Outflows						
A. Tree Farm Start-Up Costs 1/						
1. Nursery planting	7,750	6,000	6,000	6,000		
2. Permanent trees	3,500	3,500	3,500	3,500		
3. Fertilizer and pesticides	5,500	5,500	5,500	5,500		
4. Tools and equipment	3,750	3,750	3,750	18,750 3/		
5. Contingencies	2,990	2,990	2,990	2,990		
Sub-total	23,490	21,740	21,740	36,740		
B. Operating Expenses						
1. Farm Supplies					7,500	7,500
2. Transport					12,500	12,500
					20,000	20,000

Table 3

	Year 1	Year 2	Year 3	Year 4	Years 5-12	Years 13-25
C. Amortization of Loan					83,000 4/	
Total Outflows	23,490	21,740	21,740	36,740	103,000	20,000
Net Cash Balance to Tree Farmers Association	57,600	57,900	57,900	72,900	157,000	240,000
Net Cash per member						
10 members	5,760	5,790	5,790	7,290	15,700	24,000
15 members	3,840	3,860	3,860	4,860	10,467	16,000

Footnotes to Tables 2 and 3

1/ In kind.

2/ The increase over the three preceding years is an incentive bonus at point of completion of first four year cycle.

3/ Includes 15,000 for harvest equipment.

4/ Includes principal and interest payments during years 5-12 at 12% plus interest accrued during four year grace period.

5/ Wood sales are calculated at the current market price of ₱65.00/ton.

Table 4
Wood-Fired Power Plant
One 5 MW Plant
Detailed Project Cost Breakdown
($000)

	FOREX	Dollar Equivalent of Peso Costs: Material and Equipment	Labor	Total	TOTAL
1. Power Plant Equipment					
a. Equipment Cost	2370				2370
b. Provision for Spare Parts	31				31
c. Auxiliary Equipment	25				25
d. Procurement Services (A&E)	125				125
e. Commissioning	76				76
f. In-Country Transportation and Handling		59	-	59	59
g. Sea Freight Insurance	140				140
h. Contingencies/Escalation - TA	233	19	-	19	252
Sub-Total	3000	78		78	3078
2. Transport Facilities					
a. Cableway		1085	-	1085	1085
b. Transport Equipment		275	-	275	275
c. Miscellaneous (Feeder roads)		120	-	120	120
Sub-Total		1480		1480	1480
3. Civil Works					
a. Power Plant Building		160	40	200	200
b. Office and Maintenance Building		44	11	55	55
c. Warehouse Building		80	20	100	100
d. Equipment Foundations		40	15	55	55
e. Site Development		90	30	120	120
f. Access Road		63	25	88	88
g. Cableways System Installation		60	15	75	75
Sub-Total		537	156	693	693
4. Mechanical and Electrical Works					
a. Major Plant Equipment Installation		176	44	220	220
b. Balance of Plant Equipment Installation		10	4	14	14
Sub-Total		186	48	234	234
5. Local A&E		188	-	188	188
6. Contingencies		388	-	388	388
GRAND TOTAL	3000			3061	6061

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Table 5a
Assumptions for
Financial Analysis for 5 MW
Wood-Fired Power Plant
(34% MC., 5000 Btu/lb)

A. Given Factor

1.	Power Plant capacity	5MW
2.	Investment	₱48,488,000
3.	Investment/kw	₱ 9,697.60
4	Fuel/MWH	1.04 MT
5.	Price of wood fuel/wt (Year 1)	₱65.00
6.	Number of power plant employees	37
7.	Foreign Exchange Rate Used	₱8.00 = $1.00

B. Assumptions

1.	Economic life of project	25 years
2.	Average operating time/year	5520 hrs.
3.	Energy available for distribution (less plant use)	90%
4.	Transformer efficiency	95%
5.	Distribution efficiency	93%
6.	Maintenance cost (Year 1) as % of investment	0.5%
7.	Administrative and General Cost as % of Production Expense	3%
8.	Annual increase in wood, personnel, maintenance and general costs: Years 1 - 10	10% Compounded
	Years 11- 25	5% Compounded

C. Policies

1. Energy rate to distribution system will be NPC grid rate for the first year, then 90% of NPC grid rate or cost plus ₱0.12 which ever is lower. The mark-up corresponds to a 4% ROI and assures recovery of investment within the economic life of the project.

2. Financing will be through a loan of ₱48.488 million from NEA under the following terms:

	Foreign Component U.S. Dollar	Local Component Pesos
a. Amount	₱24,128,000	₱24,360,000
b. Interest Rate	9.75%	3% (Years 1-3) 9.5% Years 4-25)
c. Repayment Period including Grace Period	25 years	25 years
d. Grace period	6 years	1 year

3. Depreciation: Straight line, 4% per year for power plant and 10% for transport facilities.

4. Organizational cost will be amortized over 25 years.

D. Evaluation

1. Energy generated (5 x 5520) — 27600 MWH

2. Wood fuel requirement/year (1.04 x 27600) — 28704 MT

3 Operating Cost - Year 1

	Total	Per KWH	%
a. Wood Fuel	₱1,865,760	₱0.08	21.96
b. Personnel	455,180	0.02	5.43
c. Maintenance	242,000	0.01	2.84
d. General	77,507	.004	0.78
e. Depreciation	2,710,110	.12	31.78
f. Interest Expenses	3,087,280	.14	36.43
g. Organization cost	70,001	.003	0.78
	₱8,507,838	₱0.377	100.00

4. Energy distributed (27600 x .90 x .93 x .95) — 21946 MWH

5. Revenue (Year 1) (21946 x .50) — ₱10,973.00

6. Financial projections for 25 years (enclosed)

   a. Income Statement
   b. Cash Flow Statement
   c. Cost Breakdown per KWH

Table 5b
Income Statement of a Wood-Fired Power Plant (34% M.C., 5000 Btu/lb)
(₱000)

	A. REVENUE			B. TOTAL EXPENSES								
				a. Production Expense			b.	c.	d.	e.		
No. of Year	a. ₱/kwh	b. kwh sold	c. Revenue a x b	Fuel Cost	Personnel Expenses	Maint.	Adm. & Gen. Exp.	Org. Expense	Depre. Exp.	Interest Exp.	Total a+b+c+d+e	Net Income A-B
1	₱0.50	21946000	10973	1866	455	242	77	70	2710	3087	8507	2466
2	.51		11192	2052	501	266	84	70	2710	3086	8769	2423
3	.54		11851	2258	551	293	93	70	2710	3445	9420	2431
4	.61		13387	2483	606	322	102	70	2710	4560	10853	2534
5	.63		13826	2732	666	354	112	70	2710	4526	11170	2656
6	.67		14704	3005	733	390	123	70	2710	5120	12151	2553
7	.72		15801	3305	806	429	135	70	2710	5660	13115	2686
8	.72		15801	3636	887	472	149	70	2710	5544	13468	2333
9	.74		16240	3999	976	519	164	70	2710	5416	13854	2386
10	.77		16898	4399	1073	571	180	70	2710	5275	14278	2620
11	.77		16898	4619	1127	600	189	70	2710	5120	14435	2463
12	.78		17118	4850	1183	630	199	70	2710	4950	14592	2526
13	.78		17118	5093	1242	661	209	70	2710	4763	14748	2370
14	.79		17337	5347	1304	694	219	70	2710	4556	14900	2437
15	.80		17557	5615	1370	729	230	70	2710	4330	15054	2503
16	.81		17776	5896	1438	765	242	69	2710	4082	15206	2570
17	.81		17776	6190	1510	803	254	69	2710	3809	15345	2431
18	.82		17996	6500	1586	844	267	69	2710	3508	15484	2512
19	.82		17996	6825	1665	886	280	69	2710	3178	15613	2383
20	.83		18215	7166	1748	930	294	69	2710	2815	15732	2483
21	.82		17996	7524	1836	977	308	68	2710	2416	15839	2157
22	.84		18435	7901	1927	1025	324	68	2710	1977	15932	2503
23	.84		18435	8296	2024	1077	340	68	2710	1495	16010	2425
24	.85		18654	8710	2125	1131	357	67	2710	964	16064	2590
25	.85		18654	9146	2231	1187	375	67	2710	381	16097	2557
TOTAL			408634	129413	31570	16797	5306	1733	67750	94063	346636	61998

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Table 5c
Cash Flow Statement of a Wood-Fired Power Plant (34% M.C., 5000 Btu/lb)
(₱000)

No. of Year	A. NET INCOME PLUS NON CASH EXPENSES a. Net Income	b. Interest Expense	c. Depreciation	a+b+c Total	LOAN FUNDS d. Foreign	e. Local	B. CASH OUTFLOW f. Investment Cost	g. Amortization Local	Foreign	f+g Total	CASH BALANCE Annual Total A-B
0					24000	24480	48488				
1	2466	3087	2710	8263				-	-	-	8263
2	2423	3086	2710	8219				1460	-	1460	6759
3	2431	3445	2710	8586				1460	-	1460	7126
4	2534	4560	2710	9804				2550	-	2550	7254
5	2656	4526	2710	9892				2550	-	2550	7342
6	2553	5120	2710	10383				2550	-	2550	7833
7	2686	5660	2710	11056				2550	4283	6833	4223
8	2333	5544	2710	10587				2550	4283	6833	3754
9	2386	5416	2710	10512				2550	4283	6833	3679
10	2620	5275	2710	10605				2550	4283	6833	3712
11	2463	5120	2710	10293			4287	2550	4283	11120	(827)
12	2526	4950	2710	10186				2550	4283	6833	3353
13	2370	4763	2710	9843				2550	4283	6833	3010
14	2437	4556	2710	9703				2550	4283	6833	2870
15	2503	4330	2710	9543				2550	4283	6833	2710
16	2570	4082	2710	9362				2550	4283	6833	2529
17	2431	3809	2710	8950				2550	4283	6833	2117
18	2512	3508	2710	8730				2550	4283	6833	1897
19	2383	3178	2710	8271				2550	4283	6833	1438
20	2483	2815	2710	8008				2550	4283	6833	1175
21	2157	2416	2710	7283			4287	2550	4283	11120	(3837)
22	2503	1977	2710	7190				2550	4283	6833	(357)
23	2425	1495	2710	6630				2550	4283	6833	(203)
24	2590	964	2710	6264				2550	4283	6833	(569)
25	2557	381	2710	5648				2550	4283	6833	(1185)
TOTAL	61998	94063	67750	223811			8574	59020	81377	148971	74840 1/

1/ The declining trend of annual cash generations is the result of a NEA pricing policy whereby prices per KWH are calculated at cost plus a constant factor. As the interest portion of loan amortizations decreases and the principal portion increases, revenues remain tied to expenses. Thus, increased cash requirements must be met from prior accumulations. If the table projected interest and principal payments equal from year to year, the annual cash generations would be approximately equal.

Table 5d
Wood-Fired Power Plant
Cost Analysis per KWH
(In Pesos)
(34% M.C., 5000 Btu/lb)

Year	Fuel Cost Amount	Personnel Expenses Amount	Maint. Exp. Amount	Adm. & Gen. Exp.	Org'n Expense	Dep. Expense	Interest Expense	Total Exp. Amount
1	.08	.02	.01	.004	.003	.12	.14	.38
2	.09	.02	.01	.004	.003	.12	.14	.39
3	.10	.02	01	.004	.003	.12	.16	.42
4	.11	.03	.01	.005	.003	.12	.21	.49
5	.12	.03	.02	.005	.003	.12	.21	.51
6	.14	.03	.02	.006	.003	.12	.23	.55
7	.15	.04	.02	.006	.003	.12	.26	.60
8	.16	.04	.02	.007	.003	.12	.25	.60
9	.18	.04	.02	.007	.003	.12	.25	.62
10	.20	.05	.03	.008	.003	.12	.24	.65
11	.21	.05	.03	.009	.003	.12	.23	.65
12	.22	.05	.03	.009	.003	.12	.23	.66
13	.23	.06	.03	.01	.003	.12	.21	.66
14	.24	.06	.03	.01	.003	.12	.21	.67
15	.26	.06	.03	.01	.003	.12	.20	.68
16	.27	.07	.03	.01	.003	.12	.19	.69
17	.28	.07	.04	.01	.003	.12	.17	.69
18	.30	.07	.04	.01	.003	.12	.16	.70
19	.31	.08	.04	.01	.003	.12	.14	.71
20	.33	.08	.04	.01	.003	.12	.13	.71
21	.34	.08	.04	.01	.003	.12	.11	.70
22	.36	.09	.05	.01	.003	.12	.09	.72
23	.38	.09	.05	.01	.003	.12	.07	.72
24	.40	.10	.05	.02	.003	.12	.04	.73
25	.42	.10	.05	.02	.003	.12	.02	.73

Table 5e
Wood-Fired Power Plant Balance Sheet (34% M.C., 5000 Btu/lb)
(₱000)

Year	1 1983	2 1984	3 1985	4 1986	5 1987	6 1988	7 1989	8 1990
Assets								
Cash	8333	15162	22358	29682	37094	44997	49290	53114
Fixed Assets	48488	48488	48488	48488	48488	48488	48488	48488
Less: Accrued Depreciation	2710	5420	8130	10840	13550	16260	18970	21680
TOTAL ASSETS	54111	58230	62716	67330	72032	77225	78808	79922
Liabilities & Surplus								
Long Term Debt - NEA	51645	52588	54664	55229	57384	60064	55405	54297
Interest Payable	-	753	732	2247	2138	2098	5654	5543
Retained Earnings	-	2466	4889	7320	9854	12510	15063	17749
Net Income	2466	2423	2431	2534	2656	2553	2686	2333
TOTAL LIABILITIES & SURPLUS	54111	58230	62716	67330	72032	77225	78808	79922

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Table 6a
Assumptions for
Financial Analysis for 5 MW
Wood-Fired Power Plant
(40% M.C., 4515 Btu/lb)

A. Given Factor

1.	Power Plant capacity	5 MW
2.	Investment	₱48,488,000
3.	Investment/kw	₱ 9,697.60
4.	Fuel/MWH	1.14 MT
5.	Price of wood fuel/wt (Year 1)	₱65.00
6.	Number of power plant employees	37
7.	Foreign Exchange Rate Used	₱8.00 = $1.00

B. Assumptions

1.	Economic life of project	25 years
2.	Average operating time/year	5520 hours
3.	Energy available for distribution (less plant use)	90%
4.	Transformer efficiency	95%
5.	Distribution efficiency	93%
6.	Maintenance cost (Year 1) as % of investment	0.5%
7.	Administrative and General Cost as % of Production Expense	3%
8.	Annual increase in wood, personnel, maintenance and general cost: Years 1 - 10	10% Compounded
	Years 11- 25	5% Compounded

C. Policies

1. Energy rate to distribution system will be NPC grid rate for the first year, then 90% of NPC grid rate or cost plus ₱0.12 which ever is lower. The mark-up corresponds to a 4% ROI and assures recovery of investment within the economic life of the project.

2. Financing will be through a loan of ₱48.488 million from NEA under the following terms:

	Foreign Component U.S. Dollar	Local Component Pesos
a. Amount	₱24,000,000	₱24,488,000
b. Interest Rate	9.75%	3% (Years 1-3) 9.5% (Years 4-25)
c. Repayment Period Including Grace Period	25 years	25 years
d. Grace Period	6 years	1 year

3. Depreciation: Straight line, 4% per year for power plant and 10% for transport facilities.

4. Organizational cost will be amortized over 25 years.

D. Evaluation

1. Energy generated (5 x 5520) — 27600 MWH

2. Wood fuel requirement/year (1.14 x 27600) — 31464 MT

3. Operating cost - Year 1

	Total	Per Kwh	%
a. Wood Fuel	₱2,045,002	₱0.09	23.53
b. Personnel	455,180	0.02	5.24
c. Maintenance	242,000	0.01	2.78
d. General	82,001	.004	0.94
e. Depreciation	2,710,110	.12	31.18
f. Interest Expenses	3,087,280	.14	35.52
g. Organizational Cost	70,202	.003	0.81
	₱8,691,775	₱0.397	100.00

4. Energy distributed (27600 x .90 x .93 x .95) — 21946 MWH

5. Revenue (Year 1) (21946 x .50) — ₱10,973

6. Financial projections for 25 years (enclosed)

   a. Income Statement
   b. Cash Flow Statement
   c. Cost breakdown per kwh

Table 6b
Income Statement of a Wood-Fired Power Plant (40% M.C., 4515 Btu/lb)
(₱000)

	A. REVENUE			B. TOTAL EXPENSES								
				a. Production Expense								
No. of Year	a. ₱/kwh	b. kwh sold	c. Revenue a x b	Fuel Cost	Personnel Expenses	Maint.	b. Adm. & Gen. Exp.	c. Org. Expense	d. Depre. Exp.	e. Interest Exp.	Total a+b+c+d+e	Net Income A-B
1	.51	21946000	11192	2045	455	242	82	70	2710	3087	8691	2501
2	.52		11412	2250	501	266	90	70	2710	3086	8973	2439
3	.55		12070	2475	551	293	99	70	2710	3445	9643	2427
4	.62		13607	2722	606	322	109	70	2710	4560	11099	2508
5	.65		14265	2994	666	354	120	70	2710	4526	11440	2825
6	.68		14923	3294	733	390	132	70	2710	5120	12449	2474
7	.74		16240	3623	806	429	146	70	2710	5660	13444	2796
8	.74		16240	3986	887	472	160	70	2710	5544	13829	2411
9	.76		16679	4384	976	519	176	70	2710	5416	14251	2428
10	.79		17337	4822	1073	571	194	70	2710	5275	14715	2622
11	.79		17337	5064	1127	600	204	70	2710	5120	14895	2442
12	.80		17557	5317	1183	630	214	70	2710	4950	15074	2483
13	.80		17557	5582	1242	661	224	70	2710	4763	15252	2305
14	.82		17996	5862	1304	694	236	70	2710	4556	15432	2564
15	.82		17996	6155	1370	729	248	70	2710	4330	15612	2384
16	.83		18215	6462	1438	765	260	69	2710	4082	15786	2429
17	.84		18435	6786	1510	803	273	69	2710	3809	15960	2475
18	.84		18435	7125	1586	844	287	69	2710	3508	16129	2306
19	.85		18654	7481	1665	886	301	69	2710	3178	16290	2364
20	.86		18873	7855	1748	930	316	69	2710	2815	16443	2430
21	.86		18873	8248	1836	977	332	68	2710	2416	16587	2286
22	.87		19093	8660	1927	1025	348	68	2710	1977	16715	2378
23	.88		19312	9093	2024	1077	366	68	2710	1495	16833	2479
24	.88		19312	9548	2125	1131	384	67	2710	964	16929	2383
25	.89		19532	10025	2231	1187	403	67	2710	381	17004	2528
			421142	141858	31570	16797	5704	1733	67750	94063	359475	61667

Table 6c
Cash Flow Statement of a Wood-Fired Power Plant (40% M.C., 4515 Btu/lb)
(₱000)

No. of Year	A. NET INCOME PLUS NON CASH EXPENSES a. Net Income	b. Interest Expense	c. Depreciation	a+b+c Total	LOAN FUNDS d. Foreign	e. Local	B. CASH OUTFLOW f. Investment Cost	g. Amortization Local	Foreign	f+g Total	CASH BALANCE Annual Total A-B
0					24000	24488	48488				
1	2501	3087	2710	8298				-	-	-	8298
2	2439	3086	2710	8235				1460	-	1460	6775
3	2427	3445	2710	8582				1460	-	1460	7122
4	2508	4560	2710	9778				2550	-	2550	7228
5	2825	4526	2710	10061				2550	-	2550	7511
6	2474	5120	2710	10304				2550	-	2550	7754
7	2796	5660	2710	11166				2550	4283	6833	4333
8	2411	5544	2710	10665				2550	4283	6833	3832
9	2428	5416	2710	10554				2550	4283	6833	3721
10	2622	5275	2710	10607				2550	4283	6833	3774
11	2442	5120	2710	10272			4287	2550	4283	11120	(848)
12	2483	4950	2710	10143				2550	4283	6833	3310
13	2305	4763	2710	9778				2550	4283	6833	2945
14	2564	4556	2710	9830				2550	4283	6833	2997
15	2384	4330	2710	9424				2550	4283	6833	2591
16	2429	4082	2710	9221				2550	4283	6833	2388
17	2475	3809	2710	8994				2550	4283	6833	2161
18	2306	3508	2710	8524				2550	4283	6833	1691
19	2364	3178	2710	8252				2550	4283	6833	1419
20	2430	2815	2710	7955				2550	4283	6833	1122
21	2286	2416	2710	7412			4287	2550	4283	11120	(3708)
22	2378	1977	2710	7065				2550	4283	6833	232
23	2479	1495	2710	6684				2550	4283	6833	(149)
24	2383	964	2710	6057				2550	4283	6833	(776)
25	2528	381	2710	5619				2550	4283	6833	(1214)
TOTAL	61667	94063	67750	223480			8574	59020	81377	148971	74509 1/

1/ The declining trend of annual cash generations is the result of a NEA pricing policy whereby prices per KWH are calculated at cost plus a constant factor. As the interest portion of loan amortizations decreases and the principal portion increases, revenues remain tied to expenses. Thus, increased cash requirements must be met from prior accumulations. If the table projected interest and principal payments equal from year to year, the annual cash generations would be approximately equal.

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Table 6d
Wood-Fired Power Plant
Cost Analysis per KWH
(In Pesos)
(40% M.C., 4515 Btu/lb)

Year	Fuel Cost	Personnel Expense	Mainte-nance	Adm. & Gen. Expense	Org. Expense	Depre-ciation	Instal. Expense	Total Expense
1	.09	.02	.01	.004	.003	.12	.14	.39
2	.10	.02	.01	.004	.003	.12	.14	.40
3	.11	.02	.01	.004	.003	.12	.16	.43
4	.12	.03	.01	.005	.003	.12	.21	.50
5	.14	.03	.02	.005	.003	.12	.21	.53
6	.15	.03	.02	.006	.003	.12	.23	.56
7	.17	.04	.02	.007	.003	.12	.26	.62
8	.18	.04	.02	.007	.003	.12	.25	.62
9	.20	.04	.02	.008	.003	.12	.25	.64
10	.22	.05	.03	.009	.003	.12	.24	.67
11	.23	.05	.03	.009	.003	.12	.23	.67
12	.24	.05	.03	.01	.003	.12	.23	.68
13	.25	.06	.03	.01	.003	.12	.21	.68
14	.27	.06	.03	.01	.003	.12	.21	.70
15	.28	.06	.03	.01	.003	.12	.20	.70
16	.29	.07	.03	.01	.003	.12	.19	.71
17	.31	.07	.04	.01	.003	.12	.17	.72
18	.32	.07	.04	.01	.003	.12	.16	.72
19	.34	.08	.04	.01	.003	.12	.14	.73
20	.36	.08	.04	.01	.003	.12	.13	.74
21	.38	.08	.04	.01	.003	.12	.11	.74
22	.39	.09	.05	.01	.003	.12	.09	.75
23	.41	.09	.05	.02	.003	.12	.07	.76
24	.43	.10	.05	.02	.003	.12	.04	.76
25	.46	.10	.05	.02	.003	.12	.02	.77

Table 6e
Wood-Fired Power Plant Balance Sheet (40% M.C., 4515 Btu/lb)
(₱000)

Year	1 1983	2 1984	3 1985	4 1986	5 1987	6 1988	7 1989	8 1990
Assets								
Cash	8368	15213	22405	29703	37284	45108	49511	53413
Fixed Assets	48488	48488	48488	48488	48488	48488	48488	48488
Less: Accrued Depreciation	2710	5420	8130	10840	13550	16260	18970	21680
TOTAL ASSETS	54146	58281	62763	67351	72222	77336	79029	80221
Liabilities & Surplus								
Long Term Debt - NEA	51645	52588	54664	55229	57384	60064	55405	54297
Interest Payable	-	753	732	2247	2138	2098	5654	5543
Retained Earnings	-	2501	4940	7367	9875	12700	15174	17970
Net Income	2501	2439	2427	2508	2825	2474	2796	2411
TOTAL LIABILITIES & SURPLUS	54146	58281	62763	67351	72222	77336	79029	80221

Table 7
Average Power Rate per KWH
Charge by Electric Cooperatives in 1980
(In Pesos)

REGION	Total KWH Sales (M)	Line Losses (%)	Average Power Rate (P/kwh)
Ilocos	185.72	25.1	0.58
Cagayan Valley	23.56	22.3	1.18
Central Luzon	214.06	25.8	0.49
Southern Luzon	160.26	20.3	0.79
Bicol	118.61	18.2	0.72
Western Visayas	138.11	16.5	0.90
Central Visayas	35.38	14.7	0.80
Eastern Visayas	45.64	16.6	0.96
Western Mindanao	61.88	20.2	1.06
Northern Mindanao	134.20	8.4	0.43
Southern Mindanao	60.16	17.9	0.85
Central Mindanao	29.43	22.9	0.65
TOTAL	1,207.01	20.0	0.78

Note: As published by NEA.

Table 8
Wood-Fired Power Plant
Summarized Costs for Installation of Three 5MW Plants
($000)

		Year 1	2	3	4	TOTAL
1.	Power plant equipment[1/]	-	-	8,334	900	9,234
2.	Transport facilities	740	1,480	1,480	740	4,440
3.	Civil works	-	-	1,079	1,000	2,079
4.	Mechanical & electrical	-	-	-	702	702
5.	Local A & E	-	64	200	300	564
6.	Contingencies	-	388	388	388	1,164
	TOTAL	740	1,932	11,481	4,030	18,183

[1/] ESF portion will total 9.0 million and will be paid in foreign exchange. Disbursement will occur in years 3 and 4 and commitment will occur in year 1.

LOAN PLAN

A. General Description

The Livelihood Support Fund as part of its objective to promote rural employment opportunities and enterprises, supports NEA's program to generate electric power through the production and use of locally-available resources.

The loan obtained from LSF enables NEA to establish three 5 MW wood-fired power plants out of approximately 70 wood-fired power plants programmed to be operated throughout the country by 1987.

A wood-fired power plant project entails the development of a tree farm to function as a continual fuelwood source, and the construction of a power plant to convert the fuelwood into electricity. These activities, together with the operation of the thermal plant, requires extensive labor inputs from two hundred unemployed rural poor. The development and construction of the two project components is financed through loans.

1. Tree Farm Loan

The tree farm loan includes the cost of land preparation, planting, management and maintenance, harvesting, labor, tools, equipment and planting of permanent trees. At 12% interest rate per annum, the loan is amortized quarterly for 12 years. The initial payment is due and payable on the first quarter of the fifth year of the project after a 4-year grace period and succeeding quarter periods until the loan is fully paid.

The loan is disbursed according to material input needs and work accomplished on the tree farms.

2. Power Plant Loan

The power plant loan involves a non-cash credit package to electric cooperatives. Loan coverage includes power plant equipment, transport facilities, civil-mechanical-electrical works, engineering services, freight, insurance and pre-operating expenses. NEA-DTDO provides the technical assistance to electric cooperatives in the construction of power plants which is undertaken by local A&E firms.

Composed of foreign and local exchange components, the loan is payable within 25 years with a 6-year grace period for the foreign component and a 1-year grace period for the local component.

The foreign component of the loan is relent to the electric cooperative at 9.75% interest rate and amortized semi-annually. The local component which is amortized quarterly incurs a 3% interest rate for the first three years upon release. This is increased to 9.5% on the fourth year until the loan is totally paid.

B. Loan Releases Scheme

In lending to electric cooperatives, NEA adds a .75% service fee to the terms of the loan. Fund releases are based on compliance of the electric cooperatives with NEA requirements.

1. Tree Farm Loan

The NEA releases loans to the electric cooperatives and the cooperatives relend the loan to the Tree Farmers Associations. The initial fund release is made available upon the approval of the project feasibility study by the NEA Board of Administrators supported by the following documents:

a. BFD endorsed approval of electric cooperatives application for a tree farm lease.

b. Soil analysis.

c. Relocation and subdivision map of the area.

d. Modular assignments of farmers associations.

e. Articles of Incorporation registered with NEA.

Subsequent releases are made at the beginning of every quarter after the loan contract is signed. The general manager of the cooperative is required to submit an annual development plan and budget duly approved by the cooperative's Board of Directors. These are further studied and reviewed by the NEA-DTDO Finance and Agro-Forestry divisions. Once approved, funds are readied for release.

Other requirements necessary for the release of funds are accomplishment reports, financial-audit-accounting reports, trial balances and cash-flow statements.

A quarterly physical inspection and evaluation of the tree farms and books of accounts is conducted by NEA-DTDO staff as a control measure for fund disbursements.

2. Power Plant Loan

The power plant loan is essentially a non-cash loan granted to cooperatives. Equipment and materials are released in kind with the exception of pre-operating expenses. Further, local A&E contractors are paid directly by NEA.

The electric cooperative is required to submit a board resolution applying for the loan after a feasibility study has been approved. When this is approved, the loan contract which includes the promissory note, mortgage and other documents required by NEA are prepared. These are presented to the NEA Board of Administrators for approval.

Loan releases come in the form of equipment delivery. NEA exercises administrative control through the regular inspection of all books of accounts, records and other documents pertaining to the project.

C. Collection Scheme

NEA prepares a loan amortization schedule along with the feasibility study before the inception of the loan contract. When the contract is approved, the amortization schedule is followed for the repayment of the loan.

Payment is done by the general manager of the cooperative to NEA on amortization periods specified in the loan contract. The power plant loan involves two repayment schedules. For the foreign component, amortization is due on the seventh

year from the date of loan release. The amortization for the local component is due on the second year from the date of commissioning. For the tree farm loan, repayment starts on the fifth year upon the sale of wood.

Official receipts are issued by NEA for every payment made. Loan payments are correspondingly entered into respective books of accounts. These books are properly kept and open to audit by NEA/DTDO.

Overdue payments accumulate interest at 1% monthly.

CONTRACT OF LOAN

FOR

THE DEVELOPMENT OF A

DENDRO THERMAL TREE PLANTATION

Attachment 1
NEA Loan to Cooperatives

WITNESS

KNOW ALL MEN BY THESE PRESENTS:

This CONTRACT, made and entered into this _____ day of _____, 19 _____ at _____ by and between:

NATIONAL ELECTRIFICATION ADMINISTRATION, a government corporation created under Presidential Decree No. 269, as amended, represented herein by _____, Filipino, of legal age with office address at 1050 D & E Building, Quezon City, Metro Manila, hereinafter referred to as "NEA".

and

WITNESS

_____, a cooperative organized and existing pursuant to Presidential Decree No. 269, as amended, with office address at _____ represented herein by _____, Filipino, of legal age, hereinafter referred to as "BORROWER".

W I T N E S S E T H :

WHEREAS, the BORROWER has applied for a loan from NEA for the development of a Dendro Thermal Tree Plantation.

WHEREAS, the NEA is willing to extend said loan to the BORROWER.

NOW, THEREFORE, for and in consideration of the mutual covenants herein contained, NEA and BORROWER agree as follows:

ARTICLE I

THE LOAN

COOP

SECTION 1. The NEA agrees to lend to the BORROWER an amount not exceeding _____ to finance the development, operations and maintenance of the _____ hectares of tree plantation of _____, Province of _____ to support the fuelwood requirements of a 3,000 kilowatt Dendro Thermal Power Plant.

ARTICLE II

LOAN TERMS

NEA

SECTION 1. The NEA shall lend and the BORROWER shall borrow an amount not exceeding _____ (₱_____) to finance the planting, maintenance, harvesting, silviculture, and administration of the PROJECT.

SECTION 2. The debt created by the loan shall be evidenced by a note to be executed by the BORROWER, payable to the order of the NEA. The note shall bear interest at the rate of 11% per annum. Interest will commence only when funds are withdrawn by specific requests from tge BORROWER. Interest will be computed on withdrawn funds at the end of each calendar year.

SECTION 3. The BORROWER shall repay NEA the principal and interest within 12 years in 33 equal quarterly installments, the first installment deing due not later than the first quarter of the fifth year from the date of first release of the loan; provided, however, NEA may accelerate the repayment if the financial condition of the BORROWER warrants.

WITNESS

SECTION 4. Should there be default in the payment of any installment, the amount in arrears shall bear interest at the rate of one per cent per month.

SECTION 5. Application of Payment - All installments shall be applied first to the payment of interest due and then to the repayment of principal.

SECTION 6. The NEA, through its authorized representatives, shall have access to and the right to inspect and require the BORROWER to submit all such books, records, accounts and other financial and technical documents pertaining to the management, operations and maintenance of the PROJECT.

WITNESS

SECTION 7. The NEA shall from time to time issue implementation Letters that will prescribe the procedures applicable to this Contract of Loan. Withdrawal of funds shall be made only in accordance with specific programs approved by NEA.

ARTICLE III

TERMS FOR RELENDING, ADVANCES, AND DISPOSITION OF FUNDS

SECTION 1. Total loan of _____ (₱ _____) shall be relent and/or disbursed by the BORROWER as follows:

COOP

(1) _____ as a loan to the _____ Dendro Thermal Farmers Associations;

(2) _____ as a loan to the _____ Dendro Thermal Power Plant;

(3) _____ for administrative expenses of the BORROWER.

SECTION 2. The Contracts of Loans between the BORROWER and _____ Dendro Thermal Farmers Associations and _____ Dendro Thermal Power Plant Corporation shall be submitted to the NEA for approval. Said Contracts of Loan shall, among others, contain the following terms and conditions:

NEA

a) The Loan shall bear interest at 12% per annum;

b) The principal and interest accrued thereon shall be payable within 12 years from the date of first release of the loan in 33 equall quarterly installments, the first installment to be payable on the fifth year from the date of first release of the loan;

c) The releases to the PROJECT and the disposition of such funds so released, shall be in accordance with the conditions and procedures that the NEA shall prescribe;

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d) The NEA shall have the power of supervision over the management operations and maintenance of the PROJECT;

e) The loan shall be secured with a chattel mortgage on the tree crop to be produced.

SECTION 3. The BORROWER shall deliver to the NEA, when directed by the NEA and subject to its approval, the following:

WITNESS

a) The promissory note;

b) Copies of the Contracts of Loan between the BORROWER and _____ Dendro Thermal Farmers Associations;

c) Other documents as may be reasonably required from time to time.

ARTICLE IV

DEFAULTS AND REMEDIES

SECTION 1. The happening of any of the following events shall constitute default by the BORROWER:

WITNESS

a) failure to perform any term, covenant, promise, condition or agreement as set forth in the Contract of Loan;

b) breach of any warranty or gross misrepresentation;

c) violation of any policies and rules issued by NEA.

SECTION 2. In the event of default, the NEA may, in addition to the rights, privileges, powers and remedies granted to it under Presidential Decree No. 269, as amended, and other pertinent laws, exercise any or all of the following remedies:

COOP

a) Suspend and/or stop loan releases;

b) Declare all unpaid obligations to be immediately due and payable;

c) Assign or appoint a Project Supervisor and/or General Manager;

d) Take-over the development, operations, management and control of the PROJECT; and

e) Take any other lawful remedial measure.

ARTICLE V

MISCELLANEOUS

SECTION 1. The Contract may be revised or amended by mutual consent of the parties.

SECTION 2. The BORROWER shall not assign to a third party any of the rights arising from this Agreement.

NEA

SECTION 3. Should any part of this Contract be declared invalid, such declaration shall not affect the validity and enforceability of the other provisions.

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IN WITNESS WHEREOF, the parties have affixed their signatures on the date and place first above written.

NATIONAL ELECTRIFICATION ADMINISTRATION

BY:

_____

_____

_____ ELECTRIC COOPERATIVE, INC.

BY:

_____

_____

WITNESSES:

_____ _____

A C K N O W L E D G M E N T

REPUBLIC OF THE PHILIPPINES)
) S.S.

BEFORE ME, Notary Public for and in _____ Philippines, on this _____ day of _____ 198 ____ personally appeared _____ _____ NEA with Residence Certificate No. _____ issued at _____ on _____ 19 ___ and _____ _____ President _____ Electric Cooperative, Inc. with Residence Certificate No. _____ _____ issued at _____ on _____ _____ 19 ____, respectively, both known to me to be the same persons who executed the foregoing Contract of Loan and who acknowledged to me that the same is their true and voluntary act and deed and the true and voluntary act and deed of the Offices they respectively represent.

I CERTIFY that this Contract consists of _____ pages including this one, each page duly signed by the PARTIES and their instrumental witnesses at the left-hand margin except page _____ which is signed at the foot thereof and this page which is the acknowledgment.

IN WITNESS WHEREOF, I have hereunto affixed my signature and my official seal on the date and at the place first above written.

_____
Notary Public

My Commission expires on

_____

PTR NO. _____

Doc. No. _____
Page No. _____
Book No. _____
Series of _____

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PROMISSORY NOTE

_____ _____

On or before _____, for value received we promised to pay the NEA, at its Office at _____ _____ Philippines, the sum of _____ Philippine Currency, with interest at the rate of _____ _____ per annum. Before the date of maturity, we hereby bind ourselves to make partial payments, the first payment to be made _____ after the date of first release and the subsequent payments shall be on the first day of every _____ thereafter, and each of all such payments shall be _____ _____(₱_____). All unpaid amortization shall earn interest at 1% per month.

In case of non-payment of the amount of this note or any portion of it on demand, when due, or any other amount or amounts due on account of this note, the entire obligation shall become due and demandable, and if for the enforcement of the payment thereof, the NEA is constrained to entrust the case to its attorneys, the cooperative binds itself to pay attorney's fees, as provided for in the mortgage contract, in addition to the legal fees and other incidental expenses. In the event of foreclosure of the mortgage securing this note, the cooperative binds itself to pay the deficiency if any.

COOPERATIVE

BY:

_____

SIGNED IN THE PRESENCE OF:

_____ _____
Witness Witness

Attachment 2
Cooperative Loan
to Farmers'
Associations

CONTRACT OF LOAN
FOR THE DEVELOPMENT OF A
FARMERS ASSOCIATION TREE PLANTATION MODULE

WITNESS

KNOW ALL MEN BY THESE PRESENTS:

This CONTRACT made and entered into
this _____ day of _____ 198 ___
at _____
by and between:

_____
an electric cooperative organized and existing
pursuant to Presidential Decree NO. 269, as amended,
with office address at _____
_____ duly represented in this CONTRACT
by _____ and
hereinafter referred to as COOPERATIVE

WITNESS

and

_____
a farmers cooperative organized and existing under
Presidential Decree NO. 269, as amended, with office
address at _____
duly represented in this CONTRACT by _____
_____ and hereinafter referred
to as BORROWER.

W I T N E S S E T H

FARMERS ASSOCIATION

WHEREAS, the COOPERATIVE has obtained a loan from the National Electrification Administration to finance the establishment, development and operations of a tree plantation to support the fuel requirements of the COOPERATIVE's dendro thermal power plant.

WHEREAS, the COOPERATIVE has made portions of this loan available for relending to farmers associations who will perform the actual establishment, development and operations of the tree plantation.

WHEREAS, the BORROWER has applied for a loan from the COOPERATIVE to develop a portion of the tree plantation with an area of _____ hectares located in _____
_____ and hereinafter referred to as PROJECT MODULE.

ELECTRIC COOP

NOW, THEREFORE, for and in consideration of the mutual covenants herein contained, the COOPERATIVE and the BORROWER agree as follows:

ARTICLE I

THE LOAN

Section 1. Amount. The COOPERATIVE will lend to the BORROWER the amount of _____ PESOS to finance the establishment, development and operations of the PROJECT MODULE.

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Section 2. Type. The COOPERATIVE may release portions of this loan in cash or in kind as may be agreed upon by the COOPERATIVE and BORROWER from time to time.

ARTICLE II

LOAN TERMS

Section 1. Interest. The BORROWER shall pay the COOPERATIVE interest which shall accrue on the outstanding balance of the principal and any due and unpaid interest at the rate of twelve percent (12%) per annum. Interest will commence only when funds are withdrawn upon specific requests of the BORROWER. Interest will be computed on withdrawn funds at the end of each calendar year.

Section 2. Repayment Period. The BORROWER shall repay the COOPERATIVE the principal and interest within twelve (12) years in thirty three (33) equal quarterly installments. The first installment shall be due not later than the first quarter of the fifth year from the first release of the loan.

Section 3. Arrears. Should there be delay in the payment of any installment, the amount in arrears shall bear interest at the rate of one percent per month.

Section 4. Application of Payment. All payments shall be applied first to the payment of interest due and then to the repayment of principal.

Section 5. Inspection of Books. The National Electrification Administration and/or the COOPERATIVE, through authorized representatives, shall have access to and the right to inspect and require the BORROWER to submit all books, records, accounts and other financial and technical documents pertaining to the management, operations and maintenance of the PROJECT.

Section 6. Security. The Loan shall be secured by a chattel mortgage on the tree crop to be produced.

ARTICLE III

DISBURSEMENT AND

UTILIZATION OF FUNDS

Section 1. Release of Funds. The COOPERATIVE shall release and the BORROWER shall use loan funds in accordance with the work plan for the development and management of the project.

Section 2. Type of Releases. Part of the loan may be released to the BORROWER in the form of supplies and materials as may be specifically agreed upon between COOPERATIVE and BORROWER from time to time.

Section 3. Use of Loan Funds. All parts of this loan, in cash or in kind, shall be used by the BORROWER exclusively for the development, maintenance and management of the PROJECT MODULE.

WITNESS

WITNESS

FARMERS ASSOCIATION

ELECTRIC COOP

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ARTICLE IV

PARTICULAR COVENANTS

Section 1. Tenuree in Project Module. The COOPERATIVE hereby guarantees that the BORROWER shall have security of tenure, occupancy and operations of the PROJECT MODULE as long as it is used to provide wood fuel for the COOPERATIVE subject to government laws and rules as may be prescribed by the COOPERATIVE.

Section 2. Use of Project Module. The BORROWER hereby guarantees that the PROJECT MODULE will be used primarily for the production of wood fuel for the use of the COOPERATIVE. No crops other than the wood crop prescribed by the COOPERATIVE will be planted or cultivated without the specific prior approval of the COOPERATIVE.

Section 3. Disposition of Wood Products. Wood products from the PROJECT MODULE shall be sold exclusively to the COOPERATIVE or as the COOPERATIVE may require. No wood product shall be removed from the PROJECT MODULE without the specific prior approval of the COOPERATIVE.

ARTICLE V

DEFAULTS AND REMEDIES

Section 1. Definition of Default. The happening of any of the following events shall constitute default by the BORROWER;

a. Failure to perform any term, covenant, promise, condition or agreement as set forth in the Contract of Loan;

b. Breach of any warranty or gross misrepresentation;

c. Violation of any policy or rule issued by the COOPERATIVE for the operations of the PROJECT MODULE.

Section 2. Remedies. In the event of default, the COOPERATIVE may, in addition to the rights, privileges, powers and remedies granted to it under Presidential Decree No. 269, as amended, and other pertinent laws, exercise any or all of the following remedies:

a. Suspend and/or stop loan releases;

b. Declare all unpaid obligations to be immediately due and payable;

c. Take over the development, operations, management and control of the PROJECT MODULE; and

d. Take any other lawful remedial measure.

ARTICLE VI

MISCELLANEOUS

Section 1. Amendment. The Contract may be revised or amended by mutual consent of the parties.

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Section 2. Assignment of Rights. The BORROWER shall not assign to a third party any of the rights arising from this agreement.

Section 3. Invalidation. Should any part of this Contract be declared invalid, such declaration shall not affect the validity and enforceability of the other provisions.

IN WITNESS WHEREOF, the parties have affixed their signatures on the date and place first above written.

_____ ELECTRIC COOPERATIVE, INC.

BY:

_____

_____

_____ FARMERS ASSOCIATION, INC.

BY:

_____

_____

WITNESS:

_____ _____

ACKNOWLEDGMENT

REPUBLIC OF THE PHILIPPINES)
) S.S
)

BEFORE ME, Notary Public for and in _____ on this _____ day of _____ 198__ personally appeared _____ President _____ Electric Cooperative, Inc. with Residence Certificate Number _____ issued at _____ on _____ and _____ President _____ Farmers Association, Inc. with Residence Certificate Number _____ issued at _____ on _____ respectively, both known to me to be the same persons who executed the foregoing Contract of Loan and who acknowledged to me that the same is their true and voluntary act and deed and the voluntary act and deed of the offices they respectively represent.

I CERTIFY that this Contract of Loan consists of _____ pages including this one, and that each page is duly signed by the parties and their instrumental witnesses at the left-hand margin except page _____ which is signed at the foot thereof and this page which is the acknowledgment.

IN WITNESS WHEREOF, I have hereunto affixed my signature and my official seal on the date and at the place first above written.

_____
Notary Public

My commission expires on

_____
PTR N. _____

Doc. No. _____
Page No. _____
Book No. _____
Series of _____

PROMISSORY NOTE

₱ _____ _____, 198_

ON or BEFORE _____ for value received we jointly and severally promise to pay the _____ Electric Cooperative, Inc. at its office at _____ _____ the sum of _____ Pesos with interest at twelve percent (12%) per annum. Before the date of maturity, we hereby bind ourselves to make partial payments, the first payment to be made on _____, and the subsequent payments to be made on the first day of each quarter thereafter. All payments in arrears shall earn additional interest at one percent (1%) per month.

In case of non-payment of the amount of this note or any portion of it on demand, when due, or any other amount or amounts due on account of this note, the entire obligation shall become due and demandable, and if for the enforcement of the payment thereof, the COOPERATIVE is constrained to entrust the case to its attorneys, the BORROWER binds itself to pay attorney's fees in addition to the legal fees and other incidental expenses. In the event of foreclosure of the mortgage securing this note, the BORROWER binds itself to pay the deficiency, if any.

_____
FARMERS ASSOCIATION, INC.

BY:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

SIGNED IN THE PRESENCE OF:

_____ _____
Witness Witness

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TABLE AND MAP SUMMARIES OF PROGRAM DEVELOPMENT

This appendix contains the following tables concerning the NEA's Dendro Thermal Power Generation Program:

Table 1	-	Dendro Thermal Program, 1981-1987
Table 2	-	Summary of Progress Report, February 28, 1982
Table 3	-	Dendro Power Program List by Year, Including Location Maps
Table 4	-	Summary of Tree Farm Development
Table 5	-	Annual Tree Farm Targets by Site

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Table 1
Dendro Thermal Program
1981-1987

Installed Capacity	200 MW
Number of Power Plants	72
Annual Energy Produced	1050 GWH
Jobs Created (Direct Only)	11000
Hectares Reforested	70000
Estimated Cost (1981 Prices)	
Foreign	$220 million
Local	₱900 million
Barrels of Oil Saved Per Year	1.75 million

Power Generation Program Targets
1982-1987

Year	Power Capacity MW
1982	29
1983	26
1984	32
1985	35
1986	38
1987	40
Total	200 MW

Table 2
DENDRO THERMAL DEVELOPMENT OFFICE
SUMMARY OF PROGRESS REPORT AS OF FEBRUARY 28, 1982

	Last Report 12/31/81	Total as of 2/28/82
1. Institutional Development		
a. Plantations Organized	25	29
b. Farmers Associations Registered	229	264
c. Total Number of Members	2,544*	2,895
2. Loan Agreements		
Plantation Development		
a. No. of Loan Agreements	24	27
b. Amount of Approved Loan	₱97.9M	₱111M
c. Amount of Released Loan	25.4M	29.5M
Power Plant		
a. No. of Loan Agreements	1	14
b. Amount of Approved Loan	₱41.9M	₱514.2M
c. Amount of Released Loan	-	-
3. Plantation Development		
a. No. of Plantation Sites Identified	72	72
b. Feasibility Studies Approved	27	27
c. Total Land Area Covered (ha.)	64,465	99,034
d. Area Planted (ha.)	8,299	9,173
4. Power Plant Facilities		
a. No. of Power Plant Sites Identified	72	72
b. Equipment Ordered	17	17
c. Feasibility Studies Approved	9	14
d. A&E Services Contracts	9	11

*Adjusted

Table 3
NEA DENDRO POWER PROGRAM PROJECT LIST
As of 4 March 1982

1982

	Province	Electric Coop.	Town	MW
1.	Antique	ANTECO	Hamtic	1
2.	Occ. Mindoro	OMECO	Magsaysay	1
3.	Ilocos Norte	INEC	Solsona	3
4.	Pangasinan	PANELCO I	Bolinao	3
5.	Isabela	ISELCO II	Ilagan	3
6.	Zambales	ZAMECO	Palauig	3
7.	Abra	ABRECO	San Juan	3
8.	Isabela	ISELCO I	Jones	3
9.	Aklan	AKELCO	Nabas	3
10.	Camarines Sur	CASURECO IV	Catarman	3
11.	Nueva Vizcaya	NUVELCO	Dupax del Norte	3
				29

1983

12.	Palawan	PALECO	Aborlan	3
13.	Marinduque	MARELCO	Buenavista	3
14.	Iloilo	ILECO II	Lambunao A	3
15.	Cebu	CEBECO I	Dalaguete	3
16.	Catanduanes	FICELCO	Virac	1
17.	Lubang	LUBELCO	Lubang	1
18.	Camarines Sur	CASURECO III	Balatan	3
19.	Masbate	MASELCO	Mobo	3
20.	Pangasinan	CENPELCO	Aguilar	3
21.	Ilocos Sur	ISECO	Burgos	3
				26

1984

	Province	Electric Coop.	Town	MW
22.	Pampanga	PELCO II	Porac	3
23.	La Union	LUELCO	Arningay	3
24.	Bataan	BATELCO	Morong	3
25.	Quezon	QUEZELCO	Macalolon	3
26.	Bulacan	BECO I	Dom. Trinidad	3
27.	Nueva Ecija	NEECO II	Pantabangan	3
28.	Nueva Ecija	NEECO I	Gen. Tinio	3
29.	Pangasinan	PANELCO III	San Manuel	3
30.	Camarines Sur	CASURECO I	Lupi	3
31.	Tarlac	TARELCO	Sacobia	5
				32

1985

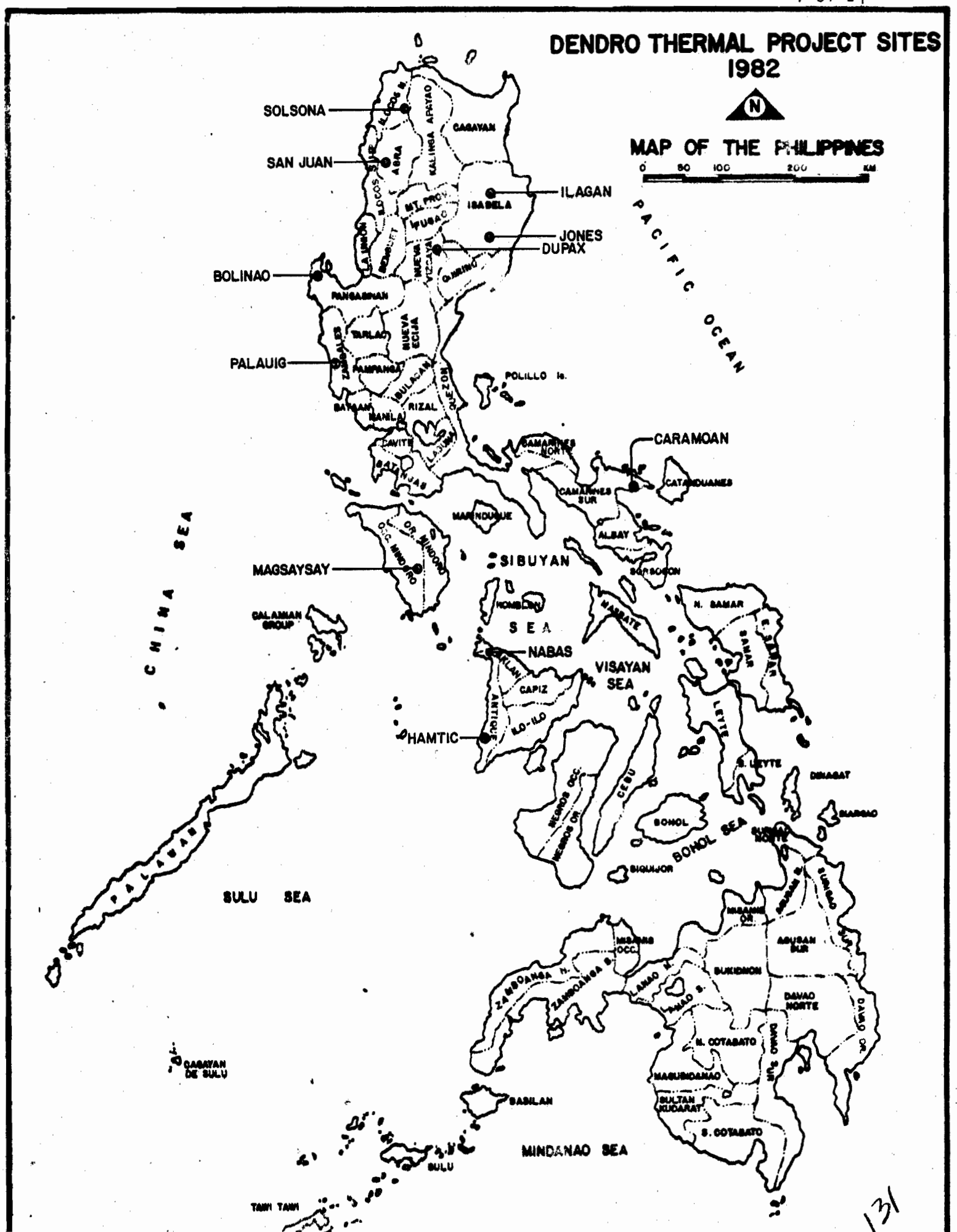
32.	Capiz	CAPELCO	Tapaz	3
33.	Iloilo	ILECO I	Miag-ao	3
34.	Negros Occidental	CENECO	Murlia	5
35.	Bohol	BOHECO I	Inabanga	5
36.	Negros Occidental	NOLECO	Binalbagan	3
37.	Bohol	BOHECO II	Danao	3
38.	Tarlac	TARELCO	Mayantoc	3
39.	Iloilo	ILECO II	Lambunao B	5
40.	Camarines Norte	CANORECO	Labo	3
41.	Palawan	PALECO	Brookes Point	1
42.	Tawi-tawi	TAWELCO	Balimbing	1
				35

1986

43.	Camarines Sur	CASURECO II	Siruma	3
44.	Albay	ALECO	Pio Duran	3
45.	Negros Occidental	VRESCO	Victorias	3
46.	Cebu	CEBECO II		3
47.	Batangas	BATELEC I	Calaca	3
48.	Batangas	BATELEC II	Rosario	3
49.	Iloilo	ILECO I	Leon	3

	Province	Electric Coop.	Town	MW
50.	Palawan	PALECO	Puerto Princesa	3
51.	Cagayan	CAGELCO II	Alcala	3
52.	Camarines Sur	CASURECO IV	Garchitorena	3
53.	Pampanga	PELCO I	Arayat	3
54.	Cagayab	CAGELCO I	Enrile	3
55.	Sulu	SULECO	Panamao	1
56.	Quirino	QUINELCO		1
				38
		1987		
57.	Negros Oriental	NORECO I		3
58.	Cebu	CEBECO III		3
59.	Cebu	CEBECO II		3
60.	Capiz	CAPELCO		3
61.	Negros Occidental	CENECO		3
62.	Negros Occidental	VRESCO		3
63.	Batangas	BATELCO II		3
64.	Nueva Ecija	NEECO III		3
65.	Bohol	BOHECO I		3
66.	Aurora	AURELCO		3
67.	Negros Oriental	NORECO II		3
68.	Northern Samar	SAMAR I		3
69.	Polilio Is.			1
70.	Mt. Province	MOPELCO		1
71.	Cuyo Is.			1
72.	Kalinga-Apayao	KAELCO		1
				40
			TOTAL:	200

130


DENDRO THERMAL PROJECT SITES
1982
N
MAP OF THE PHILIPPINES
0 50 100 200 KM
SOLSONA
SAN JUAN
ILAGAN
JONES
DUPAX
BOLINAO
PALAUIG
CARAMOAN
MAGSAYSAY
NABAS
HAMTIC
PACIFIC OCEAN
CHINA SEA
SULU SEA
SIBUYAN SEA
VISAYAN SEA
BOHOL SEA
MINDANAO SEA
CAGAYAN
ISABELA
KALINGA APAYAO
ABRA
ILOCOS N.
ILOCOS S.
MT. PROV.
BENGUET
LA UNION
NUEVA VIZCAYA
QUIRINO
PANGASINAN
TARLAC
NUEVA ECIJA
ZAMBALES
PAMPANGA
BULACAN
MOZ ZON
BATAAN
MANILA
RIZAL
CAVITE
LAGUNA
BATANGAS
POLILLO Is.
CAMARINES NORTE
CAMARINES SUR
CATANDUANES
ALBAY
SORSOGON
MARINDUQUE
OCC. MINDORO
OR. MINDORO
CALAMIAN GROUP
PALAWAN
ROMBLON
MASBATE
N. SAMAR
E. SAMAR
SAMAR
LEYTE
S. LEYTE
DINAGAT
SURIGAO
BUCAS GRANDE
CAPIZ
ILO-ILO
ANTIQUE
NEGROS OCC.
NEGROS OR.
CEBU
BOHOL
SIQUIJOR
MISAMIS OR.
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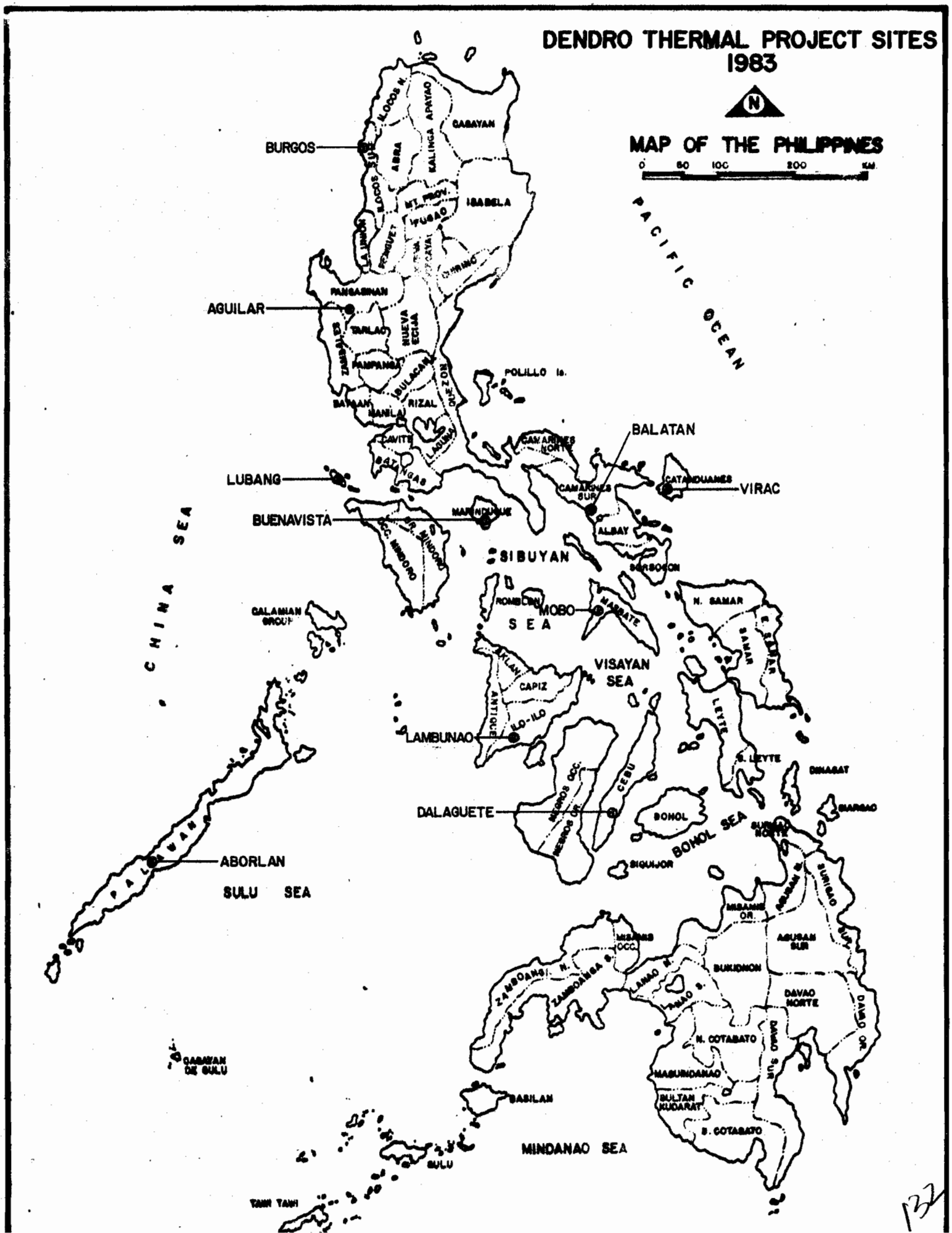
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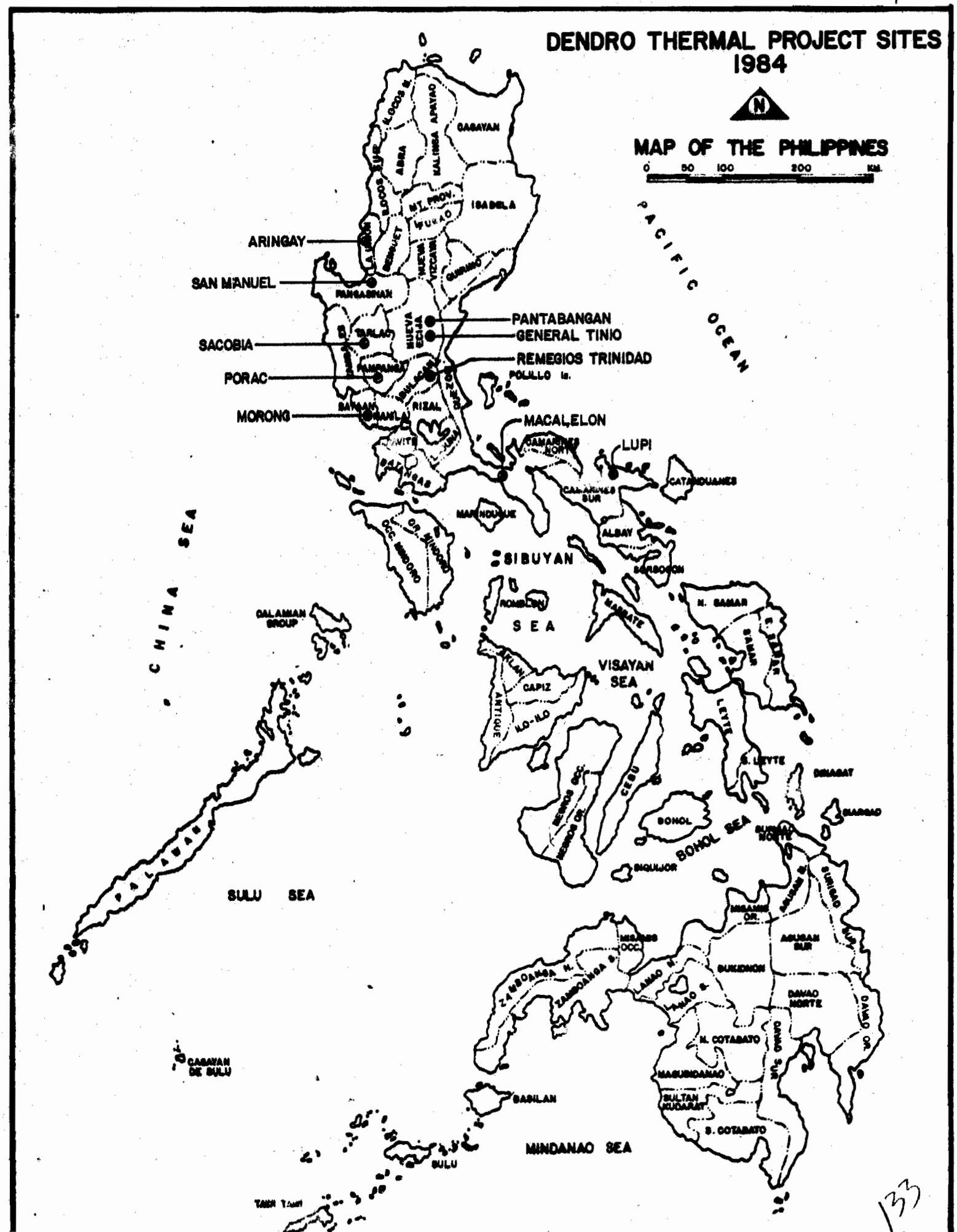
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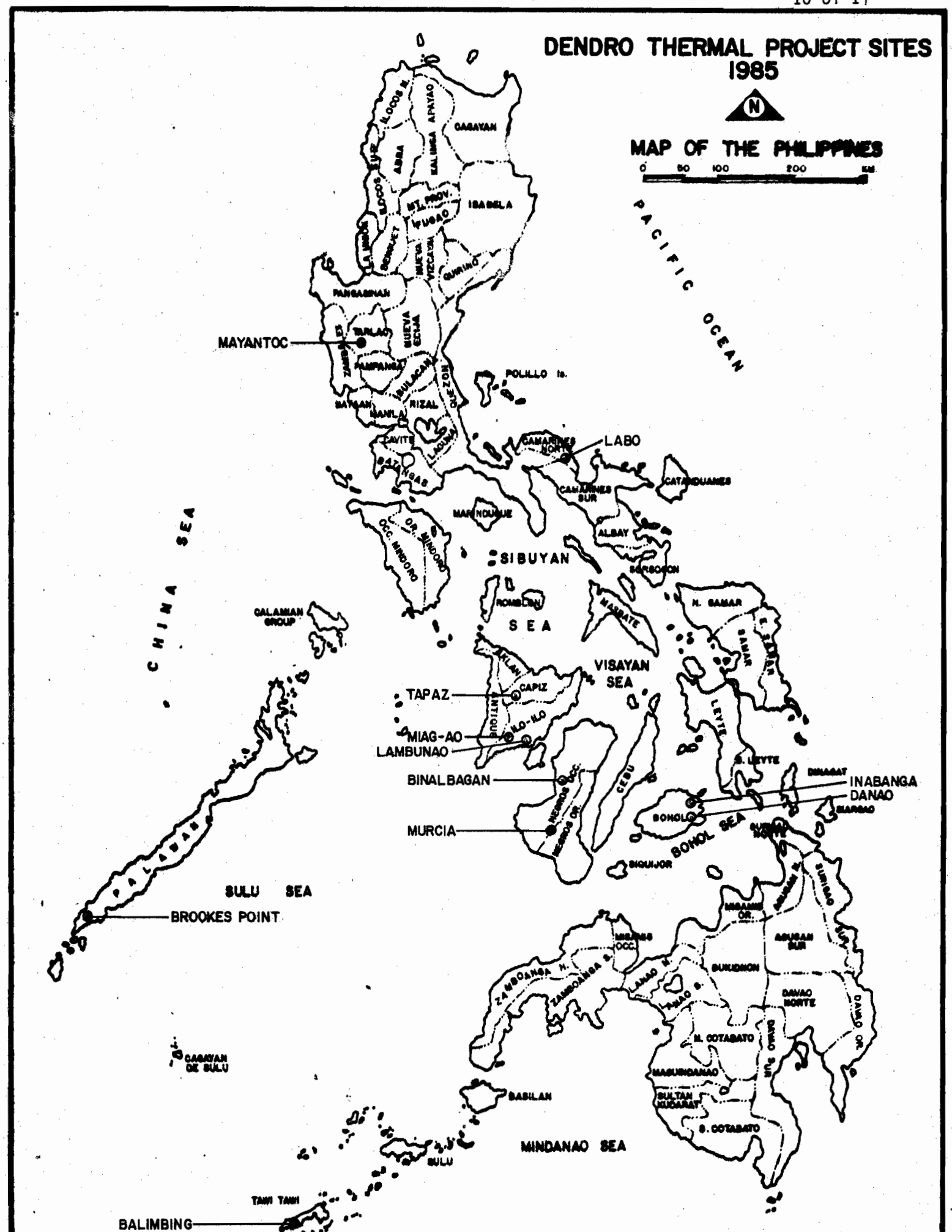
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LABO
TAPAZ
MIAG-AO
LAMBUNAO
BINALBAGAN
MURCIA
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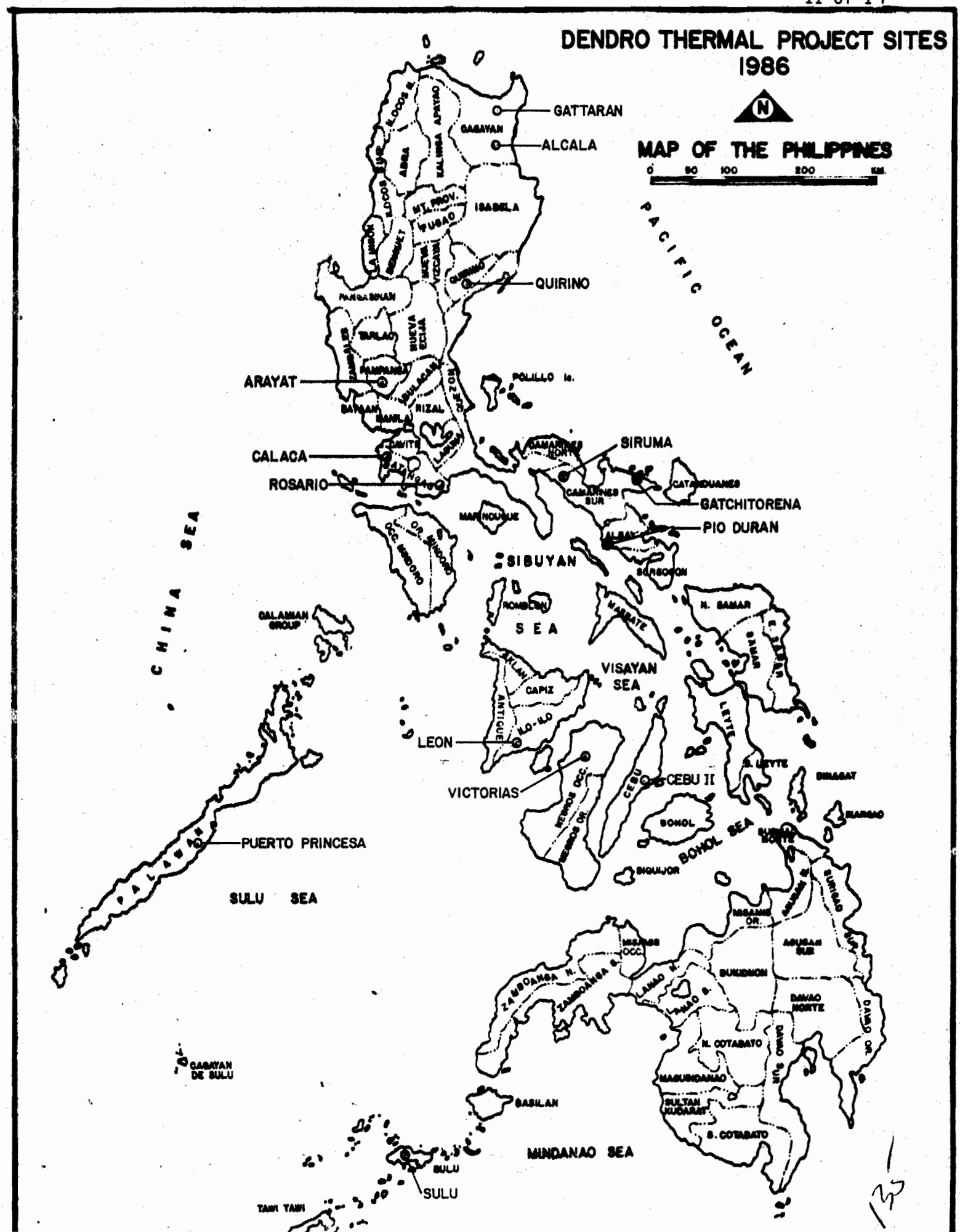
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CHINA SEA
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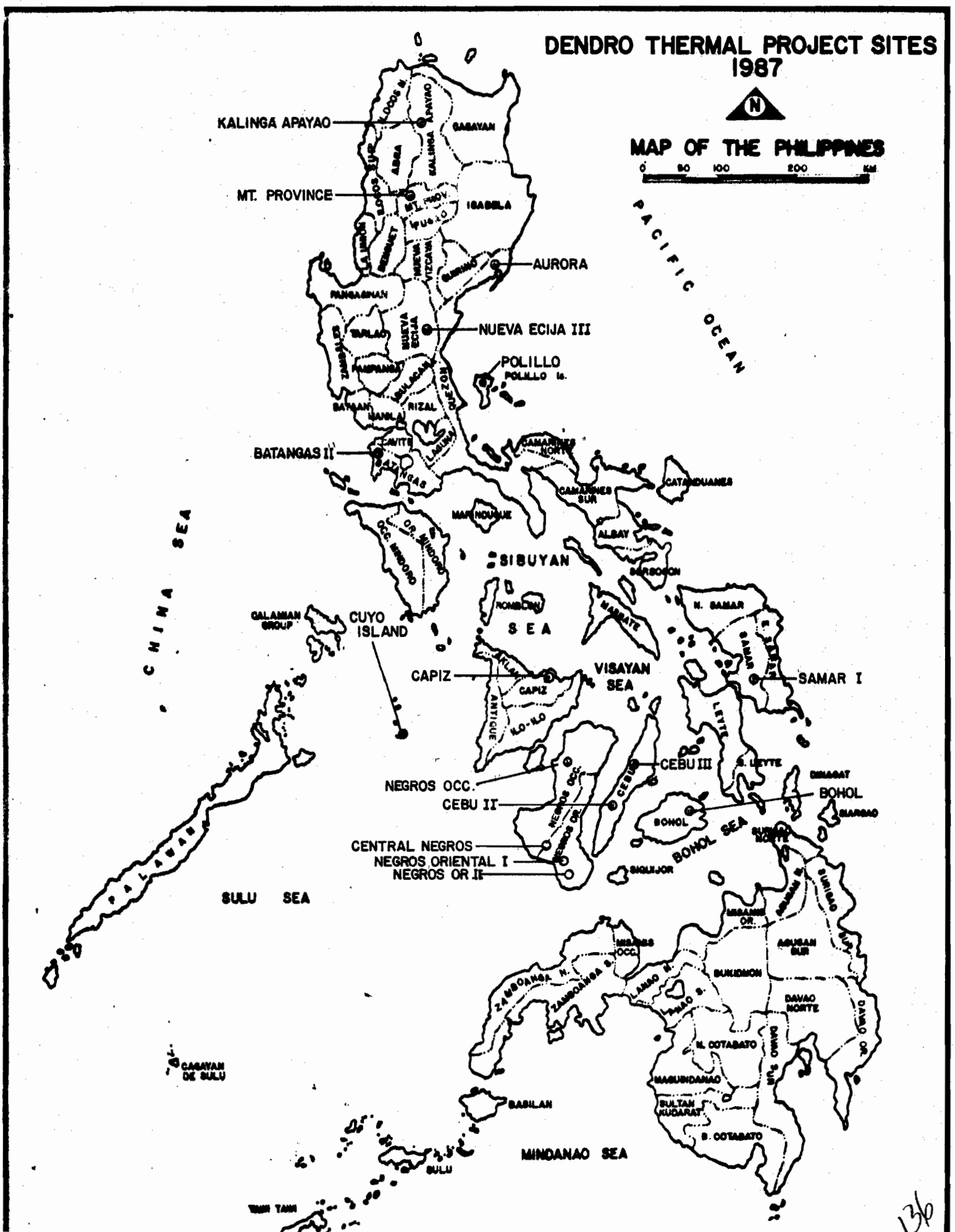
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NUEVA ECIJA III
POLILLO
POLILLO Is.
BATANGAS II
CUYO ISLAND
CAPIZ
NEGROS OCC.
CEBU II
CENTRAL NEGROS
NEGROS ORIENTAL I
NEGROS OR II
CEBU III
BOHOL
SAMAR I
PACIFIC OCEAN
CHINA SEA
PALAWAN
SULU SEA
SIBUYAN SEA
VISAYAN SEA
BOHOL SEA
MINDANAO SEA
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ISABELA
PANGASINAN
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CEBU
NEGROS OCC.
NEGROS OR.
BOHOL
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S. COTABATO

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Table 4

Summary
Tree Farm Development

Year of Energization	No. of Sites	MW	Area Reqmt.	1980	1981	1982	1983	1984	1985	1986	1987
1982	11	29	10,900	822	3,262	3,159	1,737	1,303	617		
1983	10	26	9,800	32	1,403	3,025	2,264	1,842	1,234		
1984	8	32	11,700	27	1,579	3,771	2,550	2,379	1,394		
1985	13	35	13,000	4	419	3,700	3,150	3,062	2,665		
1986	16	38	14,200				4,600	3,400	3,200	3,000	
1987	14	40	15,200					5,000	3,400	3,400	3,400
Total	72	200	74,800	885	6,663	13,655	14,301	16,986	12,510	6,400	3,400
			Cum:	885	7,518	21,173	35,474	52,460	64,970	71,370	74,770

General Area Requirement:

1. MW = 500 has.
3. MW = 1,100 has.
5. MW = 1,800 has.
6. MW = 2,200 has.

Summary : 72 projects

Total Area: 74,800 has.

Table 5
Annual Tree Farm Targets
by Site

	1982	MW	1980	1981	1982	1983	1984	1985	1986	1987
1.	Antique	1	8	152	225	115				
2.	Occidental Min.	1		53	325	122				
3.	Ilocos Norte	3	300	571	229					
4.	Pangasinan I	3	300	610	190					
5.	Isabela II	3	10	136	350	250	250	104		
6.	Zambales	3	15	502	250	250	83			
7.	Abra	3	110	800	190					
8.	Isabela I	3	15	77	350	250	250	158		
9.	Aklan	3	14	266	350	250	220			
10.	Camarines Sur IV	3	50	85	350	250	250	115		
11.	Nueva Vizcaya	3		10	350	250	250	240		
		29	822	3262	3159	1737	1303	617		
	1983									
12.	Palawan	3	12	521	250	250	67			
13.	Marinduque	3		105	350	250	250	145		
14.	Iloilo II	3		15	350	250	250	235		
15.	Cebu I	3			350	250	250	250		
16.	Catanduanes	1	13	148	200	139				
17.	Lubang	1			225	125	125	25		
18.	Camarines Sur III	3			350	250	250	250		
19.	Masbate	3		350	250	250	250			
20.	Central Pangasinan	3		450	250	250	150			
21.	Ilocos Sur	3	7	164	300	250	250	79		
		26	32	1403	3025	2264	1842	1234		

	1984	MW	1980	1981	1982	1983	1984	1985	1986	1987
22.	Pampanga II	3		109	350	250	250	141		
23.	La Union	3			350	250	250	250		
24.	Bataan	3			571	250	250	29		
25.	Quezon	3			350	250	250	250		
26.	Bulacan I	3		26	350	250	250	224		
27.	Nueva Ecija II	3		278	350	250	222			
28.	Nueva Ecija I	3			350	250	250	250		
29.	Pangasinan III	3	2	441	250	250	157			
30.	Camarines Sur I	3			350	250	250	250		
31.	Tarlac (B)	5	25	725	500	300	250			
		32	27	1579	3771	2550	2379	1394		
	1985									
32.	Capiz	3	4	334	350	250	162			
33.	Iloilo I	3			350	250	250	250		
34.	Central Negros	5			500	450	450	400		
35.	Bohol I	5		40	350	500	500	410		
36.	Negros Occ. III	3		30	350	500	500	420		
37.	Bohol II	3			350	250	250	250		
38.	Tarlac	3			350	250	250	250		
39.	Iloilo II (B)	5		15	350	250	250	235		
40.	Camarines Norte	3			350	250	250	250		
41.	Palawan (Brookes)	1			200	100	100	100		
42.	Tawi-Tawi	1			200	100	100	100		
		35	4	419	3700	3150	3062	2665		

	1986	MW	1980	1981	1982	1983	1984	1985	1986	1987
43.	Camarines Sur II	3				350	250	250	250	
44.	Albay	3				350	250	250	250	
45.	Negros Occ (VRESCO)	3				350	250	250	250	
46.	Cebu II	3				350	250	250	250	
47.	Batangas I	3				350	250	250	250	
48.	Batangas II	3				350	250	250	250	
49.	Iloilo I (B)	3				350	250	250	250	
50.	Palawan	3				350	250	250	250	
51.	Cagayan II	3				350	250	250	250	
52.	Camarines Sur IV	3				350	250	250	250	
53.	Pampanga I	3				350	250	250	250	
54.	Cagayan I	3				350	250	250	250	
55.	Sulu	1				200	200	100		
56.	Quirino	1				200	200	100		
		38				4600	3400	3200	3000	
	1987									
57.	Negros Or, I	3					350	250	250	250
58.	Cebu III	3					350	250	250	250
59.	Capiz	3					350	250	250	250
60.	Cebu II	3					350	250	250	250
61.	Central Negros	3					350	250	250	250
62.	Negros Occ. (VRESCO)	3					350	250	250	250
63.	Batangas II	3					350	250	250	250
64.	Nueva Ecija III	3					350	250	250	250
65.	Bohol I	3					350	250	250	250
66.	Aurora	3					350	250	250	250

1987 (cont)	MW	1980	1981	1982	1983	1984	1985	1986	1987
67. Negros Or, II	3					350	250	250	250
68. Samar I	3					350	250	250	250
69. Polilio	1					200	100	100	100
70. Mt. Province	1					200	100	100	100
71. Cuyo Island	1					200	100	100	100
72. Kalinga-Apayao	1					200	100	100	100
	40					5000	3400	3400	3400

FUNCTIONS OF THE DENDRO-THERMAL DEVELOPMENT OFFICE (DTDO)

The DTDO establishes the cbjectives and targets of the program, formulates policies and systems, obtains funds, coordinates with local agencies and oversees the implementation of wood-fired power plant projects carried out by the electric coops and the Farmers Associations. The Office is composed of six divisions whose functions are divided into administration, engineering, agroforestry, finance, institutional development and a program control and information center. (See Attachment 1.) The organization is headed by an Executive Director who directs all office activities including: development plans, targets and priorities, coordinates with foreign governments and financing institutions for the funding requirements of dendro-thermal projects and supervises the proper disbursement of these funds in accordance with contracts, guidelines and policies, and evaluates program implementation. An assistant executive director helps the executive director perform his main functions and is in charge in the latter's absence.

The DTDO has a total of 59 employees whose competence, dedication and enthusiasm for the program have been responsible for its initial success. During 1982, the DTDO staff is being doubled to cope with the increased work load and to implement the larger program even more effectively in the coming years. The offices operating budget has been increased from ₱6 million in 1981 to ₱11 million in 1982 to fund the new employee level and a recruitment campaign is underway. (See Attachments 2 and 3.)

The Program Control and Information Center is composed of a project supervisor, contracts administrator, information and project specialists who monitor and evaluate project implementation in relation to plans and schedules through the operation of a data bank and provide NEA management with regular progress reports. This division prepares project proposals, conducts research and special studies regarding the impact of the program in rural areas. The division distributes study findings and information on new data and techniques regarding species characteristics and care, and tree farm management, as well as program promotion through its information service.

The Engineering Division establishes procedures and guidelines in the extension of technical assistance to electric cooperatives, assists in the negotiation of local Architecture and Engineering contracts and supervises the construction of the physical plant and transport systems of the projects. These activities are currently executed by a team of highly qualified engineers whose fields of specialization are: four mechanical, three electrical and two industrial engineers. Also with this group is an architect and a contracts specialist. Two more mechanical, two electrical and three civil engineers have been selected for hiring in the near future to augment the division's capabilities and to provide needed in-house expertise in civil works.

The Agro-Forestry Division provides the guidelines for tree farm operations and management, technical assistance to the coops and the associations in the establishment and maintenance of tree farms and undertakes research in species applicability. It is composed of university and agricultural college trained

agriculturists, agricultural engineers, economists and foresters responsible for project planning, carrying information and technical services to the field and evaluation. During 1982, the division will double its present staff of nine agriculture and forestry specialists to assist in realizing this year's target of planting 13,600 hectares of energy tree farms. This office will also receive a large part of the species culturation and tree farm development and management assistance being provided under the separate Technical Assistance Project, as well as the staff development that will evolve from working with the project's consultants.

All activities related to funds and budgets are undertaken by the Finance Division. It maintains books of accounts, prepares and reports budgetary requirements, assists in negotiations for loans, releases funds to electric cooperatives and monitors their use. The Finance Division also conducts periodic financial and management audits of projects. The audits are accomplished by a group of qualified bookkeepers and certified public accountants. Because of the increased fund releases dictated by stepped-up program implementation, this division has programmed the employment of an additional four accountants, three budget specialists and four auditors/systems analysts to buttress its present complement of seven.

The Institutional Development Division plans for and provides members of farmers associations, electric coop management staff and operation personnel with continuous specialized training to equip all program participants with management concepts and skills. The division is subdivided into training and organization development units manned by eight project management specialists and analysts, organization specialists and training assistants. The hiring of four other training specialists, a sociologist and a lawyer specializing in land lease/acquisition will complete the division's staffing needs.

The Administrative Division provides general and personnel services. Personnel and administrative officers are in charge of recruitment/placement, internal policy implementations, employee performance appraisal, and allied activities. Supply and records officers render staff functions in records management, and supply/property programming, procurement, custody, allocation and distribution. Its present complement of six will be doubled to implement this year's hiring schedule and to meet an increased need for staff assistance resulting from the program's growth. This Division also oversees security, janitorial, document reproduction, transportation and messenger services.

A technical support service composed of locally based foreign consultants will assume a pivotal role in overall program implementation. These consultancy services, are part of the loan or grant packages negotiated between NEA and various foreign governments and lending institutions, e.g. France, United Kingdom, Japan, Asian Development Bank, A.I.D. and by the cable systems supplier, Lasso. Working in close coordination with the various line divisions, specialists in this group have already started providing technical services at all levels of operation: the NEA, the electric cooperatives, and the farmers associations. Others, such as AID and ADB will be starting in Summer 1982.

The technical support consultants' relationship at the NEA level is essentially on a policy formulation basis. By implementing research and conducting studies on biomass yields, species evaluation, energy plantation management practices,

site experiences, and energy production economics, among others, the consultants shall assist the NEA in developing data, information and advise on improving production and management practices. The consultants will also assist in conducting NEA's continuous program review and evaluation process, assess its prospects and potentials, and recommend refinements and revisions to further strengthen the program. In addition, they will examine the program's engineering aspects (such as cogeneration design, gasification system, plant capacity) to determine possible improvements, and provide other inputs for program decision-making.

At the electric cooperative level, consultants will provide supervision and guidance in the physical construction of 17 sites and in the commissioning of 11 power plants programmed for this year, totalling 29 MW. Similarly, Lasso will also oversee the installation of the cableways at the project sites. The consultants focusing on fuelwood production will work closely with the coops.

Technology transfer will be most apparent at the Tree Farmers Associations level. Some of the technical areas to be covered are failure to meet production targets, alternate species, innovative farm management techniques, pest infestation and fire protection planning. In addition, the technical support services initially provided by the consultants shall evolve into a program action center manned by NEA staff to deal with specific problems that arise at project sites.

NEA - Coop Relationship

The electric cooperatives are the direct implementors of the program in their respective rural areas. This task is delegated to the coops because of their exceptional performance in developing the country's successful rural electrification program. NEA provides support to the coops and the Tree Farmers Associations through the DTDO's established technical, financial and administrative support system.

Consonant to NEA-DTDO guidelines, an electric cooperative employs fulltime, one forester and two agronomists for every 1,000 hectares of energy farm to assist the Tree Farmers Associations. The electric cooperative's pool of engineers are fully able to carry out the program's technical aspects with some guidance from DTDO's technical support service.

Funds provided by NEA for project development are accounted for by coops in terms of fund disbursements and overall project output. NEA's guidelines for program implementation are made flexible in order to allow electric cooperatives to adopt and adapt systems which are best suited to each organization's particular situation.

NEA - DTDO Training Program

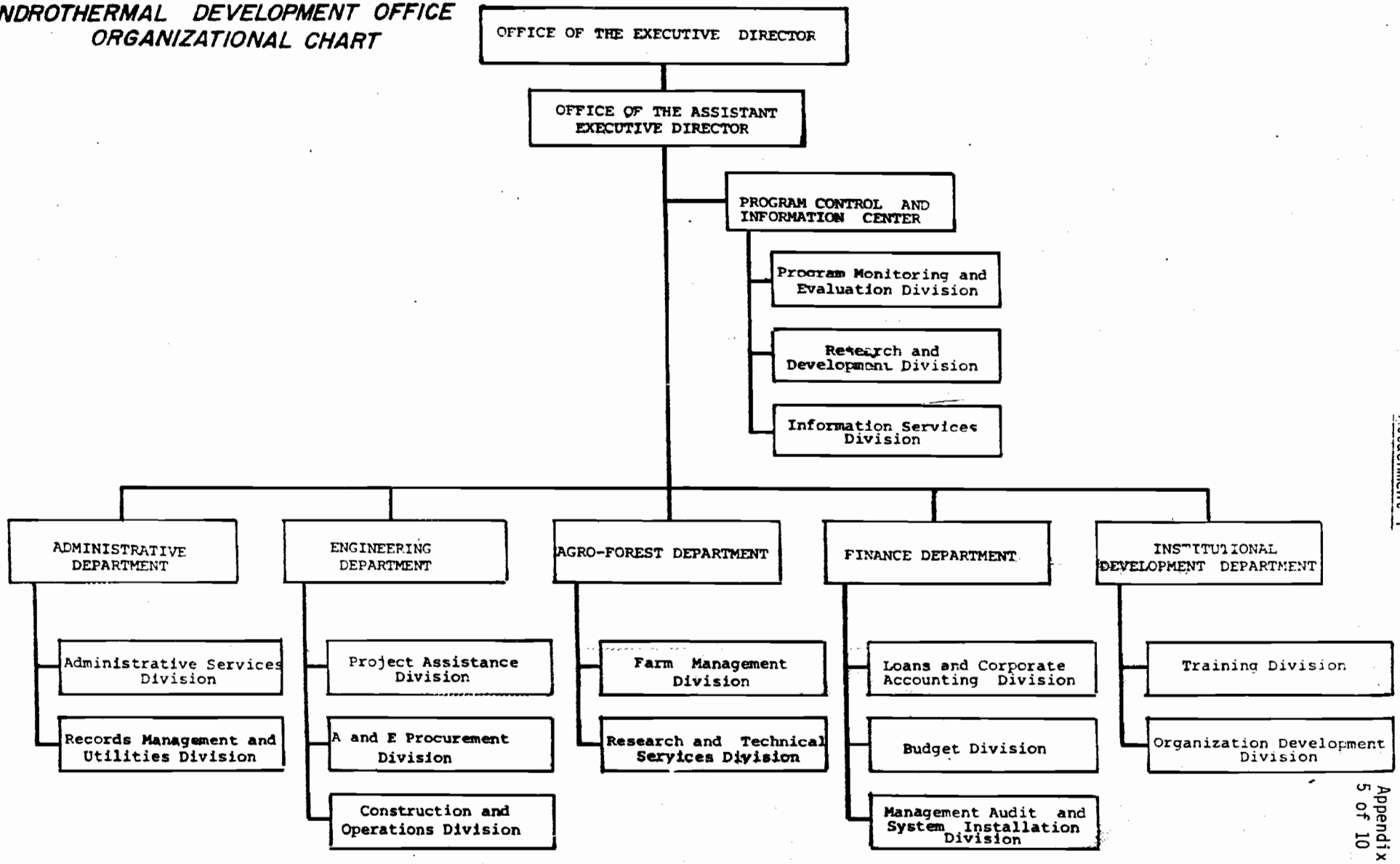
NEA-DTDO has a continuing education program designed to train and equip central office, electric cooperative staff and Tree Farmers Association members with management and technical concepts and skills for the timely and effective implementation of the program.

Through the Institutional Development Division, nine workshops were conducted

in the second half of 1981 and more than 400 members from 50 electric cooperatives throughout the country participated. The workshops covered introducing new tree species, tree farm development and management and examined the program's impact on the economy and society of the communities involved. The education program also conducted several workshops and discussion sessions for training farmers, and provided them with information and demonstrations on the latest farming techniques and tree care.

Attachment 4 is the DTDO's tentative schedule of training courses and seminars to be conducted in CY 1982.

DENDROTHERMAL DEVELOPMENT OFFICE ORGANIZATIONAL CHART



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DENDRO THERMAL DEVELOPMENT OFFICE

FUNDS FLOW STATEMENT

	1981	1982	1983	1984	1985	1986	1987	TOTAL
Sources of Funds								
Government Counterpart	55	207	181	182	173	206	214	1 218
Foreign Counterpart	173	156	62	237	286	333	420	1 667
Total	228	363	243	419	459	539	634	2 885
Uses of Funds								
Loans to Farmers Associations	30	55	53	51	12	20	14	235
Operational & Capital Expenditures of Coop	8	6	6	7	7	3	2	39
Dendrothermal	158	283	170	346	424	499	600	2 480
Wood Gasifier	26	8						34
In-House Operations	6	11	14	15	16	17	18	97
T O T A L	228	363	243	419	459	539	634	2 885

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Attachment 3

DENDRO THERMAL DEVELOPMENT OFFICE
HIRING SCHEDULE
CY - 1982

DIVISION/POSITION TITLE	1st QUARTER	2nd QUARTER	3rd QUARTER	4th QUARTER	TOTAL NUMBER
Program Control & Info. Center:					
Management Info. Chief B	1				1
Management Info. Analyst A		1		1	2
Management Info. Analyst B	1		1		2
Research Analyst A		1		1	2
Training Specialist		1			1
Secretary A		1			1
Draftsman B	1			1	2
Clerk B	1				1
	4	4	1	3	12
Administrative Division:					
Personnel Officer	1				1
Administrative Officer A			1		1
Administrative Assistant A	1			1	2
Supply Officer B		1			1
Supply Officer A			1		1
Records Officer B			1		1
	2	2	2	1	7
Engineering Division :					
Principal Engineer A	1	1			2
Engineer B	1	1	1		3
Engineer A		1	1		2
Project Specialist C		1			1
Project Assistant B		1			1
Purchaser B		1			1
	2	6	2	0	10
Agro-Forestry Division :					
Forestry Officer	2		1		3
Senior Agriculturist				1	1
Agriculturist	3				3
Statistician			1		1
	5	0	2	1	8
Finance Division:					
Mgmt. Systems Specialist A	1				1
Mgmt. Systems Analyst B		1			1
Sr. Corporate Accountant A				1	1
Budget Officer A		1		1	2
Corporate Accountant			1	1	2
Budget Analyst A	1			1	2
Clerk B	1			1	2
	3	2	2	6	13
Institutional Development Division:					
Sr. Training Officer B	1				1
Training Officer B		1			1
Training Assistant B		1	1		2
Corporate Attorney A				1	1
Sociologist A			1		1
Clerk B	1			1	2
Internal Messenger				1	1
	2	2	3	2	9
Office of the Executive Director:					
Secretary B	1				1
GRAND TOTALS	19	16	12	13	60

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Attachment 4

1982 TENTATIVE SCHEDULE OF DENDRO TRAINING AND SEMINARS

A. AGRO-FORESTRY

1. Seminar-Workshop on Energy Plantation Development and Management

Date	:	2nd week of March
Venue	:	Central Luzon State University (CLSU)
Duration	:	5 days
Participants	:	Agriculturists/Foresters
Number of Participants	:	23

2. Seminar-Workshop on Advanced Plantation Development and Management

Date	:	(2 schools) 2nd week of February
Venue	:	Continuing Education Center (CEC) UPLB College, Laguna
Duration	:	3 days
Participants	:	Agriculturists/Foresters who have attended the basic course on Plantation Development
Number of Participants	:	22

3. Seminar-Workshop on Dendro Power Projects (for new implementing teams)

Date	:	(3 schools) 3rd and last week of April
Venue	:	
Duration	:	2 days
Participants	:	Board President General Manager Dendro Coordinator Accountant/Bookkeeper Agriculturist Farmers' Association President
Number of Participants	:	128 (8 cooperatives per school)

B. ENGINEERING

1. Training for Power Plant Operators and Engineers

Date	:	1st week of February
Venue	:	Mindoro Occidental Dendro Project
Duration	:	3 days
Participants	:	Engineers and Dendro Power Plant Operators
Number of Participants	:	34 (17 cooperatives)

2. Seminar on Power Plant Operations and Maintenance

Date	:	2nd week of May
Venue	:	Mindoro Occidental Dendro Project
Duration	:	2 days
Participants	:	Engineers and Dendro Power Plant Operators
Number of Participants	:	34

3. Training on Transport System

Date	:	2nd week of August
Venue	:	Bolinao Dendro Project, Pangasinan
Duration	:	3 days
Participants	:	Engineers and Dendro Power Plant Operators
Number of Participants	:	34

4. Safety Seminar on Operations and Maintenance

Date	:	2nd week of November
Venue	:	
Duration	:	3 days
Participants	:	Engineers and Dendro Power Plant Operators
Number of Participants	:	34

C. FINANCE

1. First Accounting Seminar on Dendro Projects

Dates	:	(3 schools) - last week of February - 2nd week of April - 3rd week of June
Venues	:	(1) Anhawan Beach Resort, Iloilo City (2) Last Resort Hotel, Alaminos, Pangasinan (3) Rural Electrification Training Center, Agoo, La Union
Duration	:	3 days
Participants	:	Accountants
Number of Participants	:	30

D. INSTITUTIONAL

1. Seminar on the Organization and Supervision of Farmers' Associations

Date	:	3rd week of March
Venue	:	Last Resort Hotel, Alaminos, Pangasinan
Duration	:	3 days
Participants	:	Dencro Project Coordinator/Organization Specialist
Number of Participants	:	25

2. Orientation Seminar for Farmers on Dendro Projects

Dates	:	September and October
Venues	:	(1) INEC
		(2) ABRECO
		(3) PANELCO I
		(4) CENPELCO
		(5) ISELCO I
		(6) ISELCO II
		(7) NUVELCO
		(8) ZAMECO
		(9) PELCO II
		(10) TARELCO
		(11) PALECO
		(12) ANTECO
		(13) AKELCO
		(14) CAPELCO
		(15) ILECO I
		(16) CEBECO I
		plus 25 new sites
Duration	:	1 day
Participants	:	Farmers in the Associations
Number of Participants		

3. Safety Training for Farmers

Date	:	last week of November
Venue	:	
Duration	:	2 days
Participants	:	Farmers
Number of Participants	:	

ENVIRONMENTAL IMPACT ANALYSIS OF WOOD-FIRED POWER PLANT PROGRAM

1. Tree Farms

The data in Table 1 show the influence on the environment resulting from tree farm development activities at the three sites identified for this program. The time frame of these influences, their onset and duration, are also shown. These influences are individually assessed as favorable or adverse in varying degrees of importance as perceived by the team. Finally, measures which can mitigate or correct adverse influences are suggested.

On the whole, the change from the present vegetation and land use to energy tree farm development using ipil-ipil, and other fast-growing species, is perceived to have a predominantly positive impact on the environment. Whatever negative influences result from this change are outweighed by the positive influences and can easily be corrected.

The highly adverse impacts indicated in Table 1, are expected to be of short-term duration. One, the increase in soil erosion because of soil disturbance during site preparation, cultivation, and road construction, is common to all plantation development projects. This adverse impact takes effect during the immediately following rainy season, but only for the first season as vegetation development and soil stabilization quickly follow. Second, the influx of pests like rats because of the concentration of available food provided by the new plants, is also common among reforestation species. This is critical during the early stage of the first growing season, and can be mitigated by proper cultural practices.

It is believed by some that the heavy rainfall, the allelopathic effect of ipil-ipil on the underbrush, and the rapid decomposition of ipil-ipil litter would tend to induce sheet erosion in the long term. However, this is counteracted by effective rainfall interception by the canopy and increased infiltration resulting from the interweaving root system of the plants. The negative and positive effects would therefore tend to balance each other and the total effect would be of minor consequence compared to soil erosion in degraded grasslands.

Another consideration is continual harvest of biomass. The harvesting process in itself will have only minor effects especially if carried out during the dry season, since the nature of the product would require only the use of manual, animal-powered, or cable transport methods. Moreover, the duration of its impact is quite short as ipil-ipil stumps coppice well and quickly. The rotation of four years should not cause much drain in soil nutrients since the plant produces organic matter and fixes nitrogen.

Other potentially adverse impacts are of relatively less significance. Many of these, such as loss of genetic diversity, increased susceptibility to diseases, and short-term increase in siltation of creeks, are again common to tree farm development activities. Others, such as air and

thermal pollution because of the power plant itself, are common to thermal power generation. But the burning of wood is considerably cleaner than the burning of coal or oil. Pollution would have less direct effect on settlements as the power plant could be situated away from settlement areas.

On the other hand, the highly favorable impacts of tree farm development on the bio-physical environment are of long-term duration. One is improved microclimatic conditions, such as stabilized soil temperature and moisture, because of the higher and close ipil-ipil canopy structure. Another is the increase in primary biomass especially wood resulting from the reforestation of degraded areas with fast-growing trees.

Other highly favorable impacts include the vegetational change from Imperata-Themeda or Chromolaena-dominated grasslands to tree farms with consequent change of vegetational structure to that of close-canopy, open understory type; increased soil fertility; stabilization of water flow with improved infiltration, drainage, and aquifer recharge; and decreased run-off because of the more effective rainfall interception provided by the canopy.

The net result in the interplay of the long-term favorable impacts and the predominantly short-term adverse impacts is the considerable improvement of the bio-physical environment from a grassland or savannah type to a forest type. These conclusions are common to the three sites of the study and in fact to other similar sites in the country, as well, which can support ipil-ipil or other forest species. Whether or not the forest plantation is used for wood-fired power generation, charcoal production, or simply for fuelwood production, its beneficial effects are essentially the same.

2. Wood-Fired Power Plant

A wood-fired power plant in the 5 MW range will have a relatively minor, if not insignificant, adverse impact on the surrounding environment. This issue will be considered in terms of the interaction with the surrounding air, water, and land. In general, the major pollutants in a typical combustion process are the oxides of nitrogen and sulfur as well as particulates and ash. Wood, however, is essentially a sulfur-free fuel and the oxides of nitrogen can be controlled in the combustion process. The majority of particulates can be removed with a simple multi-cyclone separator while the bottom ash can be disposed of by applying it to the land.

Furthermore, with a wood-fired plant, there is no potential for major spillages or leaks such as from liquid petroleum, gas or radioactive sources which could harm the surrounding environment. In fact, the establishment of the surrounding energy tree farm will have a positive effect on soil and water conservation as well as the overall improvement of the region. Denuded lands are subject to erosion and deterioration.

In two sites the cooling water requirements for the plant will be satisfied by nearby rivers. In both cases the river flow is approximately an order of magnitude greater than the requirements by the plants. The construction of a cooling pond will be necessary to satisfy the cooling water

requirements of the third site. The boiler blow down can be injected into the spent condenser cooling water and consequently discharged in a very diluted form in the downstream section of the river.

Specific aspects of the environment assessment will be developed from available data on wood firing. There is a paucity of documented data on the emissions from the combustion of Leucaena and other fast-growing species.

Air Emissions

The firing of wood in a boiler can result in the emission of particulates and traces of carbon monoxide, sulfur, nitrogen oxides and hydrocarbons. The hydrocarbons are mostly low molecular-weight hydrocarbons and some polycyclic organic material (POM). Although some POM's have been identified as photochemically active and potentially carcinogenic the amounts discharged to the atmosphere in a remote area should not cause any significant health or air pollution problems.

Airbone emissions are determined by several variables including composition of the fuel, firing method and flame temperature, physical form of the fuel, completeness of combustion, excess air, pollution control system installed, and degree of fly ash reinjection. Also, increases in the fuel moisture content will reduce the heating value and boiler efficiency resulting in increased fuel consumption and hence emissions.

Particulate emissions have the potential to cause the greatest impact on ambient air quality. Several control technologies can be incorporated into the system design which may be used to reduce these emissions below the significant threshhold. Control efficiencies as high as 99.9% have been noted with achievements generally between 90-99% in conventional practice. Generally, mechanical collectors and two-stage combustion techniques can reduce emissions to the 0.1-0.5 lb/10^6 Btu range. Mechanical collectors are effective with wood fly ash due to the relative coarseness of this material. Some recent studies show average uncontrolled and controlled particulate emissions to be 6.0 g/NM^3 and 1.1 g/NM^3, respectively, for emission levels monitored on 26 boilers firing wood waste. The average collection efficiency for control equipment consisting of cyclone collectors was 83 percent.

When viewed in terms of the amount of emissions on an energy basis, the wood and bark fired boiler data indicate that particulate emissions on the order of 1.4 to 3.6 g/MJ and 0.2 to 0.4 g/MJ occur for uncontrolled and cyclone-controlled systems respectively. For consistency of presentation, using average values, this would correspond to 0.58 to 0.07 lb/10^6 Btu for the uncontrolled and controlled respectively. The proposed 5 MW plant with co-generation will require an energy input on the order of 70 x 10^6 Btu/hr. Consequently, based on the reported data, the uncontrolled particulate emission could be as high as 400 lb/hr. With controls this would be reduced to about 48 lb/hr which is actually higher than the other mechanical separation data (ave. of 0.3 lb/10^6 Btu) i.e. 21 lb/hr of

particulates. Most likely, using some controls, particulate emissions on the order of 30 lb/hr can be obtained.

Emissions of oxides of nitrogen are basically determined by flame temperature and fuel-bound nitrogen content. Available data indicate that NO_x emissions may range from 0.2 to 1.2 pounds per million Btu heat input. As reported by the EPA, studies by Oregon State University[1/] (1978) show that air emissions rates of 23 lb/hr for a 100 million Btu/hr boiler have been achieved. Whether or not these quantities of NO_x are significant depend upon other site-specific considerations such as the existence of atmospheric inversion layers, the migration of plumes, etc.

Sulfur dioxide emissions are directly related to the fuel-bound sulfur content and the rate of fuel combustion. Since wood contains virtually no sulfur, SO_x emissions are not significant.

No well-defined emission criteria can be attached to the carbon monoxide (CO) and hydrocarbon (HC) emission rates to delineate a level of significance. Data provided by Supernant et al[2/] (1976) indicate that CO emissions from biomass may reach 2.6 to 3.1 pounds per million Btu. Data reported by Boyes[3/] (1978) indicate that the level of HC emissions may reach 0.44 per million Btu. In general, CO and HC formation is excessive only in poorly-operated and/or uncontrolled boilers. The emission levels of both of these compounds may be adequately controlled and substantially reduced by achieving a high degree of carbon conversion to CO_2 in the combustion process. Wood combustion at too low excess air produces high levels of CO and HC, but these are regarded as exceptional circumstances and can be avoided by proper operation procedures. If proper excess air levels are used, 98% carbon conversion efficiencies (to CO_2) can be achieved and hydrocarbon and CO emissions can be minimized. In order to avoid fouling problems, occupational health, safety, and explosion hazards as well as emissions, the maintenance of proper excess air levels is absolutely necessary. CO emissions from high temperature combustion may also arise from dissociation of CO_2. However, wood combustion is typically carried out within the 1600-2000°F range. Calculations show emissions due the dissociation of CO_2 are less than 100 ppm and are, therefore, not a major concern.

Liquid Emissions

A certain amount of liquid effluents may be produced as run-off from fuel storage, particularly when the moisture content is above 60 to 62%. The run-off may contain minor amounts of water-soluble extractives such as tannins which can

1/ Preliminary Assessment of Biomass Conversion to Synthetic Fuels, EPA-600/7-78-204, Industrial Environmental Research Lab. USEPA, Cincinnati, 1978.

2/ Supernant, N. et al, Preliminary Emissions Assessment of Conventional Stationary Combustion Systems, TCA Corp. Report to USEPA, 1976

3/ Boyes, P.A., Comparison of Emissions Between Oil-Fired Boilers and Wood Wastes Boilers, USEPA, 1978.

impose a small biological oxygen demand (BOD) and may also contain some pigments. Typically, it has been shown that run-off resulting from rain falling on fuel piles is not significant because, in a properly constructed storage pile, the rain water does not penetrate beyond the surface of the pile.

The normal practice for dealing with the cooling water is to recycle all but the small quantities contaminated with oil. These waters flow through oil coolers in turbines and boiler feed pumps and are exhausted into a settling tank to control contamination in the coolers. Their quantities are equipment-specific and not of great concern. In some cases, water is used to quench ash and slag. Experience has shown that for small-scale (i.e., less than 100 x 10^6 Btu/hr) systems, dry ash handling is economically feasible. Also as previously mentioned, boiler blowdown discharges are small and easily controlled.

Consequently, in general, the potential sources of pollution may include acid substances, tannins and lignins, and suspended solids. These substances have an inherently low aquatic toxicity (i.e., relatively large concentrations are required to damage biological systems). They tend to affect aquatic environments by depressing dissolved oxygen concentrations, because of their biodegradation, decreasing primary productivity by reducing light penetration (because of the brown color of tannins and lignins) and increasing sedimentation. Ash from biomass facilities possess low concentrations of harmful elements and none of these are highly toxic to aquatic life. Furthermore, the chemical composition of some woodfuel ash contains 19 ppm silicon, 3.6 ppm aluminum, 2.9 ppm calcium (the most abundant elements), but contains only 0.003 ppm lead (the most abundant heavy metal).

The cooling water requirements and their impact can be summarized as follows: A 5 MW plant with cogeneration will discharge approximately 53 x 10^6 Btu/hr in the condenser cooling water. Using a flow rate on the order of 1800 M^3/hr, an energy balance indicates that the temperature of the cooling water would increase about 7 to 8°C. Since the river flow at two of the sites is at least an order of magnitude greater than the required river flow rate, and the third site will utilize a cooling pond, the amount of water discharged at a 7 to 8°C elevation in temperature should not pose a threat to the aquatic biota in the stream.

River Flow Rates and Equipment Cooling Water Requirements (M^3/HR)

Site	River	Wet Season	Dry Season	Equipment Requirement
CENECO	Bago	36,000	25,200	1,800
BOHECO 1/	Inabanga	10,800	2,160	1,800
ILECO	Jayobo Tagbacan	26,600	7,200	1,800

1/ During the dry season (approximately three months), the flow rate in the Inabanga River (Bohol site) is reduced by approximately a factor of five. The cooling requirements by the power plant can be satisfied by including a cooling pond with a capacity of about 10^6 gallons. The construction of the pond would increase the civil works cost of the project by approximately 1.5%. A cooling pond has been selected instead of a cooling tower because of the pond's cost-effectiveness and simplicity of operation. Furthermore, the pond would not increase foreign exchange.

Solid Waste

The solid waste associated with wood combustion includes the bottom ash from the boiler plus residues collected in the air pollution control system. Fermentable carbon in the ash is the most serious problem. It can be reduced to less than 5% for bottom ash and further controlled through recirculation of fly ash. Unlike the wastes from coal combustion, those from wood do not contain significant quantities of hazardous or toxic materials. The amount of ash generated is estimated to be about 5 to 8% (by weight) of the total fuel load.

A typical combustion facility would yield a 98% conversion efficiency of carbon to CO_2. This conversion efficiency implies that a maximum of 21 lb C/oven-dried ton of wood can be produced even assuming no production of CO. Thus, solid carbon discharges are expected to be in the range of 200-800 tons/yr in moderate size facilities. These quantities are of the magnitude as the particulate emissions mentioned previously. For the 5 MW plant, the particulates remaining (not discharged into the atmosphere) could be about 1000 to 1500 tons/yr assuming 24 hr/day, year-round operation.

Noise

A wood-fired plant using roundwood fuel is less noisy than one using chippers. Some noise emissions result, nonetheless, from fuel unloading, fuel hogging (if necessary), gang sawing, the operation of the boiler equipment (i.e., the forced draft and induced draft fans), and the transport and disposal of the residual ash. Of these sources, the sawing or hogging systems are the most significant noise emitters.

Table 1
Environmental Impacts of Tree Farms for Thermal Power Generation

Environmental and Resource Items	Predicted Impacts: Description	Causative Factors	Time Frame: Onset	Time Frame: Duration	Relative Weight	Mitigating Measures and Remarks
A. Physical Environment						
1. Run-off	a) Overall reduction of run-off due to interception of rainfall, impedance of surface flow, and increased infiltration	Presence of ipil-ipil canopy cover, organic matter and deeper root system	M*	L*	HF*	Positive impact
2. Erosion	a) Net reduction of soil erosion from less run-off and raindrop impact	Presence of ipil-ipil canopy cover, organic litter, and interweaving root system	M	L	F	Positive impact. Any activities that may cause soil disturbances should be conducted during the dry season.
3. Soil Fertility	a) Increased soil fertility	N-fixing capability of ipil-ipil and increased organic matter	M	L	HF	Positive impact

*Symbols

Onset

I = Immediate
M = Medium term (about 4-5 years)
L = Long term (5 and above)

Duration

S = Short term
M = Medium term
L = Long term

Relative Weight

HF = Highly favorable impact
F = Favorable impact
A = Adverse impact
HA = Highly adverse impact

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Environmental Impacts of Tree Farms for Thermal Power Generation

Environmental and Resource Items	Predicted Impacts: Description	Causative Factors	Time Frame: Onset	Time Frame: Duration	Relative Weight	Mitigating Measures and Remarks
4. Water Quality	a) Increased siltation of creeks and rivers at some sites	Soil disturbance as a result of clearing and planting and construction of infrastructure	I	L	A	Conduct activities which may cause soil disturbance during the dry season.
	b) Stabilization of flow with improved infiltration, drainage and aquifer recharge	Improved canopy cover, organic litter/matter on soil and deeper interweaving root system	M	L	HF	Positive impact
	c) Generation of wood waste, thermal and chemical pollution	Harvesting and hogging will generate wastes which can be transported gravitationally down to water systems. Excess hot water may be dumped in the rivers/creeks. Accidental spills of oil and other chemicals used in plant operation could end up in the rivers/creeks.	L	L	A	Develop program for use of of wood waste (i.e. composting). Construct cooling ponds for hot water waste if necessary.

Environmental Impacts of Tree Farms for Thermal Power Generation

Environmental and Resource Items	Predicted Impacts: Description	Causative Factors	Time Frame: Onset	Time Frame: Duration	Relative Weight	Mitigating Measures and Remarks
	d) Loss of water in rivers/creeks or underground water tables if wells are used.	Water requirements for boiler and cooling pond	L	L	A	Locate dendrothermal power plants in areas with sufficient water output; and construct small cooling ponds if necessary.
5. Microclimate	Improved and stabilized soil temperature and moisture, humidity and wind movement	Higher and close canopy structure of ipil-ipil and the wind-break effect of its rigid stems	M	L	HF	Positive impact
6. Air quality	Overall improvement of air quality in the region due to increased oxygen and reduction of dust.	Concentrated tree growth	I	L	HF	Positive impact
B. Biological Environment						
1. Primary productivity	a) Loss of some savannah and secondary forest trees within the plantation area	Site preparation, clearing for road, transport systems and other infrastructure	I	L	A	Extension campaigns to emphasize importance of remaining trees; careful planning so that construction activities will veer away from forested areas
	b) Increased primary biomass especially wood	Reforestation of formerly denuded areas with fast growing ipil-ipil and other trees	M	L	HF	Positive impact

Environmental Impacts of Tree Farms for Thermal Power Generation

Environmental and Resource Items	Predicted Impacts: Description	Causative Factors	Time Frame: Onset	Time Frame: Duration	Relative Weight	Mitigating Measures and Remarks
2. Succession	a) Vegetational change from Imperata - Themeda or Chromolaena dominated grasslands to pure plantations of ipil-ipil with consequent change of vegetation structure to close canopy, open understory type	Dominance by faster and taller growing ipil-ipil through shading, general improvement of soil structure and fertility and protection from fire	M	L	HF	Positive impact
	b) Change in animal population from predominantly grassland/savannah types to forest type	Transformation of their habitat	L	L	F	Positive impact
3. Genetic Resources	Loss of genetic diversity and also probably the flexibility to adapt to environmental changes	Simplification of vegetative cover to adominant species which is ipil-ipil	M	L	A	Intercrop other species with ipil-ipil and plant belts of mixed species
4. Pest Occurrence	a) Increase of insect pests especially of Araecerus fasciculatus which usually attacks giant ipil-ipil pods	Monoculture/concentration of the insect pest's food source	M	L	A	Monitor pest occurrence and perform necessary pest management strategy

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Environmental Impacts of Tree Farms for Thermal Power Generation

Environmental and Resource Items	Predicted Impacts: Description	Causative Factors	Time Frame: Onset	Time Frame: Duration	Relative Weight	Mitigating Measures and Remarks
	b) Potential influx of vertebrate pests like rats (i.e. Rattus mindanensis, Rattus exulans querati)	Young shoots of ipil-ipil are food for these rats	I	M	A	Clear area where young ipil-ipil are planted and growing
5. Aquatic Resources	Possible degradation of aquatic resources (i.e. fish) due to siltation.	Planting and construction activities, wood harvesting increased local demand for planting and domestic needs (see 4a, 4c & 4d)	I,M	L	A	Strict implementation of erosion control measure

PROJECT SITE DESCRIPTION: INCLUDING COOPERATIVES' CAPACITY (CURRENT AND PLANNED), PLANTATION DESIGN AND ENVIRONMENTAL STATEMENT

This appendix focuses on the three power plant and tree farm sites to be financed under this subproject, and consists of three sections. First, is a description of the current and planned capacity and demand of each of the rural electric cooperatives involved (this appears below). Second, copies of instructions sent by the Director of the Bureau of Forest Development (BFD) to all Regional and District BFD officers to provide NEA and the electric cooperatives full and immediate assistance in starting tree farm development. Third, is the site investigation report and suggested tree farm development and operational plan as prepared by outside consultants. Because of its size, this report is submitted as an accompaniment to the Project Paper.

1. Capacity and Demand

Negros Occidental Site

The Central Negros Electric Cooperative (CENECO) is located at Bacolod City. The cooperative had a peak demand of approximately 21 MW in 1981. Energy requirements were over 100,000,000 kwh to serve the cooperative's 36,000 customers.

Revenue in 1981 was almost ₱80 million with a margin after expenses of about ₱7 million. This cooperative faces no problems of economic and financial viability.

The peak demand for 1985 is forecast at 38 MW. Energy requirements are forecast at 180,000,000 kwh per year by that time. Revenues will not increase commensurately since power costs and, consequently, rates will fall sharply as new generation plants come on line. These new plants will be the NEA/CENECO mini-hydro and wood-fired power plants and the National Power Corporation (NPC) geothermal plant in Southern Negros.

Iloilo Site

The Iloilo Electric Cooperative II (ILECO II) is located at Pototan, Iloilo and served approximately 19,492 customers in 1981. It purchased some 12,174,000 kwh in 1981 and had a peak demand of about 4 MW.

Gross revenue in 1981 was about ₱8.7 million. The cooperative is relatively affluent and faces no problem of economic and financial viability.

By 1985 peak demand is projected to be well over 8 MW and energy requirements are forecast at 39,332,000 kwh. To produce these requirements, the cooperative has started two wood-fired power plant projects; one of 3 MW and the 5 MW plant funded under this subproject. The former to come on line in 1983, and the latter in 1985.

Bohol Site

The Bohol Electric Cooperative I (BOHECO I) is located in Tubigon, Bohol and serves approximately 18,000 customers. It purchased some 5,000,000 kwh in 1981.

Its peak demand was about 2.2 MW. In recent years demand has grown at more than 30% per year as new lines have been constructed to reach additional customers. By 1985, peak demand is projected to be just under 5 MW and electric power requirements to be about 15,000,000 kwh per year.

Revenue in 1981 was ₱6.2 million and operating expenses just over ₱3.0 million. Loan amortization was ₱1.35 million. For 1985, its revenue is projected at ₱18.3 million in terms of 1981 prices, with a margin of about ₱2.5 million.

In 1985, a 5 MW wood-fired power plant will come on line. Excess power will be sold to the neighboring BOHECO II which by then will require 10,000,000 kwh per year. By 1990, however, the combined power requirements for BOHECO I and II will be 45,000,000 kwh per year.

2. Instructions to Regional and District BFD Officers

Copies of March 1982 instructions sent out by the Director, Bureau of Forest Development to all Regional and District BFD Officers are Attachment 1 to this Appendix.

3. Consultant's Site Report and Letters from Reviewers

The consultant's report on the three sites identified for this subproject accompanies this Project Paper separately because of its size. The letters (Attachment 2) were received from four different private sector forestry groups and serve as a review of the consultant's report as required in State Cable No. 317473. The four groups have extensive experience in growing trees for profit in the Philippines, and in three cases, have managed very large reforestation efforts. NOTE: The letters include the three original project sites: Bohol, Negros Oriental and Negros Occidental. The Negros Oriental site, NOCECO, has since been dropped, because of population density, in favor of the much better Iloilo site.

Attachment 1(a)

Republic of the Philippines
Ministry of Natural Resourc
BUREAU OF FOREST DE'

04 March 1982

Gen. Pedro G. Dumol
Administrator
National Electrification Administration
E & E Bldg., Quezon Avenue
Quezon City

Dear Gen. Dumol:

I am pleased to acknowledge receipt of your letter of 25 February 1982 reiterating your request for the expeditious action on applications filed by electric cooperatives for tree plantation development.

May I inform you that I have given instructions to all the Regional Directors and District Foresters of the Bureau of Forest Development to expedite the processing of applications of dendro-thermal plantations filed by electric cooperatives accredited by the NEA. In addition, I have also instructed these forestry officials to allow such applicants to undertake immediate developmental activities in the areas applied for, such as nursery establishment and planting operations, provided the area is available.

Enclosed is a copy of my instructions for your information and reference.

With my warmest personal regards.

Very truly yours,

EDMUNDO V. CORTES
Director

Encl.:

04 March 1982

RADIO MESSAGE/TELEGRAM FOR TRANSMISSION

TO : ALL DISTRICT FORESTERS
ALL REGIONAL DIRECTORS
BUREAU OF FOREST DEVELOPMENT

IN CONNECTION WITH THE REPRESENTATIONS MADE BY THE NATIONAL ELECTRIFICATION ADMINISTRATION REGARDING APPLICATIONS FILED BY NEA ACCREDITED ELECTRIC COOPERATIVES FOR THE ESTABLISHMENT OF DENDRO THERMAL PLANTATIONS, YOU ARE HEREBY INSTRUCTED TO IMMEDIATELY TAKE ACTION AS FOLLOWS:

1) AREAS COVERED BY APPLICATIONS TO ESTABLISH DENDRO THERMAL PLANTATIONS SHOULD IMMEDIATELY BE VERIFIED AND THE STATUS OF SAID AREA BE REPORTED. IN CASES WHERE THE APPLIED AREA EMBRACES OR ENCROACHES ON RESERVE AREAS SUCH AS NATIONAL PARK, THE SAME SHOULD BE IMMEDIATELY DELINEATED AND MARKED AND ALSO REPORTED.

2) THE PROCESSING OF ALL SUCH APPLICATIONS SHALL BE EXPEDITED AND IN CONSONANCE WITH BFD CIRCULAR NO 52, SERIES OF 1980.

3) IF AN EVALUATION OF THE APPLICATION AND ALL SUPPORTING PAPERS DISCLOSES THAT THE SAME IS IN ACCORDANCE WITH POLICY AND REGULATIONS, THE ELECTRIC COOPERATIVE CONCERNED SHOULD BE ALLOWED IMMEDIATELY TO UNDERTAKE INITIAL DEVELOPMENTAL ACTIVITIES. DISTRICT FORESTERS ARE REQUIRED TO GIVE UTMOST PREFERENCE TO ALL APPLICATIONS OF ELECTRIC COOPERATIVES BY EXPEDITIOUSLY ACTING ON THEIR APPLICATION PAPERS AND IF POSSIBLE, TO BE HANDCARRIED BY SPECIAL MESSENGER TO THE CENTRAL OFFICE THRU THE REGIONAL OFFICE FOR FURTHER ACTION.

4) DISTRICT FORESTERS AND REGIONAL DIRECTORS ARE FURTHER DIRECTED TO SUBMIT REPORTS ON THEIR ACTIONS TAKEN ON THIS INSTRUCTION WITHIN FIVE (5) DAYS FROM RECEIPT HEREOF.

(SGD.) EDMUNDO V. CORTES
Director

CERTIFIED TRUE COPY:
ALICE F. MERCADO
DTDO Administrative
11 March 1982

FAR EAST WOOD CONSULTANTS
GROUND FLOOR, VALDERRAMA BLDG., ESTEBAN STREET
LEGASPI VILLAGE, MAKATI, PHILIPPINES

March 1, 1982

Attachment 2(a)

Energy Department
United States Agency for
International Development (USAID)
1501 Magsaysay Centre Bldg.
1680 Roxas Boulevard, Manila

Attention: Mr. Lawrence Ervin

Dear Sirs,

Ceneco/Nareco II/Boheco I - MADECOR's Report to the Ministry of Human Settlements

As requested by you, we have read NADECOR's report on three sites prepared for NEA Dendro Thermal Plantation Projects which we understand are considered for some assistance by USAID.
We find MADECOR's presentation in general clear and adequate with emphasis on all main parameters which should be considered when assessing the suitability of the proposed plantations. Particularly, yield and fuelwood harvesting and transport are discussed at some length in the report. In these comments, we would like to focus on these two main fields of observation.

A. Yield of Ipil-ipil

MADECOR have based their assessment of the production possibilities on a previous study that encompassed 62 yield plots "all over the country" (and on height measurement in existing "Giant Ipil-Ipil" plantations at the Lacson ranch in CENECO plantation site).

This makes, probably, their basic yield data conservative for the following reasons:

1. Some of the measured trees are likely to be of other and inferior origin than from the giant clones K8, K22, K28 and K27.
   Seed control has not been the strength of Philippine silviculture and especially at the onstart of the 'Giant Ipil-Ipil fever' in this country, the extraordinary prices paid for Ipil-Ipil seed gave reason to uncontrollable shortcuts.
   MADECOR's production figures assume the usage of K8 and K28.

Tel. Nos. 817-1541-43
88-1226
Telex No. 63619 Metal PH
Cable Address: FEWMANILA

Attachment 2(b)

2. Especially in a short rotation cycle, the condition of the plants at the time of planting will affect the growth conditions.
In the material that served MADECOR as references, a variation in this respect was, most probably, represented.
Such a variation would be much less in a dendro thermal plantation using direct seeding limited to the start of the rainy season as assumed by MADECOR.

3. Good management of plantation likewise will contribute to a higher yield as detailed in MADECOR's report.
In all probability, MADECOR's reference material was not subject to such intensive care that they prescribe for the dendro thermal plantations.

On the other hand, MADECOR based the effect of upgrading of growth conditions by liming and fertilizing on field observations covering a period of only 16 months. Considering the application methods recommended by MADECOR and aware of silviculture practices in the Philippines, this calls for some cautioning:

The type of upgrading as prescribed by MADECOR certainly gives a good start to the plant - but a decline normally occurs during the later part of the growth period when the roots of the plants have spread out.
Therefore, the effect of the application of lime and fertilizer should be kept under observation and additional upgrading efforts may prove necessary in a strive to achieve the production target.

MADECOR recommend Giant Ipil-Ipil as the main species to be planted, but advocate "species diversification," in one case 20% contour planting of Glyricidia sepium, in other cases second growth forest development. It is a weakness of the study that it does not discuss the production effects of such a mix. We assume, however, that such diversification generally will be on a scale that does not influence on the main conclusions valid for Ipil-Ipil stands.

The total effect of the conservative reference material and the somewhat optimistic reliance on the upgrading of the soil is not possible to judge - but it should be within reach to counteract on a retarded growth, thus, until further studies, MADECOR's yield figures may be accepted.

B. Harvesting and Transportation

MADECOR's conclusion on harvesting methods seem practical and tally with our own experience. Also their analysis of skidding and hauling arrangements seem practical. However, there is a slight over-emphasis of cableway transports in their recommendations.

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Attachment 2(c)

In an intensively managed plantation area, many other transport tasks arise aside from the hauling of fuel wood. A comparison of the economy of cableway transport with that of road bound transportation methods must include such other benefits of road constructions. Also usage of light wheel tractors with trucks for hauling on temporary log bed roads in the gullies may be considered.
The organization of bundles and the crosscutting into shorter sizes would have to be analyzed in some detail.
In general, cost of wood transportation is lesser when long bundles can be handled. However, without a physical inspection of the areas, we can not give any critical remark to MADECOR's recommendations in this respect but that also other modes of transport should be considered. A mix of various methods may well prove advantageous.

Other aspects covered by the report are either not possible to comment on without our own site inspection or seem convincing enough. Our impression is that MADECOR's study should give you sufficient background as to your decision to support the proposed plantations or not.

Sincerely yours,

FAR EAST WOOD CONSULTANTS CORP.

ULF ERLANDSON

UE:eva

PALAWAN LUMBER MANUFACTURING CORPORATION

3RD FLOOR JEG BUILDING
150 LEGASPI STREET
LEGASPI VILLAGE, MAKATI, METRO MANILA

Attachment 2(d)

March 24, 1982

Mr. Lawrence J. Ervin
Senior Energy Advisor
U.S. AID
Ramon Magsaysay Center Bldg.
Roxas Blvd., Manila

Subject: NEA Dendrothermal Plantation Projects

Dear Mr. Ervin,

Thank you for allowing me to peruse over the project study of the above subject projects.

Taking into account the cost of oil nowadays in producing electricity, it is really hightime that we consider using the renewable resources (Forest plantation) as source of fuel.

Your propose project will further assist the government's serious program of reforestation aside from the employment generation and other benefits that the local pepulace will derive from said project.

Your choice of area is meritorious considering the denudation of the forest of Mt. Kanlaon in Negros, much more so with Bohol province which is one of our most unfortunate areas which is not only in need of reforestation and electricity but is presently beset by lack of wood supply to the point wherein they even use coconut trunks as wood post for their housing construction.

For your next project, will you please consider Palawan as a site, specially Puerto Princesa City going north? This, we will highly appreciate, since this is also the hometown of Minister T. Q. Peña of the Natural Resources Ministry.

Sincerely,

Edgar Lee Rodriguez
Vice - President

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PAPER INDUSTRIES CORPORATION OF THE PHILIPPINES
A. SORIANO CORP. – GENERAL MANAGERS
UPRC BUILDING, 399 BUENDIA EXTENSION, MAKATI, METRO MANILA
P. O. BOX 192 COMMERCIAL CENTER, MAKATI, METRO MANILA, PHILIPPINES
(TEL. NO. 68-80-11 MAIN EXCHANGE)

CABLE ADDRESS
"PICOP"
MANILA

Telex Nos.: ITT 45044 & 45521
RCA 22142
Eastern 63648

MILLSITE:
BISLIG, SURIGAO DEL SUR
MINDANAO

80. MARIA CRISTINA, BALO-I
LANAO DEL NORTE
MINDANAO

Attachment 2(e)

26 March 1982

Mr. Lawrence J. Erwin
Senior Energy Advisor
USAID
Ramon Magsaysay Center
1680 Roxas Blvd., Pasay
Metro Manila

Sir:

This has reference to your letter of 5 March 1982, requesting for reaction/comments on the correctness and feasibility of the operational plans prepared by Mandala Agricultural Development Corporation (MADECOR) for the CENECO and BOHECO I dendrothermal plantation projects.

In this connection, we are pleased to inform you that the plans prepared by MADECOR are technically feasible except for a few constraints which are as follows:

1. CENECO Dendrothermal Plantation Project

a. The need to apply lime in area at 450 g. per hole or 2 tons per hectare to neutralize the acidity of the soil is very costly. Based on the average price of agricultural lime at ₱700/ton the project would spend ₱6 million in terms of lime inputs alone. The reduction of the dosage recommended to one half or 225 g/hole or 1 ton/ha would mean a savings of ₱3 million and there would also be considerable effect on the growth of the seedlings/trees.

b. Direct seeding of inoculated seeds of Ipil-ipil is not quite a good recommendation considering the characteristics of the plantation area which are mostly open, cogonal and denuded. The use of nursery propagated seedlings would ensure higher survival of seedlings planted in such areas. A temporary nursery

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Mr. Lawrence J. Erwin
26 March 1982
Page two

Attachment 2(f)

located in the most strategic location within the plantation area using around 6 to 8 personnel would not cost much if compared to the higher survival rate of planted seedlings which would be very low using the direct seeding technique.

2. BOHECO I Dendrothermal Plantation Project

Except for the direct seeding of ipil-ipil in planting holes the operational plan looks sound and feasible.

Furthermore, we believe MADECOR made a good job in preparing the subject plans except for few necessary revisions.

We hope we have been of assistance to your office.

Warm regards.

Very truly yours,

PAPER INDUSTRIES CORPORATION
OF THE PHILIPPINES
A. Soriano Corporation - Gen. Mgrs.

Y. E. BINUA
Senior Forester

YEB:tll

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Attachment 2(g)

March 31, 1982

Mr. Lawrence J. Ervin
Senior Energy Advisor
U.S. AID
Ramon Magsaysay Center Bldg.
Roxas Blvd., Manila

Mr. Ervin:

Comments on Madecor's Paper: "Operational Planning for NEA Dendrothermal Plantation Projects".

The above project if pushed thru, would be a laudable one. It will be hitting the heart of the problem-which is the economic underdeveloped sector of the society, which is the "slash and burn" shifting cultivators and the upland farmers.

In so far as the local situation is concerned, we envision the following scenario:

A. You will be adding fuel to the country's growing momentum on reforestation and afforestation, specially on areas surrounding the mountain of the project site.

B. Erosion will further be prevented thus lessening floods and damages on lowland areas.

C. The income of the local people will be augmented by participating in said project.

D. The residuals of the natural forest will not be over-burden by constant cutting of the community for their fuel wood requirements.

Attachment 2(h)

E. When the plantation is on going, it will induce other farmers with idle lands to plant trees, since we presume that it can also be sold to the proposed Dendro plant but even the local sugar mills which have converted to fuel wood will have continues supply.

The project will just act as a Catalyst for the further development of reforestation programs of our country.

F. And finally, when the plant is on stream, it will be a great boom to business development considering the low cost of electricity it can offer to the community.

The possibilities, therefore, are endless. And this will support the industry's contention that "we can only have a stable forest with a stable community and vise-versa".

We wish you success in pushing thru the said project.

Very truly yours,

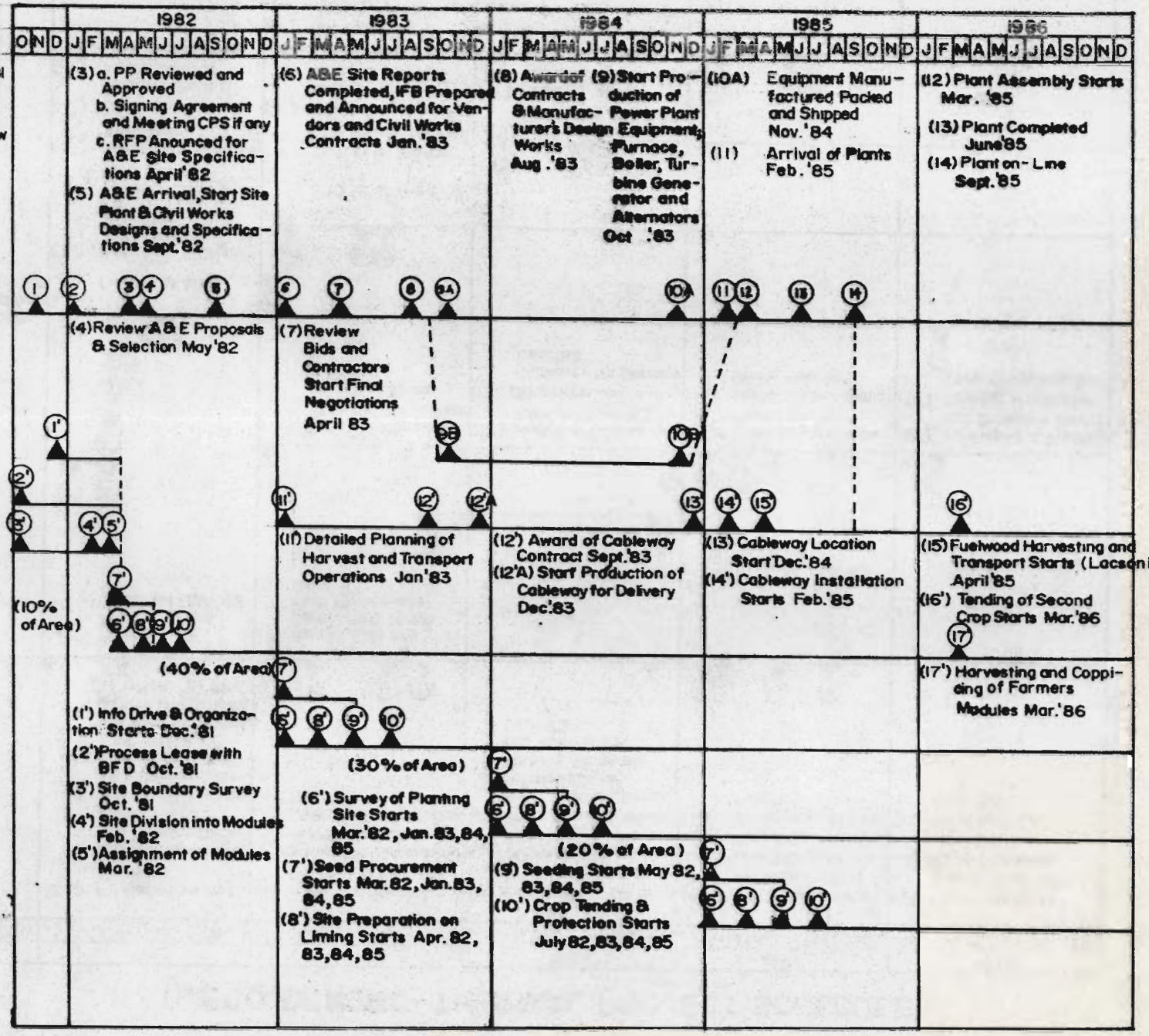
JOSELITO C. BALTAZAR I
Vice-President-Forest
Resources & Conservation

PROJECT FLOW SHEET

This appendix contains project implementation/ development flow charts for each of the subproject sites.

NOTE: The flow charts were developed for an April 1982 PP approval. While this approval date no longer stands, the basic time frame remains the same in terms of project months.

CENECO DENDRO-THERMAL PROJECT SCHEDULE



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ILECO DENDRO-THERMAL PROJECT SCHEDULE

(1) PP Starts Oct. '81
(2) PP Cleared by GOP and Mission & Sent to Aid/w Jan. '82

1982	1983	1984	1985	1986
(3) A. PP Reviewed and Approved B. Signing Agreement and Meeting CPS if any. C. RFP Announced for A&E Site Specifications April '82 (5) A&E Arrival, Start Site Plant & Civil Works Designs & Specifications Sept. '82	(6) A&E Site Reports Completed, IFB Prepared and Announced for Vendors and Civil Works Contracts Jan. '83	(8) Award of Contracts and Manufacturers Design Works Aug. '83 (9A) Starts Production of Power Plant Equipment, Furnace, Boiler, Turbine Generator and Alternators Oct. 83	(10A) Equipment Manufactured Packed and Shipped Nov. '84 (11) Arrivals of Plants Feb. '85	(12) Plant Assembly Starts Mar. '85 (13) Plant Completed June '85 (14) Plant on Line Sept. '85
(4) Review A&E Proposals and Selection May. '82	(7) Review Bids and Contractors Starts Final Negotiations April '83			
(1') Info Drive & Organization Starts April '82 (2') Process Lease with BFD Feb. '82 (3') Site Boundary Survey April '82 (4') Site Division into Modules April '82 (5') Assignment of Modules April '82	(11') Detailed Planning of Harvest and Transport Operations Jan. '83	(12') Award of Cableway Contract Sept. '83 (12A') Start Production of Cableway for Delivery Dec. '83	(13') Cableway Location Starts Dec. '84 (14') Cableway Installation Starts Feb. '85	(15') Fuelwood Harvesting and Transport Starts April '85 (16') Tending of Second Crop Starts Mar. '86
(10% of Area) (40% of Area)	(30% of Area) (6') Survey of Planting Site Starts May '82 (7') Seed Procurement Starts April '82, Jan. '83, '84, '85 (8') Site Preparation on Liming Starts May '82, Feb '83, '84, '85	(20% of Area) (9') Seeding Starts June '82, '83, '84, '85 (10') Crop Tending & Protection Starts July '82, '83, '84, '85		

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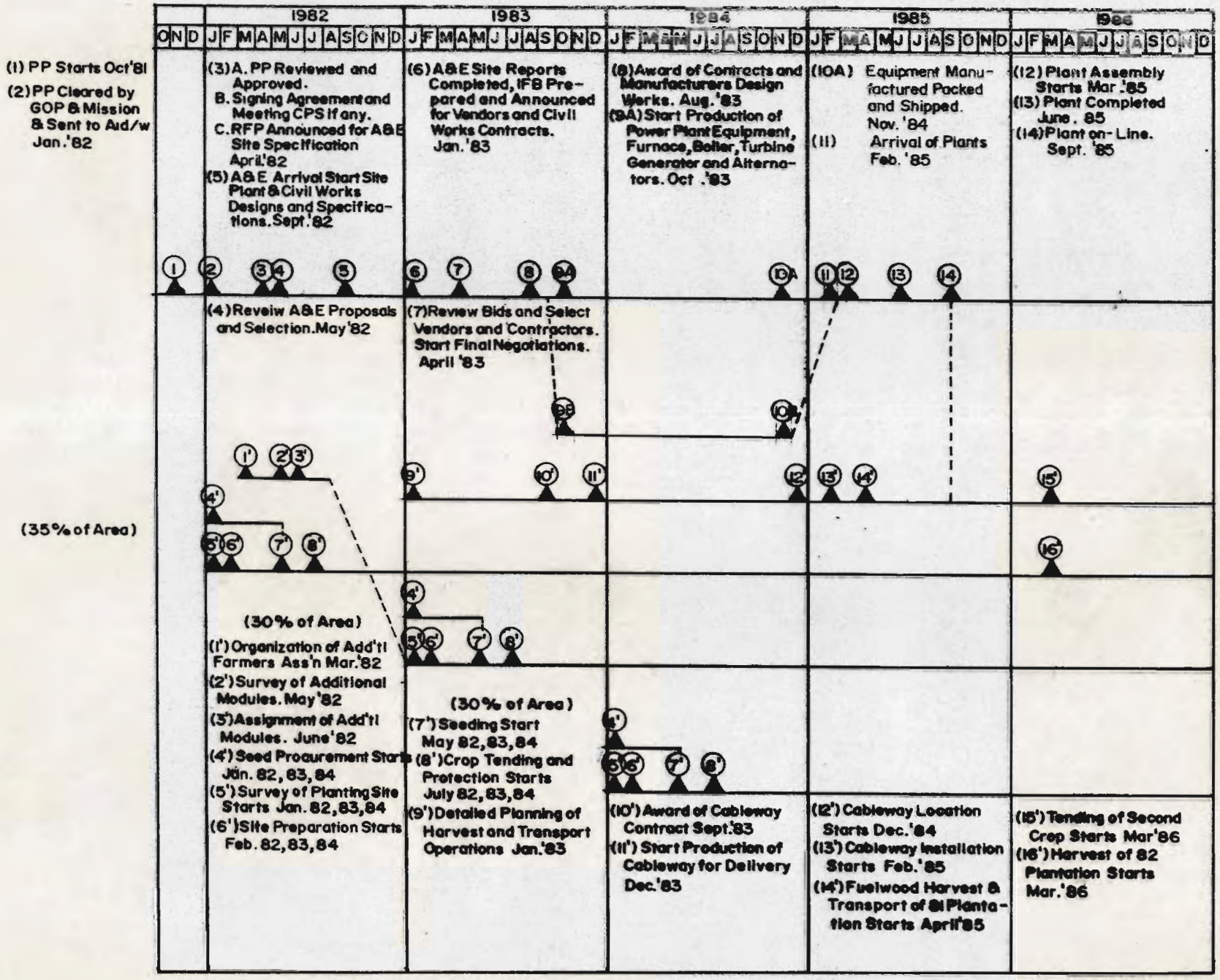
BOHECO I DENDRO-THERMAL PROJECT SCHEDULE



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VISAYAS GRID DEVELOPMENT

As a result of discussions held in August and October 1981, called for by the Prime Minister and coordinated by NEDA, NEA and NPC reached an agreement on their respective roles in the generation and distribution of electricity in the Philippines. Of the many points of agreement reached the following are most relevant to this project:

a. NEA will be responsible for developing wood-fired power plants.

b. NEA will increase its electrical generation efforts throughout the Visayas with priority attention given to Panay. (The Visayas rely almost 100% on diesel fuel). NEA efforts in Luzon will be correspondingly decreased.

c. NEA's wood-fired and mini-hydro projects will be integrated into NPC's development plans in the NPC grids. NEA is responsible for constructing 69 KV lines on Panay, Samar and Lanao Norte Province in Mindanao.

d. NEA and NPC are to hold coordinating meetings at least once a month to ensure effective development planning.

The discussion below is based on meetings involving the USAID, Secretariat, NPC, NEA and ADB officials. The discussion focuses on the development of the Visayas grid and the collaborative program of the two agencies involved (NEA and NPC).

Since power planning was first introduced in the 1960s, the long term power development program of the three national grids: Luzon, Mindanao and Visayas, has undergone a number of revisions, particularly the areas of project prioritization and load supply optimization. The present Visayas power plan has evolved from dynamic iterations and has recently been replanned to incorporate the latest assessments of load growth capabilities, geological potentials, as well as other techno-economic parameters, including the NEA role.

The Visayas grid consists of five separate island grids: Leyte-Samar, Cebu, Bohol, Panay and Negros. While the grid program emphasizes development of geothermal and coal generation, priority is also assigned to the development of wood-fired power plants and mini-hydro units to augment power systems that will have to be installed.

The program features a major reduction in heavy reliance on imported oil-based fuels through the exploitation and utilization of stable priced, indigenous non-oil energy resources. The expanded use of geothermal, coal, wood-fired plants and mini-hydro is expected to effect a shift in the current power supply structure, and provide a favorable mix of resource supply. The increased introduction of the latter two technologies will also enable NPC to reduce its development costs.

NEGROS

The power program of the Negros grid will pursue, as its primary source, the development of the geothermal field in Palimpinon. Three geothermal units (112.5MW) now under construction, are expected to be operational in 1983 and another two are planned for 1985 (see Table 1, Negros Power Grid), making a total geothermal capacity of 222.5 MW, and realizing the full capacity of the field. The newly available power will satisfy the requirements of the Construction and Development Corporation of the Philippines (CDCP) and Marinduque mining companies. The availability of power would allow these companies to undertake production expansion programs. With the full commissioning of the five planned geothermal units, the 32 MW diesel power barge #1 (currently servicing the requirements of cooperatives: VERESCO, NOCECO and CENECO) can be transferred to Panay by 1987.

The power outlook for the Negros grid presented in Table 1 shows the installed capacity growing from around 386.1 megawatts in 1985 to 528.1 megawatts by 1987. This reflects an 11% growth over the three-year period. Of the 386.1 megawatts in 1985, geothermal is 59%, diesel 37%, wood-fired 4% and hydro 21%. The total dependable capacity will be 340.4 megawatts in 1985 and 465.9 in 1987. The installations of wood-fired power plants as base load units will enable the NPC to reduce its use of oil-based power generation in the Negros grid by 10.6% and 27.3% in 1985 and 1987 respectively.

CENECO, which served 36 thousand customers, a total of 100 million kwh in 1981, has a projected peak demand of 38 megawatts by 1985. The wood-fired power plants will be used to help meet the growing demand for electricity of CENECO customers.

In absolute terms, the contribution of wood-fired power plants to the island is around 281,666 barrels of oil equivalent in 1987, realizing a gross foreign exchange savings of $9.6 million in current prices of crude oil imports.

Peak demand and capability for 1980 to 1990 is presented in Figure 1. The energy requirement and supply curves for the same period is shown in Figure 2.

PANAY

The Panay grid is currently 100% diesel dependent. Panay is serviced by diesel systems in operation since 1974 and before, which in the past provided sufficient amounts of reasonably priced electricity. As the cost of using this equipment has become quite high, as would be the cost of introducing additional diesel units, the island's rapidly increasing electricity demand is not being met. Thus, economic development is restrained and household electricity needs are not fully met.

By 1985, however, the NPC and NEA power expansion program of the Panay grid (see Table 2, Panay Power Grid) provides for an additional installed capacity of 21 megawatts from wood-fired power plants in addition to the diesel. In introducing the new systems, a continuous and expanded supply to the coops will become possible.

By 1985, the total installed capacity is estimated to be 98.94 megawatts,

increasing to 191.94 megawatts by 1987 or an increase of 25%. Of the total installed capacity in 1985, diesel is 79% and the balance is provided by wood-fired plants; reducing diesel consumption by 27% in 1985 and 35% in 1987.

By the end of 1987, oil's share of the total Panay grid supply base is projected to decrease to 57% as a coal thermal plant and two new wood-fired plants are added to the system. The expected contribution of the wood-fired power plants by 1987 is estimated to be 561,666 barrels of oil equivalent or a foreign exchange savings of approximately $19.1 million.

The system peak demand and capability as well as the energy requirement and supply curves are presented in Figures 3 and 4 respectively.

BOHOL

At present, Bohol's total installed capacity is 23.2 megawatts. The present energy mix is such that 93% (22 MW) is provided by diesel and the balance (1.2 MW) by hydroelectric.

The generation expansion program of the Bohol grid is geared to approximately doubling its capacity by 1985 and then a slight increase between 1985-1990. Although the Bohol grid carries a small load compared to Negros, Cebu, or Panay, its requirements are important to the NPC and NEA because 73% of its customers are coops which cater essentially to households. A primary goal of the two agencies in Bohol is to enable the cooperatives to expand their services to more remote areas.

By 1985, the NPC and NEA programs will be capable of generating 6.2 megawatts from a new hydro plant and 13 megawatts from wood-fired power plants. The total installed capacity by 1985 is estimated to be 41.2 megawatts and 44.2 megawatts in 1987. (See Table 3, Bohol Power Grid.)

Of the 41.2 megawatts installed capacity by 1985, diesel is 53%, wood 32%, and hydro 15%. By 1987, the share of diesel's contribution declines to 49.7%, with the wood-fired component increasing to 36% and hydro remaining at 15%. The construction of wood-fired power plants is projected to reduce diesel consumption by 59% in 1985 and 73% in 1987. The availability of 16 megawatts from wood-fired power plants on the island by 1987 is projected to reduce diesel consumption by 150,000 barrels of oil equivalent for a foreign exchange savings of $5.1 million.

The program in the Visayas grid calls for an added capcity of 675.9 MW between 1982 and 1990, with total capacity at the end of 1990 projected at 1121.64 megawatts from the following sources:

Visayas Capacity by 1990[1/]
(In megawatts, MW)

Hydro[2/]	Geothermal	Coal-Thermal	Diesel	Wood-Fired	Total
166.0	228.5	278.0	364.14	85.0	1121.64

A total of 407 megawatts of new power generation is projected to be added to the grid over a six-year planning period (1984-1990). Between 1982 and 1990, the total demand in the Visayas market is projected to increase from 2400.4 gigawatt-hours to 5413.3 gigawatt-hours. See Tables 1 to 4 for details. The last column of Tables 1 to 4 shows either a surplus or a deficit. The surplus means that the diesel component of the total generation capacity can be reduced and non-oil fuel used in its place.

In summary, the total contribution of the 85 MWs produced by the wood-fired power plants between 1985 and 1990 is estimated to be 800,000 barrels of oil equivalent or gross foreign exchange savings of $27.2 million.

The power program of NPC and NEA in the Visayas grid will result in foreign exchange savings, employment generation, technology transfer and linkage effects on the industrial as well as the agricultural sectors. Although fossil fuel products (mostly imported) will continue to be the largest single fuel source in the islands, non oil-based energy use will become a significant factor in future electricity generation.

The system peak demand and capability curves is shown in Figure 5. The energy requirement and supply curves are given in Figure 6.

1/ Excluding Leyte-Samar.

2/ This does not include 46.5 MW of mini-hydro units being installed by NEA during this same period. While the majority of this capacity will be in Panay, the NPC has not included them in their tables as the final decision on most of the exact sites has not yet been made. The development of this capacity is, however, agreed upon between the two agencies.

Table 1

NEGROS POWER GRID
GENERATION EXPANSION PROGRAM
(1980-1990)

YEAR OF COM.	PLANT ADDITION	INSTALLED CAPACITY (MW)						DEP. CAP.	PEAK DEMAND	RES. CAP.	% RES.	AVAILABLE ENERGY (GWH)	ENERGY CAPABILITY AND REQUIREMENT (GWH)							
													SYSTEM CAPABILITY							
		HYDRO	GEO	DENDRO THER	POWER BARGE	DIESEL	TOTAL						HYDRO	GEO.	DENDRO THER.	POWER BARGE	DIESEL	TOTAL	GENE-RATION LEVEL	SUR-PLUS (DEF.)
1980	Amlan H.E. (2x0.4)	0.8	3			48	51.8	42.4	33	4.4	13	5	5	7			274	286	155	131
	Amlan D. (2x5.5)											67								
	Talisay D. (14.6)											89								
	Bacolod D. (22.46)											118								
/9	Palimpinon Geo. (3)											20								
81/4	P. Barge #1 (32)	0.8	3		32	48	83.8	70.4	39.9	23.5	59	196	5	20		147	274	446	233	213
82/2	Palimpinon Geo (3)	0.8	6		32	48	86.8	72.9	45.0	20.9	46	20	5	38		196	274	513	268	245
1983	CDCP (31.8)	0.8	118.5		32	109.8	261.1	222.4	138.5	54.4	39	195	5	408		196	653	1262	982	280
	MMIC (30.0)											184								
83/4	Palimpinon Geo 1(37.5)											245								
/7	" " 2 (37.5)											245								
/10	" " 3 (37.5)											245								
84/10	Dendro Ther. (5)	0.8	118.5	5	32	109.8	266.1	232.4	170.0	26.9	16	28	5	775	7	196	653	1636	1262	374
1985	Palimpinon Geo 4&5 (2 x 55)	0.8	228.5	15	32	109.8	386.1	340.4	206.0	98.9	48	720	5	1495	84	196	653	2433	1567	866
	Dendro Ther. (5)											28								
	Dendro Ther. (5)											28								
1986	Dendro Ther. (3)	0.8	228.5	18	32	109.8	389.1	342.9	212.1	95.3	45	17	5	1495	101	196	653	2450	1601	849
1987	Bago H.E. (3x53)	159.8	228.5	30	-	109.8	528.1	465.9	300.1	115.8	38.6	338	343	1495	169	-	653	2660	2366	294
	P. Barge to Panay											(196)								
	Dendro Ther. (4x3)											68								
1988	-	159.8	228.5	30	-	109.8	528.1	465.9	306.1	109.8	36		343	1495	169	-	653	2660	2408	252
1989	-	159.8	228.5	30	-	109.8	528.1	465.9	312.3	103.6	33		343	1495	169	-	653	2660	2448	212
	-																			
1990	-	159.8	228.5	30	-	109.8	528.1	465.9	319.0	96.9	30.3		343	1495	169	-	653	2660	2490	170
	-																			

Source: System Planning, National Power Corporation.

Figure 1
Negros Power Grid
System Peak Demand & Capability Curve
(1980-1990)

Source: System Planning,
National Power Corporation

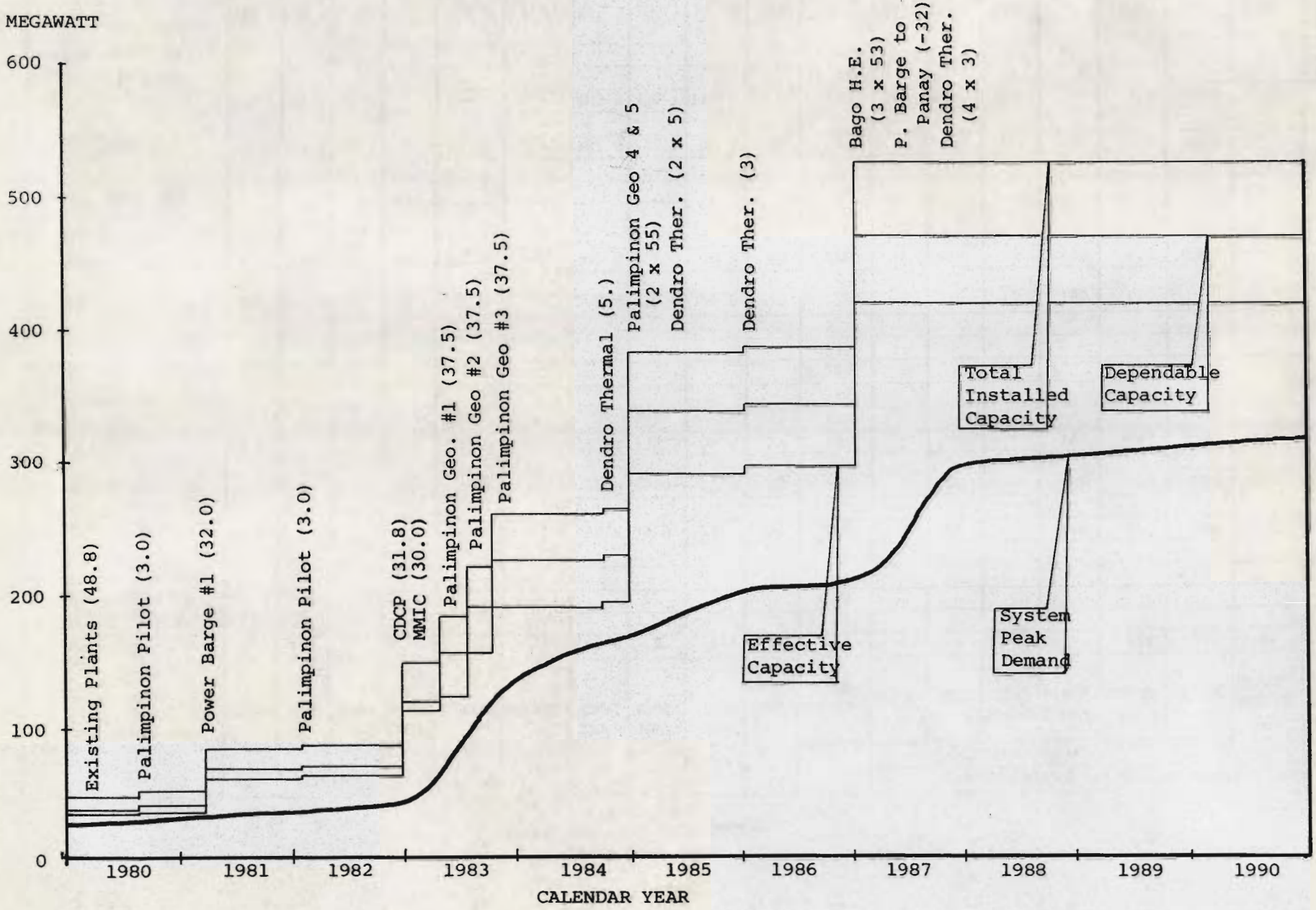

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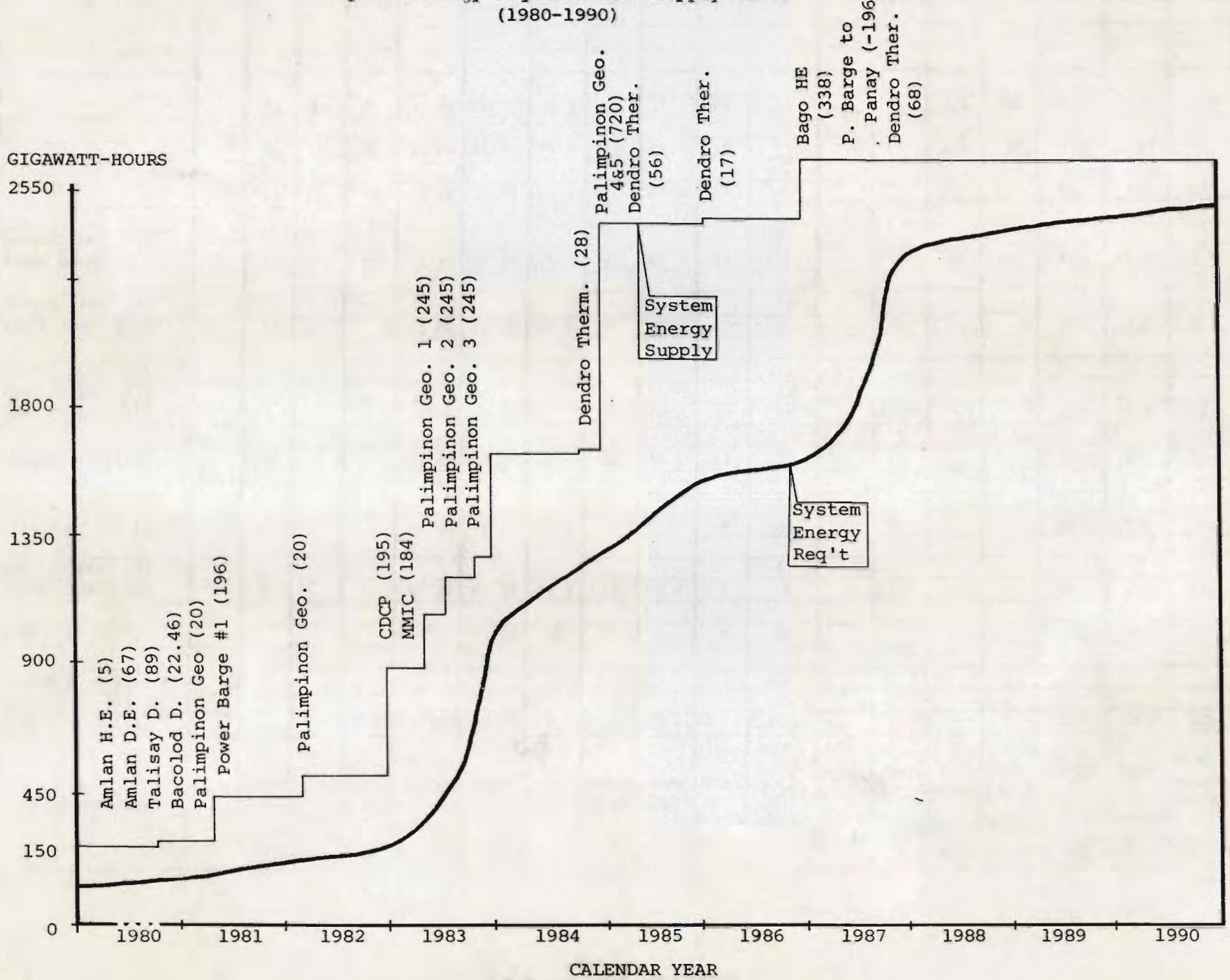
Figure 2
Negros Power Grid
System Energy Requirement & Supply Curve
(1980-1990)



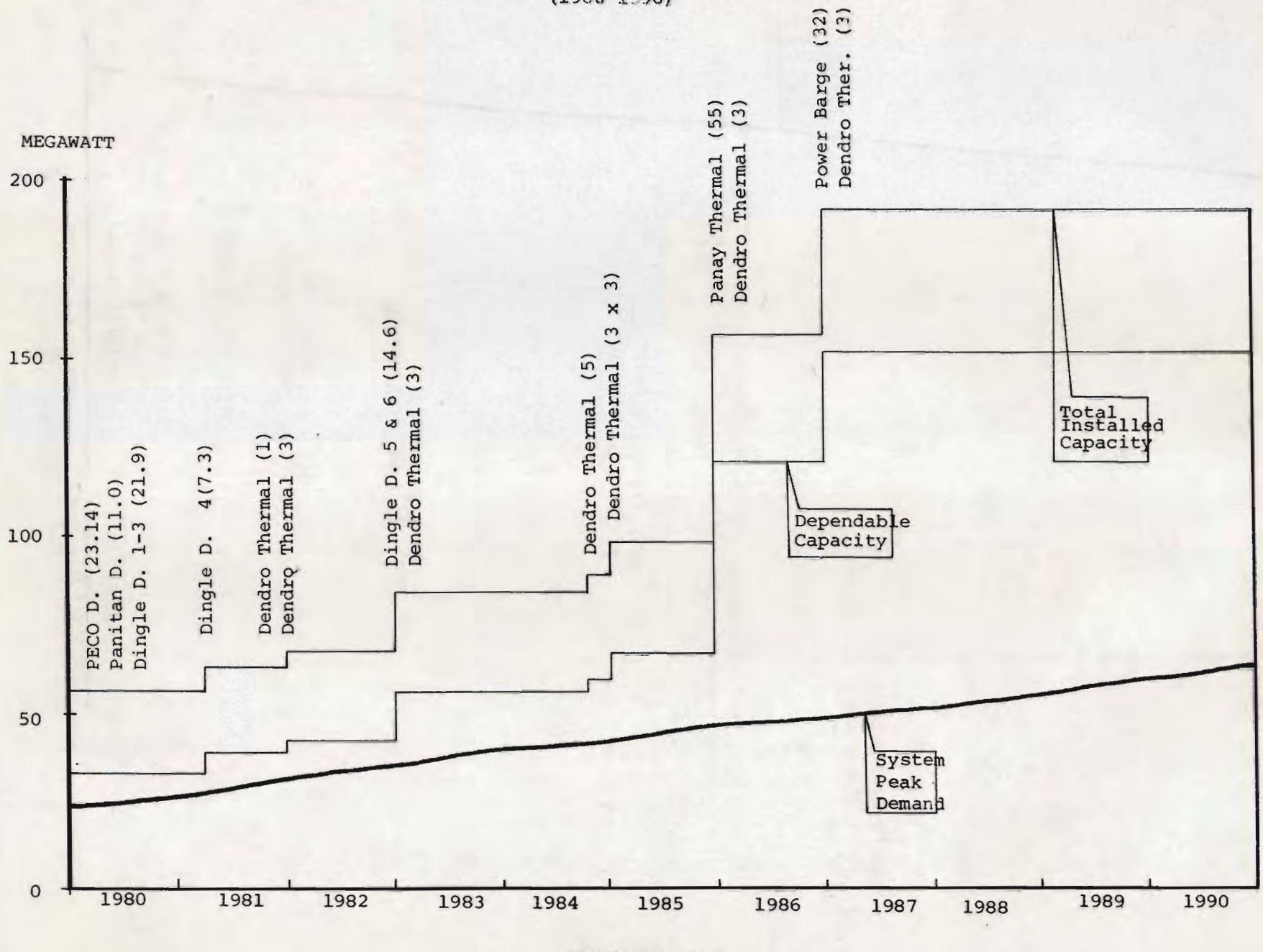
Source: System Planning, National Power Corporation

Table 2
PANAY POWER GRID
GENERATION EXPANSION PROGRAM
(1980-1990)

YEAR OF COM.	PLANT ADDITION	INSTALLED CAPACITY (MW)						DEP. CAP.	PEAK DEMAND	RES. CAP.	% RES.	AVAILABLE ENERGY (GWH)	ENERGY CAPABILITY AND REQUIREMENT (GWH)							
													SYSTEM CAPABILITY						GENERATION LEVEL	SURPLUS (DEF.)
		HYDRO	DENDRO	THER	POWER BARGE	DIESEL	TOTAL						HYDRO	DENDRO	DENDRO THER	POWER BARGE	DIESEL	TOTAL		
1980	PECO D. (23.14)					56.04	56.04	32	26	(0.5)		115					317	317	135	182
	Panitan D. (11.0)											67								
	Dingle D. 1-3(21.9)											135								
81/3	Dingle D. 4(7.3)					63.34	63.34	38	31	1	3	45					355	355	162	193
1982	Dendro Ther. (1)		4			63.34	67.34	41.3	34	0.8	2.3	6		23			362	385	175	210
	Dendro Ther. (3)											17								
1983	Dingle D. 5&6 (14.6)		7			77.94	84.94	55.8	39	10.3	26	90		40			452	492	196	296
	Dendro Ther. (3)											17								
84/10	Dendro Ther.(5)		12			77.94	89.94	59.8	42	11.3	27	28		47			452	499	216	283
1985	Dendro Ther. (3)		21			77.94	98.94	67.3	45	15.P	35	17		119			452	571	232	339
	Dendro Ther. (3)											17								
	Dendro Ther. (3)											17								
1986	Panay Ther. (55)		24	55		77.94	156.94	121.8	48	21.8	45	337		136	337		452	925	253	672
	Dendro Ther. (3)											17								
1987	Power Barge (32)		27	55	32	77.94	191.94	152.3	52	48.3	93	196		153	337	196	452	1138	271	867
	Dendro Ther. (3)											17								
1988	-		27	55	32	77.94	191.94	152.3	55	45.3	82			153	337	196	452	1138	291	847
1989	-		27	55	32	77.94	191.94	152.3	59	41.3	70			153	337	196	452	1138	311	827
1990	-		27	55	32	77.94	191.94	152.3	63	37.3	59			153	337	196	452	1138	333	805

Source: System Planning, National Power Corporation.

Figure 3
Panay Power Grid
System Peak Demand & Capability Curve
(1980-1990)



Source: System Planning, National Power Corporation

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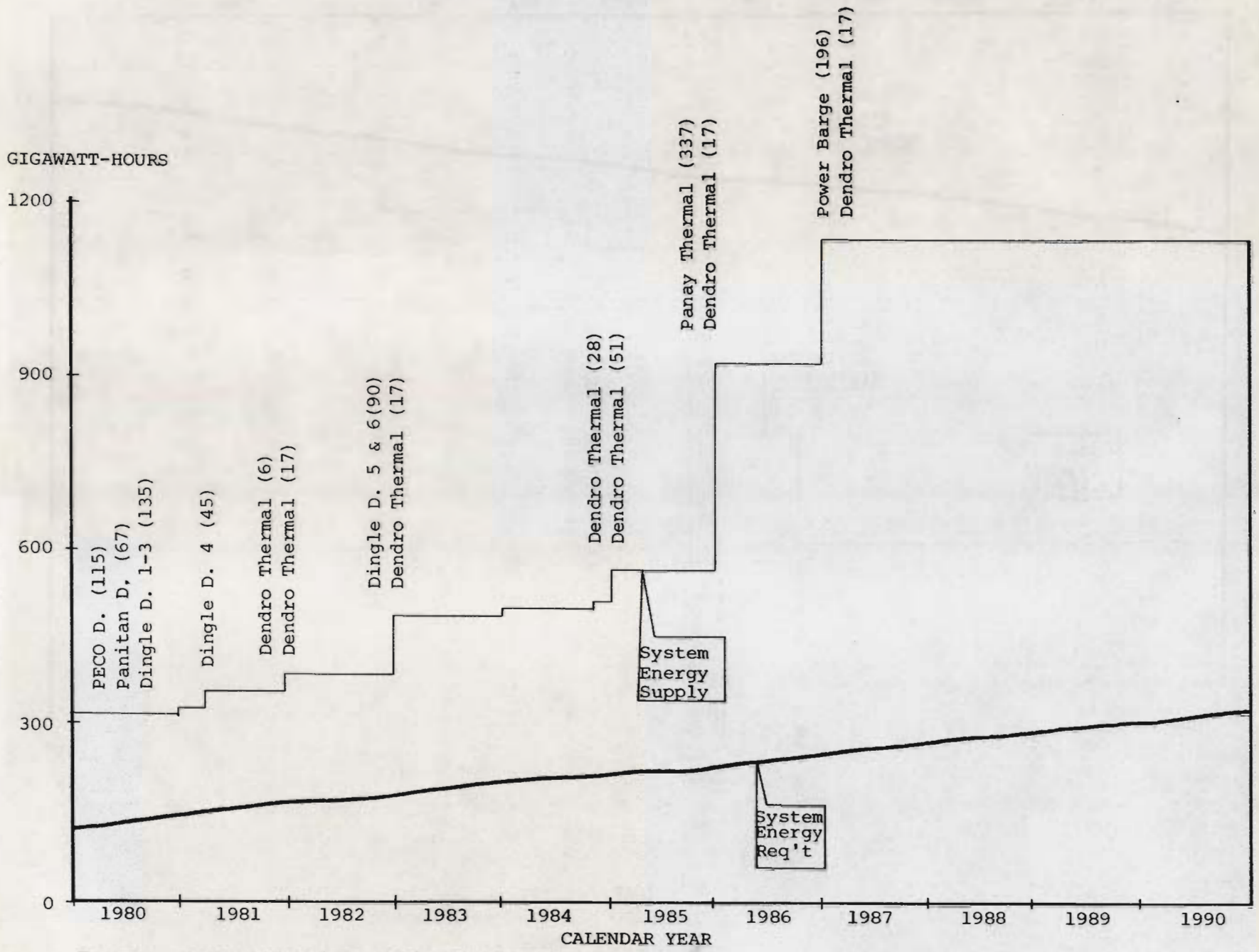
Figure 4
Panay Power Grid
System Energy Requirement & Supply Curve
(1980-1990)



Source: System Planning, National Power Corporation

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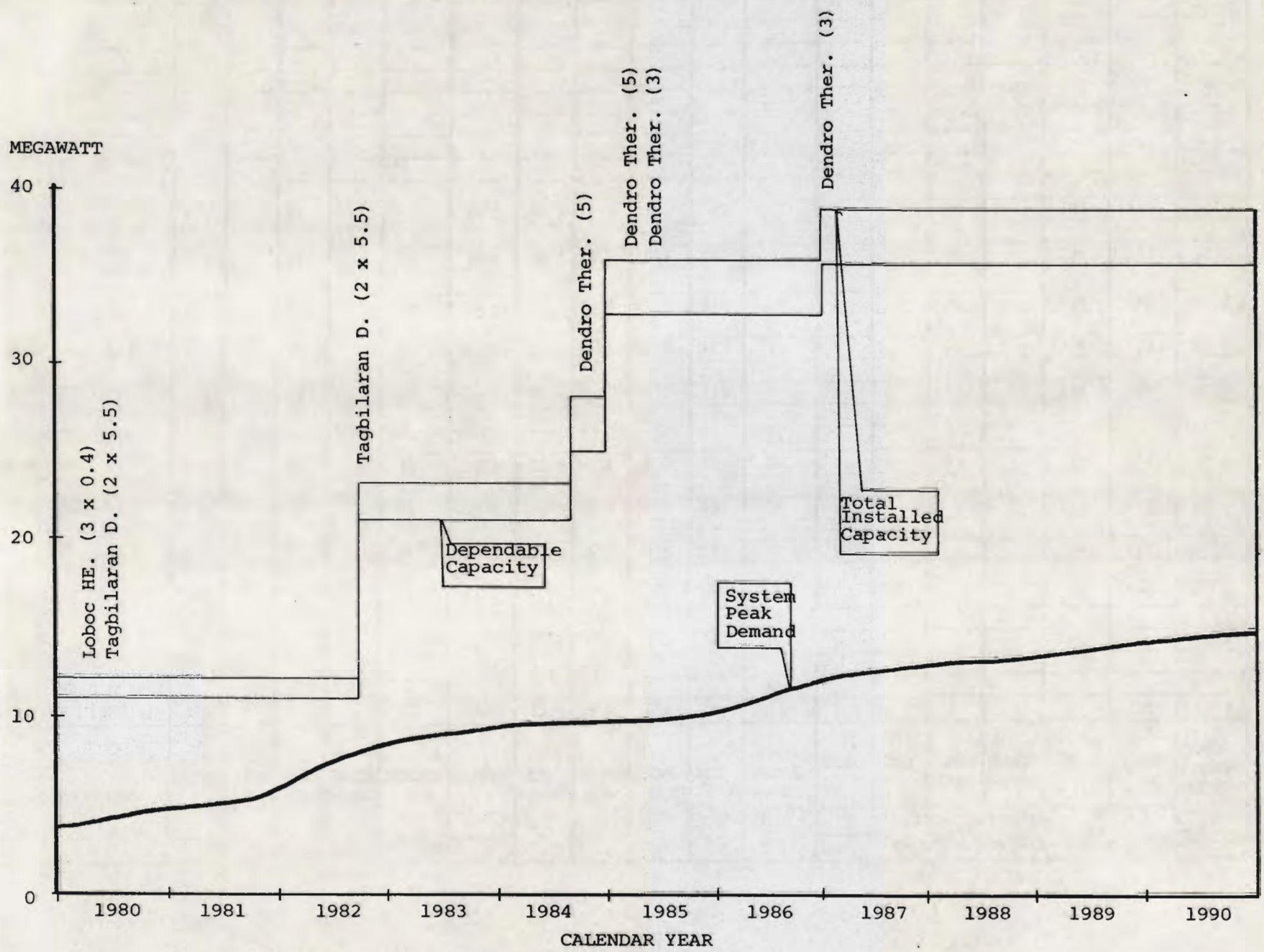
Table 3

BOHOL POWER GRID
GENERATION EXPANSION PROGRAM
(1980-1990)

YEAR OF COM.	PLANT ADDITION	INSTALLED CAPACITY (MW)						DEP. CAP.	PEAK DEMAND	RES. CAP.	% RES.	AVAIL-ABLE ENERGY (GWH)	ENERGY CAPABILITY AND REQUIREMENT (GWH)							
													SYSTEM CAPABILITY						GENE-RATION LEVEL	SUR-PLUS (DEP.)
		HYDRO	GEO	DENDRO THER	POWER BARGE	DIESEL	TOTAL						HYDRO	GEO.	DENDRO THER	POWER BARGE	DIESEL	TOTAL		
1980	Loboc H.E. (3x0.4)	1.2				11	12.2	11.2	4.8	1.4	29	7	7				67	74	13.0	61.0
	Tagbilaran D.(2x5.5											67								
1981	-	1.2				11	12.2	11.2	5.8	0.4	7	-	7				67	74	22.3	51.7
82/9	Tagbilaran D.(2x5.5)	1.2				22	23.2	21.2	8.5	7.7	91	67	7				89	96	41.4	54.6
1983	-	1.2				22	23.2	21.2	9.5	6.7	71	-	7				134	141	46.2	94.8
84/10	Dendro Ther. (5)	1.2		5		22	28.2	25.2	10.0	10.2	102	28	7		7		134	148	48.9	99.1
1985	Dendro Ther. (5)	1.2		13		22	36.2	31.7	10.4	16.3	157	28	7		73		134	214	59.9	154.1
	Dendro Ther. (3)											17								
1986	-	1.2		13		22	36.2	31.7	12.2	14.5	119		7		73		134	214	62.3	151.7
1987	Dendro Ther. (3)	1.2		16		22	39.2	34.2	13.1	16.1	123	17	7		90		134	231	65.1	165.9
1988	-	1.2		16		22	39.2	34.2	13.6	15.6	115		7		90		134	231	67.6	163.4
1989	-	1.2		16		22	39.2	34.2	14.5	14.7	101		7		90		134	231	71.3	159.7
1990	-	1.2		16		22	39.2	34.2	15.2	14	92		7		90		134	231	74.3	156.7

Source: System Planning, National Power Corporation

Figure 5
Bohol Power Grid
System Peak Demand & Capability Curve
(1980-1990)



Source: System Planning, National Power Corporation

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Figure 6
Bohol Power Grid
System Energy Requirement & Supply Curve
(1980-1990)

Source: System Planning
National Power Corporation

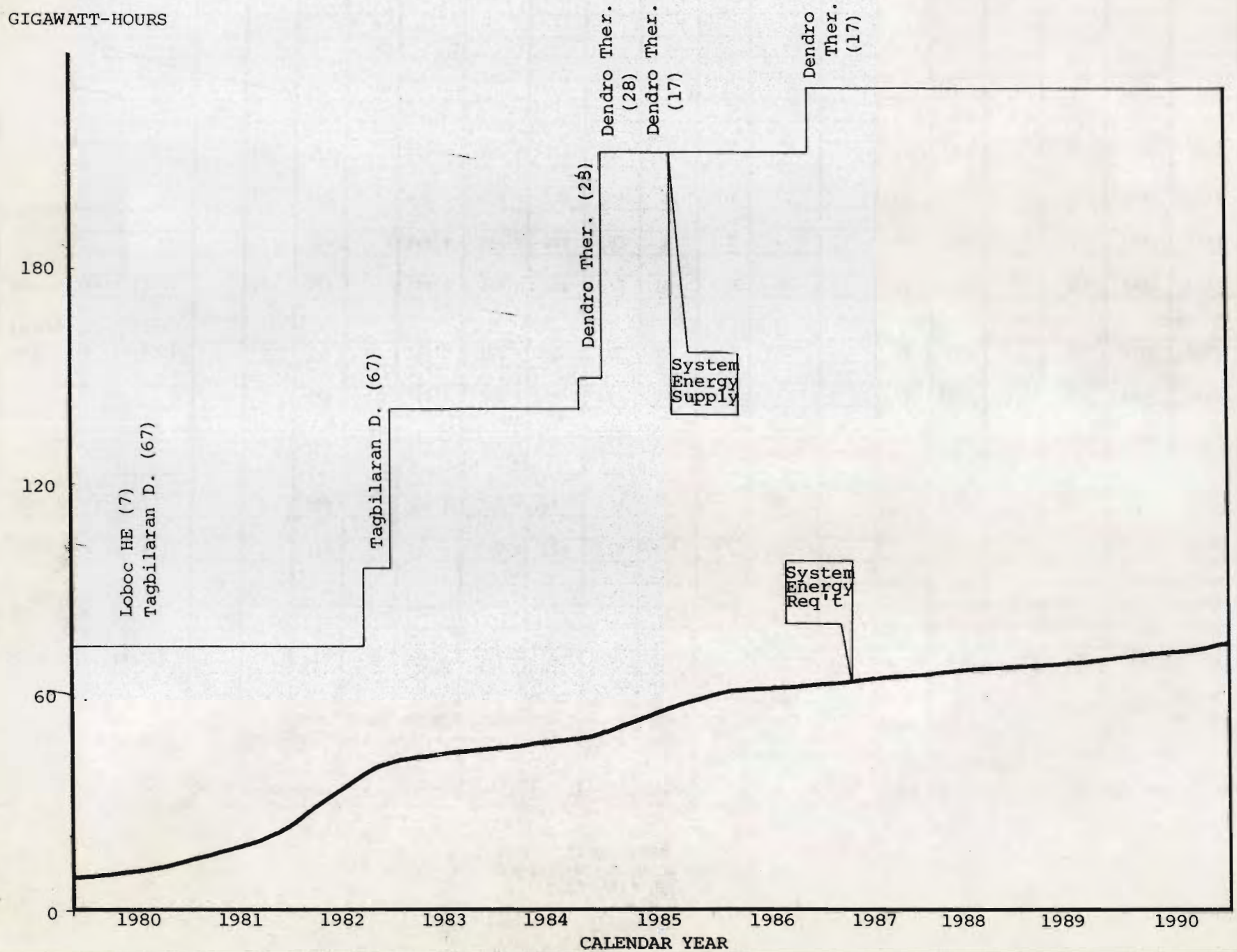

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Table 4

CEBU POWER GRID
GENERATION EXPANSION PROGRAM
(1981-1990)

YEAR OF COM.	PLANT ADDITION	INSTALLED CAPACITY (MW)						DEP. CAP.	PEAK DEMAND	RES. CAP.	% RES.	AVAIL-ABLE ENERGY (GWH)	ENERGY CAPABILITY AND REQUIREMENT (GWH)							
													SYSTEM CAPABILITY							
		HYDRO	Coal	DENDRO THER	POWER BARGE	DIESEL	TOTAL						HYDRO	coal	DENDRO THER	POWER BARGE	DIESEL	TOTAL	GENE-RATION LEVEL	SUR-PLUS (DEF.)
1981	Cebu D. I (7x7.3)			113		100.4	213.4	182	200	(23.5)	-	315			826		596	1422	1719	(297)
	VECO D. (49.3)											281								
	VECO Ther. (10)											61								
	ACMDC (103)											765								
1982	Naga Ther. I (55)			168		100.4	268.4	234	224	(42)	-	337			1163		596	1759	1916	(157)
1983	Cebu D. II (54)		3	168		154.4	325.4	284.5	234	(1.5)	-	330		17	1163		926	2106	1997	109
	Dendro Ther. (3)											17								
1984	-		3	168		154.4	325.4	284.5	248	(15.5)	-			17	1163		926	2106	2124	(18)
1985	-		3	168		154.4	325.4	284.5	256	(23.5)	-			17	1163		926	2106	2193	(87)
1986	Naga Ther. II (55)		6	223		154.4	383.4	339	265	22	8.3	337		34	1500		926	2460	2269	191
	Dendro Ther. (3)											17								
1987	Dendro Ther. (2x3)		12	223		154.4	389.4	344	273	19	7.0	34		68	1500		926	2491	2325	169
1988	-		12	223		154.4	389.4	344	283	9	3.2			68	1500		926	2494	2375	119
1989	-		12	223		154.4	389.4	344	291	1	0.3			68	1500		926	2494	2441	53
1990	-		12	223		154.4	389.4	344	302	(10)	-			68	1500		926	2494	2516	(22)

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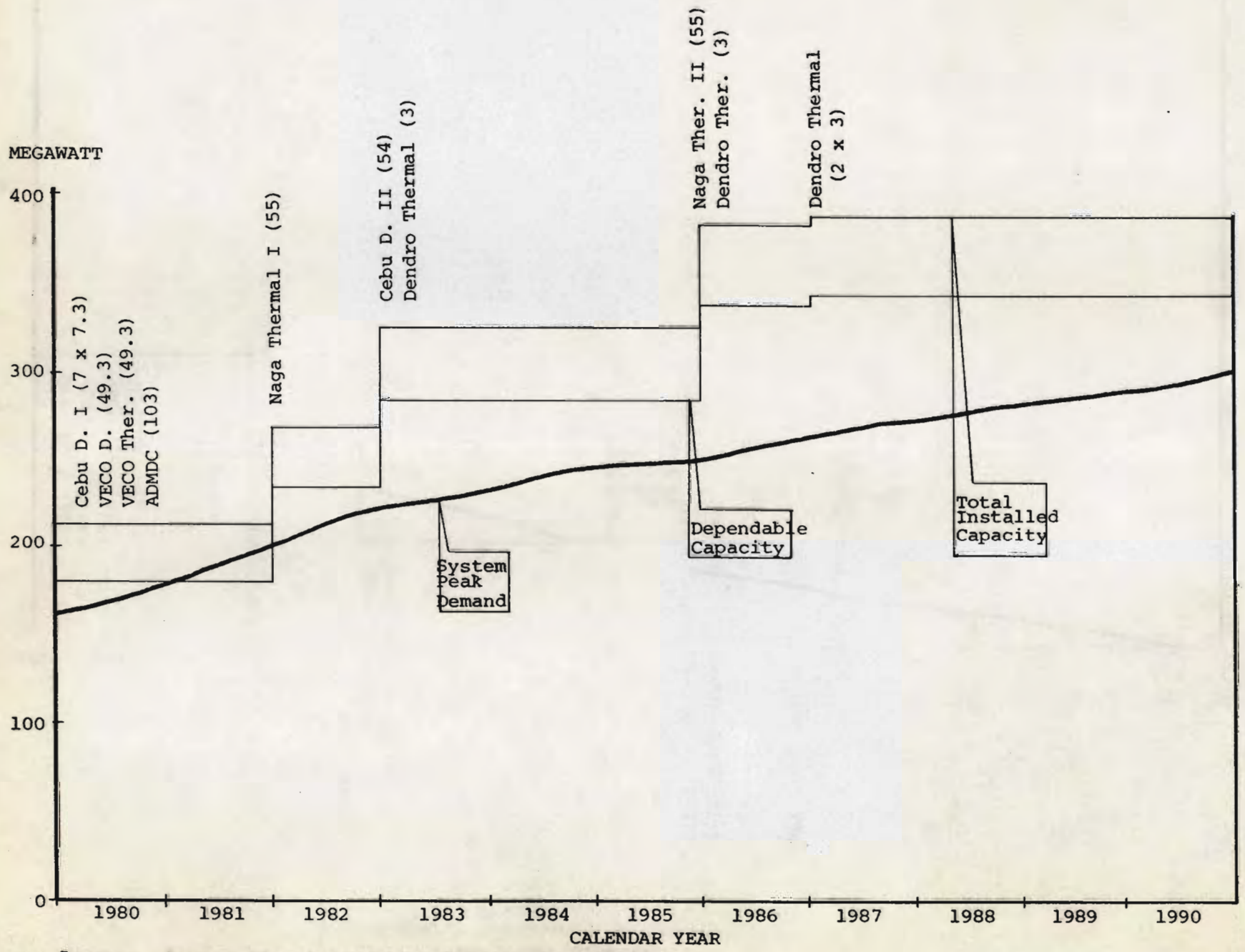
Figure 7
Cebu Power Grid
System Peak Demand & Capability Curve
(1980-1990)



Source: System Planning, National Power Corporation

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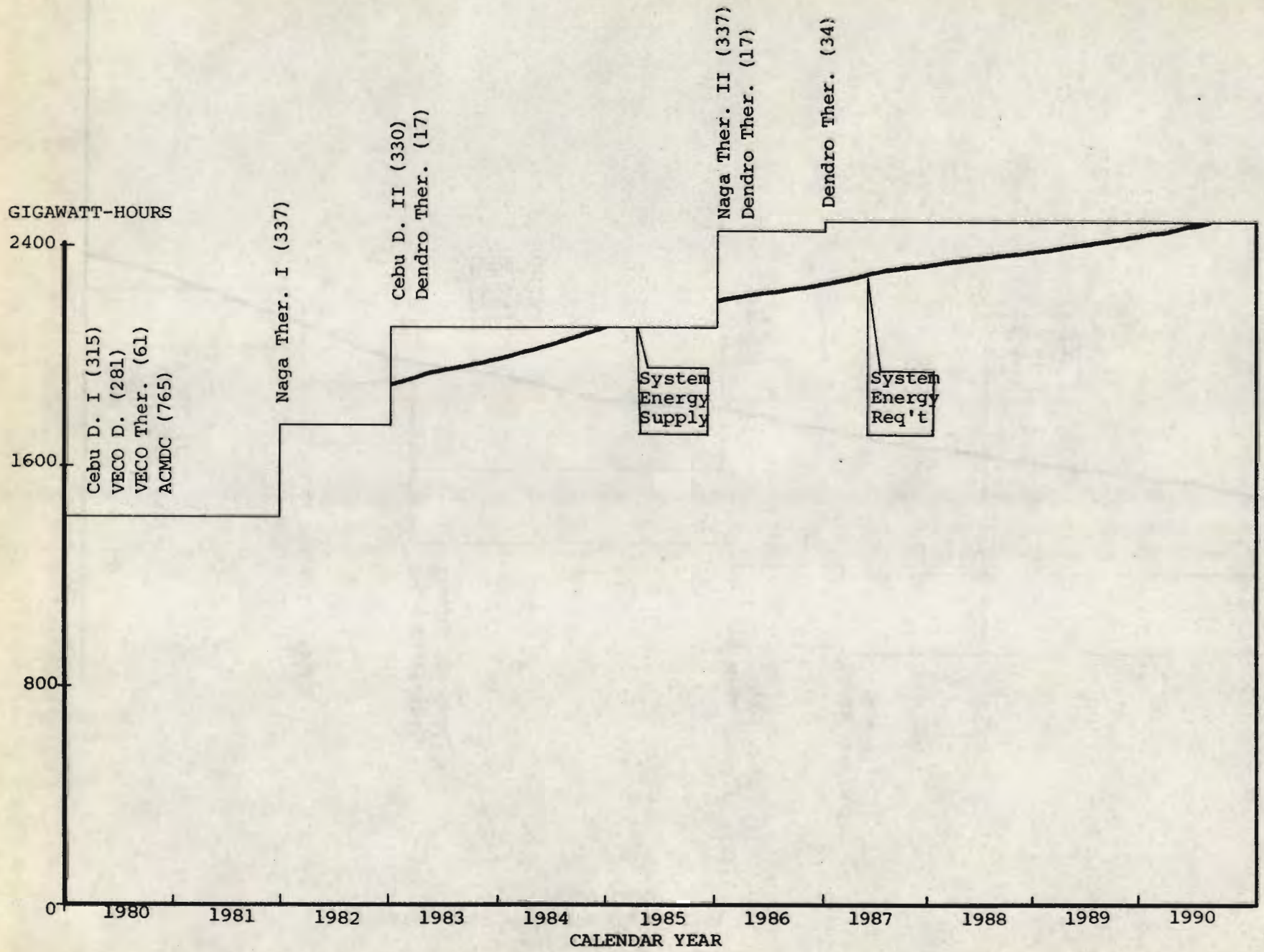
Figure 8
Cebu Power Grid
System Energy Requirement & Supply Curve
(1980-1990)



Source: System Planning, National Power Corporation

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