PN-ABE-113

64904

Report No. 89-11

A Report of the

Office of Energy
Bureau For Science and Technology
United States Agency for International Development

TECHNICAL, ECONOMIC, FINANCIAL AND COMMERCIAL CONSIDERATIONS OF THE SAN MIGUEL CORPORATION PRIVATE POWER PROGRAM

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Conventional Energy Technical Assistance Project
Contract No. LAC-5724-C-00-5126-00

August 1989

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I. Executive Summary

This report presents the findings of a study conducted on two industrial complexes owned and operated by the San Miguel Corporation (SMC) in the Philippines. The study was performed under the USAID/Office of Energy, Conventional Energy Technical Assistance (CETA) Project. The assistance was requested by San Miguel Corporation through the USAID Mission in Manila, as a direct result of a seminar on private power held jointly by the Office of Energy and the Mission in Manila.

The Republic of the Philippines faces a serious power shortage situation. Due primarily to a decision to mothball the 620 MW nuclear power station, the problem is further complicated by a heavy debt burden and a rapidly growing economy, which increased the industrial electric load demand by 12 percent nationwide, and by 25 percent in the Metro Manila area during 1988.

In response to this crisis, President Aquino signed into law Executive Order 215, legalizing private enterprise participation in the power sector.

San Miguel Corporation is one of the largest enterprises in the Philippines with about 23,000 employees and with total sales of US $1 billion in 1988. SMC is presently in its second year of a US $300 million expansion plan to double its present manufacturing capabilities by 1993.

To undertake this expansion, in light of the present power shortage, SMC has made a corporate decision to implement a program to secure its own sources of reliable power.

The purpose of this study was to evaluate the technical, commercial, and economic aspects of various alternatives for self generation of electricity that are being considered by the San Miguel Corporation.

There are two proposed sites under consideration by SMC:

- Canlubang, approximately 50 km south of Manila
- San Fernando, located about 110 km north of Manila

Both sites have a substantial demand for electricity and steam. Electricity consumed at the San Fernando site is being purchased from the National Power Corporation (NPC), while the Manila Electric Company (Meralco) supplies power at Canlubang. Presently, SMC installations at both sites have standby diesel generations for emergency supply of electricity and steam generation equipment for the production of process steam.

Both the San Fernando and the Canlubang sites are currently utilizing No. 2 diesel fuel oil and residual fuel oil No. 6 (bunker) purchased from Petron (Philippine National Oil Company). There is bagasse available within 2 km of the Canlubang site, but its utilization is deemed unlikely due to the quantities available.

At the San Fernando site, rice hulls and bagasse biofuels are available. The use of rice hulls may be feasible depending on the economics and logistics of its collection. Utilizing bagasse to produce surplus electricity will depend on the willingness of mill owners to make changes to improve the energy utilization efficiency at the mills.

Generation options for the near term (less than 2 years) and for the long term (over 2 years) were evaluated according to the following criteria:

- Characteristics of electricity and steam demand.
- Available time for implementation.
- Cost of power currently being purchased.
- Long term fuel availability and costs.

The use of "slow speed diesels" using residual fuel oil, steam injected gas turbines for cogeneration, and simple cycle gas turbines were studied for the near terms.

Alternatives utilizing biofuels were not evaluated due to the lack of detailed information on fuel availability and costs. However, it appears that these alternatives merit further consideration for the long term outlook.

Distribution of electricity at each site will be relatively simple and inexpensive since the facilities are clustered together within the sites. It will not be necessary to use NPC's or Meralco's transmission or distribution lines.

The Report addresses several economic and financial considerations and options for the project; including capital and operating costs typical for the different alternatives presented, potential sources of financing, possible commercial arrangements (wholly-owned by SMC or on a separate ownership basis with power sales to SMC), and projected electricity cost for each of the three generation alternatives considered.

Based on the data and information obtained from the above described process, this report recommends the implementation of 10 to 13.5 MW of generating capacity at the Canlubang site, using diesel generator sets with speeds of up to 900 RPM burning residual fuel oil No. 6 (bunker) as the primary fuel.

The report also recommends that further studies be conducted at the San Fernando site to establish the availability and feasibility of biofuels to meet the energy needs of that installation. Once those investigations are concluded, a judgment can be made in the merits of self-generation at the San Fernando site.

II. INTRODUCTION AND BACKGROUND

The Republic of the Philippines is facing a very serious power shortage problem. This problem has been precipitated largely by the decision to mothball the 620 MW nuclear power station, cutting deeply into the National Power Corporation's (NPC) ability to meet load demand. This problem is further aggravated by two other key factors:

(1) The Republic is saddled with a heavy national debt burden of about US $28 billion, compromising its ability to provide additional capital infusion into NPC for new generation capacity. NPC forecasts the need for new capital requirements of about $11 billion over the next 10 years.

(2) The Philippine economy grew at an overall rate of 7.5 percent in 1988, causing a corresponding increase in electric load demand of more than 8 percent. The demand in the industrial sector increased by 12 percent nation-wide, and 25 percent in the Metro Manila area in the same year. The Asian Development Bank estimates that Luzon alone will require an additional 3,773 MW of new power plants by the year 2000, costing over US $5 billion.

NPC has been unable to add any significant new capacity in the last 2 years, and estimates that a publicly funded base load power plant may take 6 to 7 years to construct even if funds are available. In the meantime, the utility system reserve margin is wearing dangerously thin. As of 1988, NPC had a total installed capacity of 4,171 MW, but of this amount, only 3,185 MW were listed as "dependable." The situation is probably more precarious because some old operating units such as Sucat No. 1 and No. 4 are overdue for rehabilitation.

In clear recognition of this power shortage problem, President Aquino signed into law Executive Order 215, legalizing private participation in the power sector. The Rules and Regulations to Implement Executive Order 215 have been prepared by NPC with consultation with the Office of Energy Affairs and the National Electrification Authority, as well as the private sector, through several public hearings. These rules and regulations, together with several proposed new pieces of legislation, are intended to encourage greater participation by the private sector in providing new additions to capacity in an effort to alleviate current shortages, as well as meet rising demand in the future.

San Miguel Corporation (SMC) is one of the largest corporations in the Philippines. It was founded in 1890, and its current employment is about 23,000. The main product lines of SMC are beverages, animal feeds and livestock, dairy products, packaging, and agribusiness. These businesses contribute significantly to the rural development of the country. SMC's sales in 1988 were US $1 billion, an increase of 28.8 percent from 1987. It is in its second year of a US $300 million expansion plan to increase its

present plant complement from 35 to 70 manufacturing facilities by 1993. Many of SMC's operations are energy-intensive. The current cost of total annual energy consumption (electricity and fuel) is US $37.5 million.

SMC is seriously concerned with the continued availability and reliability of power supply from NPC and has made a corporate decision to launch its own program to secure alternative sources of reliable power. This program includes the immediate installation of ten standby power units totalling 11.7 MW at nine of its production plants, boosting its in-house emergency power capacity to 14.3 MW. In addition, SMC is planning to install new power plants that would provide reliable around-the-clock firm capacity.

This plan is envisioned in three phases, feasibility of which has yet to be explored:

Phase 1

Install a 7-10 MW cogeneration power plant to supply electricity and process steam to a beer bottling plant, a metal closure and lithography plant, and a flexible tube packing plant in Canlubang, 50 km south of Manila.

Install a 7-10 MW cogeneration power plant to supply electricity and process steam to a beer brewery plant, a poultry processing plant, a fruit puree plant, and a shrimp processing plant in San Fernando, 110 km north of Manila.

Phase 2

Expand the power and steam supply from Phase 1 to additional SMC plants in Canlubang and San Fernando.

Install similar cogeneration power plants in other SMC locations.

Phase 3

Expand from Phase 2 to provide electricity and process heat to neighboring companies.

To implement such a plan, SMC is investigating two options:

Option 1

SMC will implement the plan with its own financial resources.

Option 2

SMC will form a joint venture company to invest and finance these power plants.

Since SMC is not familiar with the power business but is being forced into a private power program by the power shortage situation, a request was submitted to A.I.D. in late March 1989 seeking technical assistance to help them sort through the technical, economic, financial, and commercial considerations for Phase 1, and to provide technical advice on the scoping of the subsequent phases. This request matches well both the desire of the government of the Philippines, as well as A.I.D.'s policy to encourage and facilitate private investment in the power sector. It is also a logical follow-up activity of the previous joint effort of the Office of Energy and USAID/Manila Mission in conducting a private power seminar on October 5, 1988. At the request of USAID/Manila, the Office of Energy responded favorably and swiftly to this request by providing two consultants to conduct an in-country consultation for SMC during April 4-10, 1989. These consultants were drawn from Bechtel National, Inc. as prime contractor of the Conventional Energy Technical Assistance Project to the A.I.D. Office of Energy, and K&M Engineering and Consultants Corporation, a subcontractor to Bechtel National, Inc. The consultation team worked in close collaboration with a technical team of San Miguel Corporation headed by Mr. Renato L. Banares, Senior Assistant Vice President and Director, Engineering Services Directorate, Corporation Technical Services Division. This report documents the findings and recommendations of this consultation.

III. TECHNICAL CONSIDERATIONS

A. POTENTIAL SITES

A preliminary evaluation of generation alternatives was conducted at the two proposed sites being considered by the San Miguel Group. These two proposed sites are:

- The Canlubang site located approximately 50 km south of Manila
- The San Fernando site located approximately 110 km north of Manila

Facilities in the Canlubang site include a beer bottling plant, a metal closure and lithography plant, and a flexible tube packaging plant. In addition to these facilities, there are several other industrial facilities within a 25 km radius of the Canlubang site which could be potential consumers of electricity produced by San Miguel. Although those additional facilities are not considered in this study, they should be kept in mind for any future follow-up studies which consider the potential expansion of the presently envisioned facilities.

The facilities to which electricity would be supplied in the San Fernando site include a beer brewery, a poultry processing plant, a fruit puree plant, and a shrimp processing plant.

A vicinity map for the Canlubang Site is shown in Figure III-1.

At both sites there is a substantial demand for electricity and steam. Electricity consumed at the San Fernando site is being purchased from NPC while that consumed at the Canlubang site is being purchased from the Manila Electric Company (Meralco). Both sites currently have standby diesel generator sets for emergency supply of electricity, and steam generation equipment for the production of process steam. Additional standby diesel and steam generation equipment are also planned for future installation at both sites. Table III-1 shows the current and planned standby equipment at both sites.

Both sites were visited on April 6, 1989. During these visits the data on existing and plant facilities and on electricity and steam demand was obtained.

FIGURE III-1

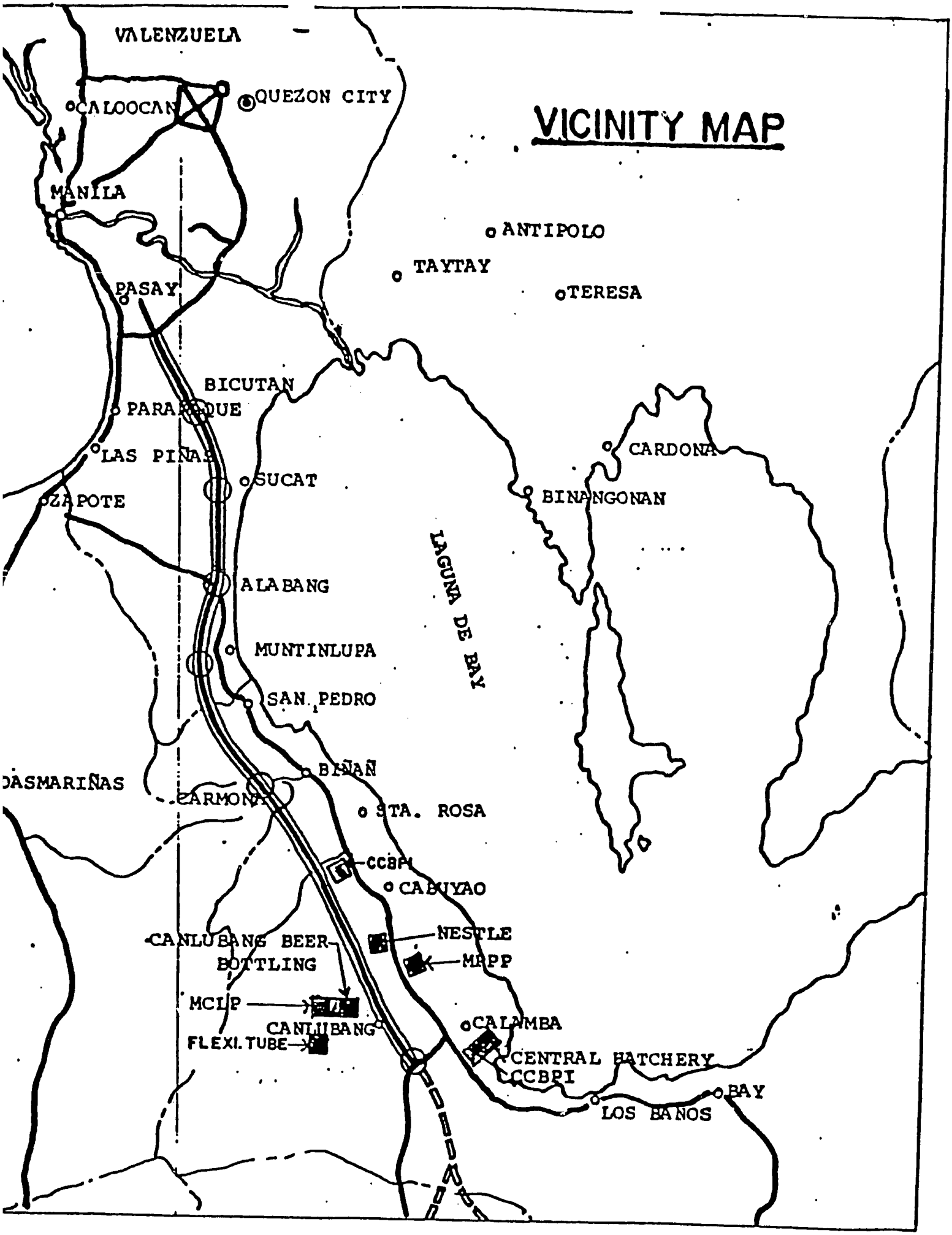

VICINITY MAP
VALENZUELA
CALOOCAN
QUEZON CITY
MANILA
ANTIPOLO
TAYTAY
TERESA
PASAY
BICUTAN
PARAÑAQUE
LAS PIÑAS
SUCAT
ZAPOTE
CARDONA
BINANGONAN
LAGUNA DE BAY
ALABANG
MUNTINLUPA
SAN PEDRO
BIÑAN
DASMARIÑAS
CARMONA
STA. ROSA
CCBPI
CABUYAO
NESTLE
CANLUBANG BEER BOTTLING
MRPP
MCLP
CANLUBANG
CALAMBA
FLEXI. TUBE
CENTRAL HATCHERY CCBPI
BAY
LOS BAÑOS

TABLE III - 1

ELECTRICITY AND STEAM GENERATION FACILITIES

LOCATION	EXISTING		ADDITIONS	
	STANDBY DIESEL GENERATORS	STEAM GENERATION BOILERS	STANDBY DIESEL GENERATORS	STEAM GENERATION BOILERS
CANLUBANG METAL CLOSURE PLANT	1 X 750 kW	--	1 X 900 KW	--
CANLUBANG BEER BOTTLING PLANT	1 X 55 kW	2 X 600 BHP	2 X 1.2 MW	*
CANLUBANG FLEXIBLE TUBE PLANT	2 X 750 kW	2 X 6,000 lb/hr	--	--
SAN FERNANDO BREWERY	2 X 2.5 MW	2 X 80,000 lb/hr	1 X 2.2 MW	*
SAN FERNANDO POULTRY PROCESSING PLANT	1 X 1.2 MW	2 X 400 BHP	1 X 1.2 MW	--
SAN FERNANDO FRUIT PUREE PLANT	--	--	--	--
SAN FERNANDO SHRIMP PROCESSING PLANT	--	--	--	--

* Proprietary Information.

B. ELECTRICITY AND STEAM DEMAND

1. Canlubang Site

The demand for electricity in the Canlubang area plants was estimated based upon the data contained in Appendix 1 and on discussions with the plant operating staff. The subject data represents actual readings during 1987 and 1988 at the beer bottling and metal closure plants and the estimates of future growth provided by the San Miguel Staff. Those estimates show a very substantial increase in electricity between 1988 and 1989 and between 1991 and 1992. The increases are caused by the expansion of the San Miguel facilities in the area during 1989, for example, the flexible tube packaging plant will be coming on stream in 1992, the beer bottling plant will be adding another bottling line to the existing two lines. No historical data are available for the flexible tube packing plant as this plant had not commenced operations at the time of the site visits. The historical data show uniform monthly power consumption as peak demands throughout the year. Therefore, it has been assumed that this pattern will continue in the future and that it will also be applicable to the flexible tube packing plant. A summary of the estimated electricity demand projections is shown in Table III-2.

Steam demands were estimated based upon the data provided by the San Miguel technical staff and the operating staff during the plant visits. The majority of the steam demand at the Calunbang Site is from the beer bottling plant. This plant will experience substantial increases in steam demand beyond 1990 as a result of the addition of additional bottling lines. The steam demand projections for the Calunbang Site were provided to the study team, but the data are SMC proprietary, and, therefore, not included in this report.

2. San Fernando Site

Current electricity demand and future projections at the San Fernando Site were also estimated based upon input from the San Miguel technical staff and plant operating personnel (see Appendix 1). As in the case of the Calunbang Site, monthly demand remains relatively constant throughout the year and it has been assumed that the trend will continue in the future. Table III-3 summarizes the electricity demand, current and future, at the San Fernando Site.

Steam demand at the San Fernando Site originates primarily from the brewery, although there is also a smaller demand from the poultry processing plant. Specific steam demands used in the brewing process are proprietary to San Miguel and, therefore, have been excluded from this report. As in the case of the Canlubang site, San Miguel is undertaking an expansion of its manufacturing facilities, particularly the brewery plant will undergo several expansions during the 1990-1991 and 1992-1993 periods.

TABLE III-2
ELECTRICITY PROJECTIONS
CANLUBANG PLANTS

YEAR	POWER CONSUMPTION (kWh)	PEAK DEMAND (kW)	AVERAGE LOAD FACTOR (%)
1987*	1,387,270**	1,884	49.5
1988*	5,696,520***	1,890	70.0
1989	23,932,000	3,900	70.0
1990	30,207,000	4,980	69.0
1991	35,340,000	5,824	69.0
1992	60,890,000	10,014	69.0
1993	66,933,840	10,920	70.0

Notes:
* Historical data
** Last 2 months of 1987
*** First 7 months of 1988

TABLE III-3
ELECTRICITY PROJECTIONS
SAN FERNANDO PLANTS

YEAR	POWER CONSUMPTION (kWh)	PEAK DEMAND (kW)	AVERAGE LOAD FACTOR (%)
1988*	41,420,694	6,900	69
1989	43,000,400	7,000	70
1990	45,000,000	7,350	70
1991	50,000,000	8,000	71
1992	59,000,000	9,570	70
1993	65,000,000	10,590	70

* Represents actual historical data

C. FUEL SOURCES

Both sites are currently utilizing No. 2 diesel fuel oil and residual fuel oil No. 6 (bunker) purchased from Petron (Philippine National Oil Company). Delivery to both sites is via tank truck from the Manila area. Both sites also have onsite storage facilities for both fuels. The costs of fuel oils currently used at both sites is shown in Table III-4.

Rice hulls and/or bagasse biofuels are available to some extent in the vicinity of both sites (see Appendix 2). At the San Fernando site both rice hulls and bagasse are available. The quantities of rice hulls available within 20 km of the site was estimated by San Miguel to be 40 to 60 tons per day. However, the total rice hull production in the Central Luzon region was estimated by Agrilectric Power, Inc., of the U.S. to be 318,600 metric tons annually. Use of this biofuel for electricity and steam generation may be feasible depending on the logistics and economics involved in its collection. The feasibility of utilizing the bagasse available in the vicinity of the San Fernando site to produce surplus electricity will depend on the willingness of mill owners to make changes which would improve the energy utilization efficiency at the mills.

At the Canlubang Site there is bagasse available within 2 km of the site. However, during discussions with the San Miguel staff, its utilization for generation of surplus electricity was judged to be unlikely because of the following factors:

- The existing quantities of excess bagasse which are available for electricity generation (approximately 6,000 tons/yr.) are not sufficient to support any significant electricity generation operation.

- There is little interest on the part of San Miguel in getting involved in changes to the mill facilities to improve their efficiency and, thus, increase excess bagasse for use in electricity generation.

- Cane production in the area will be declining in the future as a result of ongoing industrialization of the Canlubang area.

TABLE III-4
FUEL PRICES
(P.P./LITER)

TYPE	SITE	COSTS*
Residual No. 6	Canlubang	2.4328
Diesel No. 2	Canlubang	3.4919
Residual No. 6	San Fernando	2.4558
Diesel No. 2	San Fernando	3.5221

* Includes freight, $1 = PP21 approximately

D. GENERATION OPTIONS

In identifying the generation options which could be considered for each site, the following criteria were utilized:

- Characteristics of electricity and steam demands
- Available time for implementation
- Cost of power currently being purchased
- Long term availability and cost of fuels

Based upon the above criteria, the following options were considered:

(1) Near term implementation (i.e., less than 2 years)

- Slow speed diesel generators burning residual fuel oil and producing process steam from the exhaust gases.
- Gas turbines with steam injection, burning No. 2 oil and producing process steam from the exhaust gases.
- Simple cycle gas turbines.

(2) Long term implementation (i.e., over 2 years)

- Steam boilers and turbines using cane derived fuels (i.e. bagasse and trash).
- Steam boilers and turbines using rice husks as the primary fuel.

Each of these options is discussed in additional detail below:

(1) Slow Speed Diesels

The definition of "slow speed diesels," as used in this study, applies to engines with speeds of 900 RPM and less which can use heavy residual fuel oil as the primary fuel. These engines provide a good combination of reasonable first cost, good reliability, and adequate intervals between scheduled maintenance outages. These engines are available from a wide variety of suppliers which include Carterpillar of the USA and Wartsila of Finland.

Special features includes fuel preparation (heating and separation) and cogeneration equipment. Table III-5 summarizes the principal features of the slow diesel equipment.

(2) Steam injected gas turbines is a relative new product which has been receiving increased acceptance, particularly for cogeneration applications. The concept is essentially a variation of the combined cycle concept whereby a portion of the steam generated from the exhaust gases is injected into the gas path to augment the power output and significantly enhance the cycle efficiency. The balance of the steam available can be used for cogeneration service. For applications where there is a substantial demand of cogeneration steam and abundant natural gas for fuel, steam injected gas turbines could be considered as an alternative to slow speed diesels. However, for this particular application, no natural gas is available. Therefore, No. 2 fuel oil would have to be used as the primary fuel. Given the higher cost of this fuel over No. 6 residual fuel oil and the higher capital cost of the equipment as compared to slow speed diesels, it appears that the steam injected gas turbines would be less attractive than the slow speed diesels. Table III-6 summarizes some of the principal features of steam injected gas turbines.

(3) Steam boilers utilizing biomass fuels such as bagasse or rice hulls.

The feasibility of implementing this alternative is highly dependent on the availability of biofuels in the immediate vicinity of the proposed sites. As previously discussed, such availability is not present in the Canlubang site area; therefore, the application of this alternative should only be considered for the San Fernando Site.

At the San Fernando Site, it appears that there is sufficient bagasse available to support operation of a cogeneration facility of approximately 20-25 MW. However, the feasibility of such a facility will depend on the extent of changes to the existing facilities at the sugar mills and its investigation is beyond the scope of this current effort.

Preliminary surveys in the San Fernando area indicate the availability of 40 to 60 TPD of rice hulls from rice mills located within 20 km radius of the site. That amount will support operation of a generating station in the 1 MW size range, which is obviously not sufficient to meet the requirements at San Fernando.

TABLE III-5
DIESEL CHARACTERISTICS

Capacities	up to 6.6 MW
Typical heat rates	2500 kcal/kWh
Speeds	720-900 rpm
Steam Cogeneration	1.2 lb/kW
Fuel	Residual oil No. 6
Installed costs*	$550-650 per kW
Delivery times	3 - 6 months

* Includes cogeneration equipment

TABLE III-6
STEAM INJECTED GAS
TURBINE CHARACTERISTICS

Size range*	:	3400 - 5200 kW
Fuel	:	No. 2 oil, natural gas
Heat Rates	:	2500 - 3000 kcal/kWh
Steam Cogeneration	:	5.2 lb/kW
Installed Costs	:	$900 - 1200 per kW
Delivery Times	:	6 to 9 months

* Sizes go up to 200 MW; however, data shown is for application size being considered (3-5 MW)

However, if approximately ten times this quantity can be collected economically from the 318,600 metric ton per year of rice hulls production in Central Luzon, a rice hull burning power plant should be seriously considered.

Concurrent with this study, Agrilectric Power, Inc., a private U.S. company, conducted a prefeasibility study of a rice hull power plant for the San Fernando site of San Miguel. The study was partially funded by the U.S. Trade and Development Program. The Agrilectric Power, Inc., is one of several U.S. companies who possess commercially proven rice hull combustion technology for steam and electric power generation. Agrilectric Power, Inc., has built, owned, and operated successfully a 12 MW rice hull power plant in Lake Charles, Louisiana for several years with an on-line availability record of 94 percent. Their technology has also been deployed successfully in a 28 MW rice hull power plant in California, meeting very stringent environmental standards. In their prefeasibility study, they have concluded that there is a sufficient supply of rice hulls in Central Luzon to fuel the electricity and steam requirements of the San Fernando site if the hulls can be collected and acquired economically. They have further estimated that such a project could provide steam and electricity at a competitive price based on their prior project experiences in the U.S. The details of Agrilectric Power's findings are being presented in a report to the Trade and Development Program. The findings are sufficiently promising that the feasibility of such an undertaking should be further explored and ascertained.

The technical characteristics and costs of plants using rice hulls as their fuel source vary widely. Appendix III contains data for various manufacturers which was collected as a source of reference for this study.

Other alternatives for generation were also considered but were not reviewed in further detail because of factors such as installed costs, construction time, availability/cost of fuels, project size, etc. These alternatives included combined cycle plants, simple cycle gas turbines, steam cycle plants with residual oil or coal as the primary fuel, and high speed diesel engines.

E. TRANSMISSION AND DISTRIBUTION

At each site the facilities are located in very close proximity to each other. Also, both sites have ample space for construction of a central generating facility. Therefore, distribution of electricity within each site will be relatively simple and inexpensive without having to utilize either NPC's or Meralco's transmission and distribution facilities. The point of interface with NPC at the San Fernando site will be the existing substation at the brewery. That substation already has the necessary equipment to allow parallel operation of the future station with NPC's electrical system. This parallel operation will make possible the sale of excess power to NPC and it could also provide emergency backup from NPC if ever required. The existence of a similar facility at the Canlubang site was not confirmed during the visit to that site. However, the installation of such a facility, if one is not already available, would be a relatively simple and inexpensive matter.

Direct sales of electricity to other SMC plants or other industrial users beyond the two sites as envisioned in Phases 2 and 3 will require the establishment of wheeling arrangements with NPC and/or Meralco. Such arrangements require agreement on line charges and losses which are sometimes difficult to negotiate. Unless the electricity users had a direct financial interest in the generating facilities, it is doubtful that either NPC or Meralco would be agreeable to such arrangements as it will likely be seen as a direct conflict with their own business operations. One possible scenario where wheeling may be feasible would be if a single generation facility were to be built utilizing bio fuels. In that event, the generating costs may be sufficiently low to justify wheeling costs. NPC and Meralco could be agreeable to wheeling on the basis of low cost excess power being sold to them for their own distribution.

IV. ECONOMIC/FINANCIAL CONSIDERATIONS

A. CAPITAL AND OPERATING COSTS

Capital and operating costs for the various alternatives of generation of electricity vary widely depending on the specific conditions of each project. Table IV-1 shows typical values for these costs.

These figures were collected from several sources including the following:

(1) Direct input from the manufacturers of the various types of equipment.

(2) A study conducted in 1989 by a mission from the United Nations Development Program (UNDP) for the Compania Dominicana de Electricidad (CDE) in which several alternatives for generation of electricity were evaluated.

(3) A study performed by Ronco Corporation and Bechtel National in 1986 for a bagasse-fired power plant in Jamaica.

B. POTENTIAL SOURCES OF FINANCING

Depending upon the size of the potential project, it is anticipated that financing could be obtained from the following sources:

- Straight equity investment
- Multilateral institutions such as the IFC and the ADB which provide financing to the private sector.
- Export credit loans
- Bilateral soft loans or grants
- OPIC loan program in the event that a substantial share of the equity investment is from US sources

Equity financing is expected to comprise 20 to 30 percent of the project capital costs. The balance of the financing should be raised through loans.

TABLE IV-1
TYPICAL CAPITAL AND
OPERATING COSTS

Type of Generation	Reference Capacity (MW)	Capital Costs US$/Installed kW	Annual Operating Costs (% of Capital Costs)
Slow speed diesels	5	550-650	4
Steam injected gas turbines	5	900-1200	3
Simple cycle gas turbines	20	400-500	3
Combined cycle gas turbines	70	430-530	2
Bagasse fired steam plants	30	1225-1485	3
Rice hull fired steam plants	3.5	1400-1700	3
Oil fired steam plants	30	1100-1300	2
Coal fired steam plants	50	1350-1650	2

In addition to the above, commercial bank financing could also be obtained. However, due to the short repayment term associated with this potential source (i.e., 4 years) as compared to the other potential sources of loans above (i.e., 10 years or more), it is recommended that those other sources be explored and exhausted first before considering commercial bank loans.

Another potential source of financing is the Technology Transfer for Energy Management Demonstration Loan Fund (TTEM-DOLF) which provides loans at relatively low interest rates for energy conservation projects, including cogeneration. This fund is financed by USAID/Manila and administered by the Office of Energy Affairs of the Philippine Government. The major obstacle in utilizing this program is the limit on the maximum amount available through this program ($200,000) which would have to be substantially increased to be of value to these projects. Regardless of which financial plan is eventually implemented, early dialogue with potential sources of financing should begin as soon as possible in order to familiarize them with the project and facilitate later processing of loan applications. Potential lenders will require a detailed feasibility study on the projects. The study should address, at a minimum, the following:

- Site investigations
- Conceptual engineering
- Detailed capital and operating costs
- Financial/economic projections

In addition, if the projects are to be set up as separate generation companies selling electricity to San Miguel, NPC, and Meralco, and financing is requested on a limited recourse basis, then the following would also have to be executed prior to closing of the financing:

- Power/Steam purchase agreements between the owners of the generating facilities and the users (i.e., San Miguel, NPC, Meralco).
- A firm price on turnkey construction contract
- An operating contract for the operation of the generating facilities
- A fuel supply contract

The above documents are further discussed in the following Section IV-C.

C. COMMERCIAL ARRANGEMENTS

The commercial arrangements to be established will depend greatly on the ownership of the projects and the type of financing being secured. Two alternatives are available:

(1) The projects are wholly owned and operated by San Miguel. All loans are guaranteed by the Corporation. In this case, processing of the financing is relatively simple and fast. The projects are set up and implemented no differently than other projects undertaken by the Corporation.

The only new element would be a power purchase agreement between San Miguel and/or NPC and Meralco for the sale of excess power. Such an agreement would sell power to NPC and/or Meralco as it is available (i.e., no firm capacity commitment) at a set price per kWh. The set price would be based on fuel costs plus operation and maintenance costs and a profit margin. The price charged could be adjusted periodically to reflect changes in fuel costs and O & M costs.

(2) The projects are set up as separate companies where San Miguel may or may not participate in their ownership and operation. In that event, financing would be sought on a limited recourse, project basis which would seek to minimize the amount of loan guarantees given by the companies participating on the ownership for the project. However, this approach will require that the following be demonstrated to the full satisfaction of all sources of financing:

- That the projects are technically feasible
- That the projects can generate sufficient revenues for repayment of debt and to provide an adequate return to investors
- That the projects can be built and operated within the amounts of provided financing and estimated operating costs
- That all potential risks faced by investors and lenders are reasonably managed in order to attenuate their impact.

The above concerns are normally addressed through a combination of feasibility study, various agreements, and project insurances. A discussion on each of the various elements is as follows:

- **Feasibility report.** This element was already addressed in the preceding section.

- **Power Purchase Agreements.** Two types of agreements will be required. The main agreement, will be between the generating company and San Miguel. The agreement will provide for the sale of electricity and steam to San Miguel. A firm capacity would be specified to be guaranteed to San Miguel which will be subject to penalties on the generating company for failure to deliver it. In return, San Miguel will be required to guarantee payment for the firm capacity. The tariff is usually broken down into a fixed charge which will cover debt repayment, other fixed costs and investor return; and a variable element, which will cover fuel and other variable costs. The second type of fuel purchase agreement is the one for sale of excess power to NPC and/or Meralco which was previously described.

- **Fuel Supply Contract.** A long term fuel supply contract will have to be placed by the generating company. This contract will specify the quality, quantities, and price of the fuel. Adjustments in the price of fuel should be reflected in any tariff adjustment provisions contained in the power purchase agreements.

- **Operating Contract.** If the generating company lacks the expertise to operate the facilities, then it will have to contract the operation to a qualified plant operator.

- **Construction Contract.** A firm price, date certain contract will have to set up with a qualified contractor. The contract will include detailed engineering, equipment supply, erection, and commissioning. The contract will include provisions for liquidated damages in the event of schedule delays and plant performance shortfalls.

- **Insurances.** The company owning the generating company will have to set up various insurances to cover risks during construction and operation of the facilities. These include construction risk, third party liability, business interruption, etc.

D. PROJECTED ELECTRICITY COSTS

A cost simplified analysis on the projected cost of electricity was conducted for the following alternatives:

- Slow speed diesels
- Steam injected gas turbines
- Simple cycle gas turbines.

The purpose of the analysis was to obtain a general indication of the relative costs associated with the above alternatives and to compare them with the cost of electricity being purchased at each site from either NPC or Meralco. The analysis does not take into account factors such as future inflation or the future possible behavior of fuel prices. However, it is assumed that the fuel prices associated with the above alternatives (No. 2 fuel oil and residual fuel oil) will generally behave in similar proportion to their present relative price differentials. Therefore, the relative price differentials between the alternatives should continue to be valid for future variations in the fuel prices.

The cost of electricity generation for alternatives utilizing biofuels such as rice hulls and bagasse were not analyzed due to the lack of information on the costs of collecting those fuels and their exact availability. However, as discussed before, these fuels are available in the vicinity of the San Fernando site in abundant quantities and further studies should be conducted to establish the feasibility of their use. Other alternatives such as combined cycle plants or conventional steam plants (oil or coal-fired) were not evaluated due to a variety of factors such as plant size (i.e., too small), lack of transportation facilities for fuels such as coal, and high installation costs.

The results of the analysis are shown in Table IV-2. These results indicate that slow speed diesel engines would offer the lowest electricity costs among the evaluated alternatives. The analysis also indicated that the cost of generation with slow speed diesels will be lower than the current price of electricity purchased from Meralco.

The analysis is based on the following assumptions:

o	Exchange Rate	1 US$ = 21 PP
o	Annual Electricity Purchases/Generation	60,000,00 KWH
o	Fuel costs	
	Residual Oil	2.45 PP/Liter
	No. 2 Oil	3.52 PP/Liter
o	Capital Costs	
	Slow Speed Diesels	$ 600/KWH
	Steam Ins. GTs	$1050/KWH
	Simple Cycle GTs	$ 450/KWH
o	Operating (% of Capital Costs)	
	Slow Speed Diesels	4 %
	Steam Ins. GTs	3 %
	Simple Cycle GTs	3 %
o	Useful Life	15 years
o	Annual Discount Rate	12 %

The analysis conducted, although general in nature, does contain sufficient conservation and margins to lend confidence that the results will remain valid after more vigorous and detailed evaluation. Also, the economics of potential sales of excess power to Meralco have not been factored in the analysis, although those sales appear to be a feasible option to be available to the project.

TABLE IV-2
ESTIMATED ANNUAL GENERATION COSTS
10 MW PLANT
(US$)

	Slow Speed Diesels	Steam Injected Gas Turbines	Simple Cycle Gas Turbines
Average Capital Costs	1,120,000	1,960,000	840,000
Average O&M Costs	240,000	815,000	135,000
Average Fuel Costs	2,040,000	2,930,000	4,285,000
Cost of Electricity Generated	3,400,000	5,205,000	5,260,000
Average Cost of Electricity			
US $/KWH	.057	.087	.088
PP $/KWH	1.197	1.827	1.848

Average price of electricity purchased from Meralco is 1.6 PP/KWH
Average price of electricity purchased from NPC is .95 PP/KWH

V. INSTITUTIONAL CONSIDERATIONS

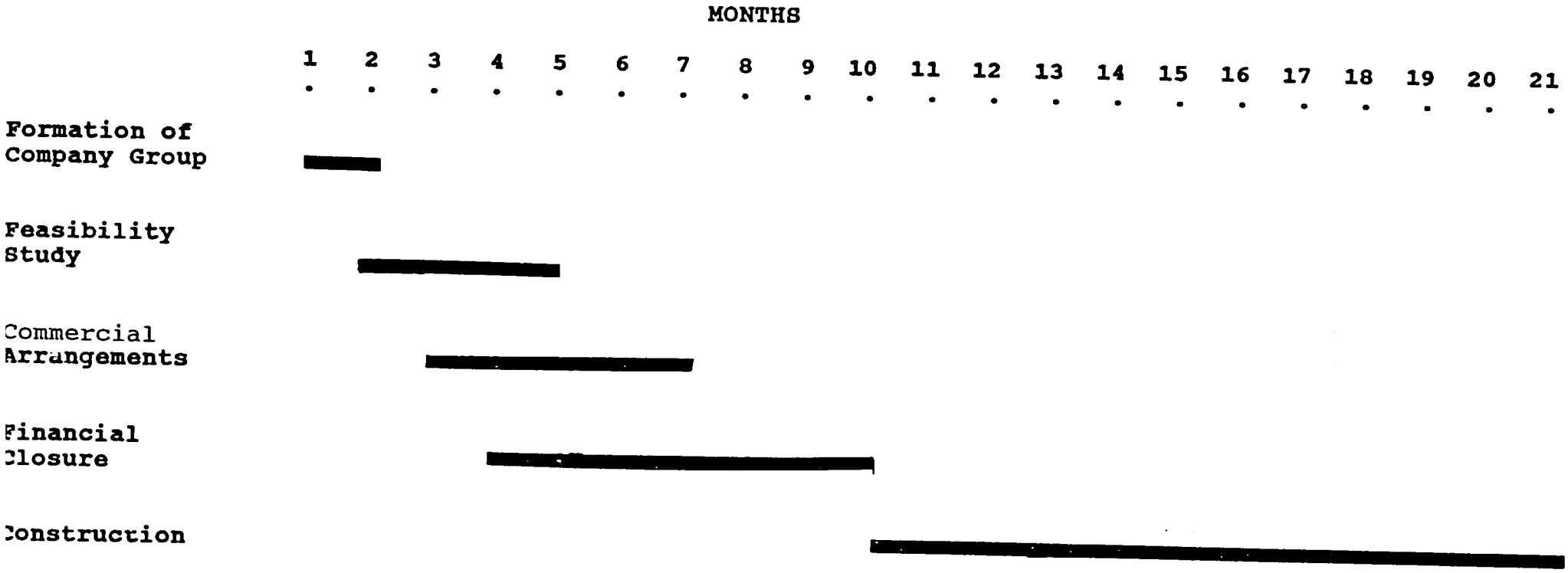
The Philippine Government is actively encouraging participation by the private sector in the generation of electricity. Accordingly, the Government has issued Executive Order No. 215 which amends a previous Presidential Decree that granted NPC the monopoly for generation of electricity in the Philippines. Executive Order No. 215 allows the private sector to generate electricity under various contractual arrangements with NPC. The detailed rules and regulations to implement Executive Order No. 215 have been recently issued and promulgated. The various alternatives for implementation of the projects which were discussed in the preceding sections, including the "wheeling" of electricity to other potential end users outside of the San Miguel Group, are all allowed and specified in the subject rules. Therefore, their implementation, at least from the legal and institutional point of view, is entirely feasible.

VI. SCHEDULES

Figure VI-1 shows a preliminary implementation schedule for Phase I at the Canlubang Site assuming the use of slow speed diesels. The schedule assumes that the project will be set up as a separate company selling power to San Miguel. Under such an arrangement, the implementation schedule will be considerably longer than in an arrangement whereby the additional facilities are treated as an ordinary plant expansion of San Miguel owned facilities. The longer duration is mainly due to the more elaborate commercial arragements and the more complex financing process which would be required.

At the San Fernando Site, more detailed investigations are required in order to establish the availability of biomass fuels for meeting the projected energy needs. Also, construction of a biomass fueled facility will likely last approximately 2 years instead of the one year assumed for the slow diesel facility.

FIGURE VI-1
Preliminary Implementation Schedule
Canlubang Site



VII. CONCLUSIONS AND RECOMMENDATIONS

From the foregoing investigations, the following major conclusions can be made:

- At the Canlubang site, a slow speed diesel plant with a capacity of 10 MW appears to be the most feasible alternative available for achieving Phase I objectives.

- At the San Fernando site, none of the alternatives which were evaluated (i.e., slow speed diesels, gas turbines) appear to be feasible at this time. This is mainly due to the higher costs of power generated under those alternatives as compared to the cost of power avaialble from NPC. However, the San Miguel site has great potential for generation using biofuels (bagasse and rice hulls). Generation of electricity with those fuels may prove to be an attractive alternative for the future, particularly under possible scenarios of increase in prices of oil and corresponding increases in the cost of power purchased from NPC.

In addition to the above conclusions, the following specific recommendations for the implementation of Phase I at the Canlubang Site are provided:

- San Miguel should decide as soon as possible on the implementation structure of the project (i.e., implementation with its own resources vs. separate company formation).

- Phase I at Canlubang should consist of two units of approximately 5 MW each. The first unit should be available for operation in mid-1991 and the second a year later.

- The proposed diesel units will not produce sufficient process steam to meet the site demands. Therefore, San Miguel should continue with its present plan to install additional steam generation capacity.

- San Miguel should consider replacing its planned addition of standby capacity at Calunbang with more slow diesel capacity. At the present time 3.3 MW of additional standby capacity are planned. If the decision is made to replace them with more slow diesel capacity, then three slow diesel units with a capacity of approximately 4.5 MW each could be built for base load operation. The first two units would be required by mid-1991 and the third a year later. The excess available generation could be sold to Meralco on an interruptible basis.

For Phases 2 and 3, it appears that future studies in the Canlubang area should continue to be focused on slow speed diesels. The San Fernando site should focus on biofuels, particularly bagasse and rice hulls.

APPENDIX I

ELECTRICITY AND STEAM DEMANDS

Notice: This information was produced by the technical staff of San Miguel Corporation and represents their analyses and forecasts of present and future demands at the Canlubang and San Fernando sites.

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CANLUBANG PLANTS
KILOWATT-HOUR ELECTRIC POWER CONSUMPTION

MONTH	BEER BOTTLING	METAL CLOSURE & LITHOGRAPHY	TOTAL
1987			
AUG.	*	454,440	
SEPT.	*	454,440	
OCT.	*	484,920	
NOV.	142,390	439,080	581,470
DEC.	424,040	381,760	805,800
1988			
JAN.	323,480	464,760	788,240
FEB.	344,840	522,240	867,080
MAR.	399,080	458,280	857,360
APR.	160,120	173,520	333,640
MAY	440,680	491,040	931,720
JUNE	511,480	464,640	976,120
JULY	492,600	449,760	942,360

NOTE: *BEER BOTTLING OPERATIONS NOT YET NORMAL.

RAL/ltb
04.19.89

CANLUBANG PLANTS
HIGHEST DEMAND CONSUMPTION IN KILOWATTS

MONTH	BEER BOTTLING	METAL CLOSURE & LITHOGRAPHY	TOTAL
1987			
AUG.		1460.0	
SEPT.		1410.6	
OCT.		1302.6	
NOV.	450.0	1403.4	1853.4
DEC.	487.5	1396.2	1883.7
1988			
JAN.	412.5	1353.6	1766.1
FEB.	867.6	1022.4	1890.0
MAR.	859.8	916.8	1776.6
APR.	830.7	907.2	1737.9
MAY	909.6	978.0	1887.6
JUNE	930.9	940.2	1871.1
JULY	938.4	879.6	1818.0

RAL/ltb
04.19.89

CURRENT DATA

PLANT: CANLUBANG BEER BOTTLING PLANT
HRS. OF OPERATION PER DAY: 16
DAYS OF OPERATION PER WEEK: 6
WEEKS OF OPERATION PER YEAR: 52

LOAD PROFILE 1988

MONTH	PEAK DEMAND (KW)	POWER USED (KWHR)	PEAK STEAM (LB/HR)	TOTAL STEAM (LBS)
JAN	413	323,480	Proprietary data	
FEB	868	344,840		
MAR	859	399,080		
APR	831	160,120		
MAY	910	440,680		
JUNE	940	511,480		
JULY	940	492,600		
AUG				
SEPT				
OCT				
NOV				
DEC				

PROJECTIONS

YEAR			
1989	1000	6,132,000	Proprietary data
1990	1000	6,132,000	
1991	1800	11,000,000	
1992	5900	36,000,000	
1993	6800	42,000,000	

CURRENT DATA

PLANT: METAL CLOSURE & LITHOGRAPHY PLANT, CANLUBANG, LAGUNA
HRS. OF OPERATION PER DAY: 16
DAYS OF OPERATION PER WEEK: 6
WEEKS OF OPERATION PER YEAR: 52

LOAD PROFILE 1988

MONTH	PEAK DEMAND (KW)	POWER USED (KWHR)	PEAK STEAM * (LB/HR)	TOTAL STEAM * (LBS)
JAN	1353	464,760	Proprietary data	
FEB	1022	522,240		
MAR	916	458,280		
APR	907	173,520		
MAY	980	491,040		
JUNE	940	464,640		
JULY	879	449,760		
AUG				
SEPT				
OCT				
NOV				
DEC				

PROJECTIONS

YEAR			
1989	1400	8,600,000	Proprietary data
1990	1480	9,075,000	
1991	1524	9,340,000	
1992	1614	9,890,000	
1993	1620	9,933,840	

* no steam requirement

CURRENT DATA

PLANT: FLEXIBLE PLANT, PPC *
HRS. OF OPERATION PER DAY: 16
DAYS OF OPERATION PER WEEK: 6
WEEKS OF OPERATION PER YEAR: 52

LOAD PROFILE 1988

MONTH	PEAK DEMAND (KW)	POWER USED (KWHR)	PEAK STEAM (LB/HR)	TOTAL STEAM (LBS)
JAN				
FEB				
MAR				
APR				
MAY				
JUNE				
JULY				
AUG				
SEPT				
OCT				
NOV				
DEC				

PROJECTIONS

YEAR			
1989	1500	9,200,000	Proprietary data
1990	2500	15,000,000	
1991	2500	15,000,000	
1992	2500	15,000,000	
1993	2500	15,000,000	

* not operational yet

SAN FERNANDO COMPLEX

KILOWATT-HOUR ELECTRIC POWER CONSUMPTION

MONTH	BREWERY	FRUIT PROCESSING	SHRIMP PROCESSING	POULTRY PROCESSING	OTHERS	T O T A L
1988						
JAN.	2,919,479	42,190			366,831	3,328,500
FEB.	2,778,972	114,413			564,615	3,458,000
MAR.	3,020,180	197,513			158,001	3,375,694
APR.	3,063,568	223,384			181,548	3,468,500
MAY	3,028,396	189,737			379,867	3,598,000
JUNE	2,651,379	84,205	126,308		603,108	3,465,000
JULY	2,818,510	247,292			189,198	3,255,000
AUG.	2,794,130	260,035			277,835	3,332,000
SEPT.	2,890,473	205,884			484,143	3,580,500
OCT.	3,015,659	203,195	13,481		334,165	3,566,500
NOV.	2,870,507	57,469	105,155	38,472	431,897	3,503,500
DEC.	3,004,818	229,398			255,284	3,489,500
TOTAL	34,856,071	2,054,715	244,944	38,472	4,226,492	41,420,694
1989						
JAN.						3,748,500
FEB.						3,734,500
MAR.						3,598,000

NOTES:
- o OTHERS INCLUDE CONSUMPTION OF ADMINISTRATION AND COMMON FACILITIES TO ALL PLANTS.
- o THE OPERATION OF SHRIMP AND POLTRY PROCESSING PLANTS ARE NOT YET CONTINUOUS FOR 1988.
- o THE NPC POWER COST INCLUDING ROYALTY FEES TO COOPERATIVE IS P1.13/KWH AS OF MARCH 1989.

RAL/ltb-04.19.89

SAN FERNANDO COMPLEX
HIGHEST DEMAND CONSUMPTION PER MONTH

MONTH	KILOWATT DEMAND
1988	
JAN.	6075
FEB.	6300
MAR.	6225
APR.	6375
MAY	6750
JUNE	6675
JULY	6900
AUG.	6600
SEPT.	6900
OCT.	6900
NOV.	6900
DEC.	6480

AVERAGE	6590
1989	
JAN.	7275
FEB.	6750
MAR.	7875

AVERAGE	7300

RAL/ltb
04.19.89

CURRENT DATA

PLANT: SAN FERNANDO BREWERY COMPLEX
HRS. OF OPERATION PER DAY: 21
DAYS OF OPERATION PER WEEK: 6
WEEKS OF OPERATION PER YEAR: 52

LOAD PROFILE 1988

MONTH	PEAK DEMAND (KW)	POWER USED (KWHR)	PEAK STEAM (LB/HR)	TOTAL STEAM (LBS)
JAN	6075	3,358,290		
FEB	6300	3,254,300	Proprietary data	
MAR	6225	3,596,350		
APR	6375	3,105,608		
MAY	6750	3,658,550		
JUNE	6675	3,242,750		
JULY	6900	3,412,438		
AUG	6600	3,437,700		
SEPT	6900	3,465,750		
OCT	6900	3,650,093		
NOV	6900	3,484,250		
DEC	6480	3,606,146		

PROJECTIONS

YEAR			
1989	7000	43,000,400	Proprietary data
1990	7350	45,000,000	
1991	8000	50,000,000	
1992	9570	59,000,000	
1993	10,590	65,000,000	

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APPENDIX II

BIOFUEL AVAILABILITY IN VICINITY OF SITES

Notice: This information was developed by the technical staff of San Miguel Corporation, results of their initial investigations on the availability of biofuels in the vicinity of the Canlubang and San Fernando sites.

P A S U D E C O

SAN FERNANDO, POMPANGA

1988-1989	1988 NOVEMBER	DECEMBER	JANUARY	1989 FEBRUARY	MARCH
BAGASSE OUTPUT, MT	23468.0	44279.0	45435.0	39351.0	16263.0
SUGAR MILL USAGE	18774.4	35423.2	36348.0	31480.8	13010.4
NET BAGASSE AVAILABLE	4693.6	8855.8	9087.0	7870.2	3252.6

	1986-87	1987-88	1988-89	1989-90
BAGASSE OUTPUT	140,492.0	173,652.0	168,798.0	195,000.0
SUGAR MILL USAGE	112,393.6	138,921.6	135,038.4	156,000.0
NET BAGASSE OUTPUT	28,098.4	34,730.4	33,759.6	39,000.0

NOTE: ALL FIGURES ARE IN METRIC TONS.

NET BAGASSE OUTPUT NORMALLY UNDER CONTRACT WITH UPPC (UNITED PULP & PAPER COMPANY).

RICE HULLS FROM RICE MILLS WITHIN 20 KM RADIUS OF THE BREWERY = 40-60 TDP (RELIMINARY SURVEY ONLY). 6 DAYS/WEEK 50 WEEKS/YEAR

APM/ltb-04.20.89

BAGASSE AVAILABILITY

PLANT: CANLOBANG SUGAR ESTATE

TABLE 1

	1987		1988			
	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL
BAGASSE OUTPUT, MT	3,942	24,196	12,107	37,330	49,405	36,511
SUGAR MILL USAGE	3,900	22,254	17,611	33,888	36,000	26,129
PULP MILL USAGE	1,218	1,547	1,322	1,293	1,659	1,356
NET BAGASSE OUTPUT	0	395	0	2,149	11,746	9,026

TABLE 2

	1986	1987	1988	1989	1990
BAGASSE OUTPUT, MT	191,618	191,000	190,000	189,000	190,000
SUGAR MILL USAGE	171,772	171,000	171,000	170,000	171,000
PULP MILL USAGE	14,115	14,000	13,000	12,500	13,000
NET BAGASSE OUTPUT	5,731	6,000	6,000	6,500	6,000

APPENDIX III
CHARACTERISTICS OF VARIOUS PLANTS UTILIZING RICE HULLS AS PRIMARY FUEL

Project: **PBN - 100**

Combustion Systems Using Rice Husk

American Manufacturer: Offering Turn-Key Supply:	PRM Energy Systems Stuttgart, Arkansas
Size Range:	4000 pph - 90,000 pph Steam
Steam Pressure:	According to Requirements
System Efficiencies:	Combustor - 76% Boiler - 92%

Installed Cost (Steam Cycle Only)

4000 - 10000 pph	:	$150 - $100 per lb of steam
10000 - 20000 pph	:	$100 - $ 85 per lb of steam
20000 - 40000 pph	:	$ 85 - $ 75 per lb of steam
over 40000 pph	:	$ 50 per lb of steam

Delivery: 12 - 15 months
Typical Figures for a 2.5 MWe + 17600 pph process steam @ 150 p sig system, and complete power generation system with controls.

Installed Cost: $5.5 million includes fuel handling, ash handling and cooling system.
System efficiency: 70%
Station heat rate with no process steam: 24700 BTU/kwh
Station heat rates with 17600 pph process steam: 39400 BTU/kwh
Calorific Value of rice husk 6200 BTU/lb.
Boiler output: 47760 pph steam @ 640psig, 750°F
Husk consumption: 16500 pph
Steam required for 1 kwh: 13.2 lbs

Foreign Manufacturer: offering turnkey supply:	Gariboldi Engineering Co., Italy
steam output range:	3600-22,000pph
boiler efficiency:	85%
electrical output range:	270-1650kw
Installed cost of system:	$1500-2000 per kw
delivery:	12-15 months

Boiler Manufacturers for Rice Husk Combustion:

Deltak Corporation, Minneapolis, U.S.A.

Babcock & Wilcox, Ohio, U.S.A.

Schule Gmbh, Hamburg, Germany: steam output 2200-22,000pph

Engineering Firm offering technical services for turn-key installation	McBurney Corporation, Atlanta, U.S.A. They have been associated with rice husk power plants built in U.S.A.

J Frank Angelo,II
UNIVERSAL ENERGY INTERNATIONAL,Inc
P O Drawer 5180
Little Rock, Ark. U S A
72225
501 666 2446
Tlx 536411 & 284794
Fax 501 682 7691

5-22-1989

E Y Lam
Bechtel National/U S A I D Energy Program
Kent St.
Rosslyn,Va

FAX 703-528-2280

Dear Dr. Lam,

Thank you for your call to UNIVERSAL ENERGY INTERNATIONAL,INC (U E I) this morning.

As you know , there is a rotary kiln combustion/gasification system designed by U E I which has recently been started up in Thailand,built under license with LATERITE PRODUCTS (THAILAND)CO., Ltd. of Bangkok.

The U E I ROTARY KILN features the Patented & Proprietary U E I STAGED SWIRL-COMBUSTION/PYROLYSIS AIR INJECTION SYSTEM. This 60 ton per day input unit is designed to operate in either a combustion/ gasification mode or a carbonization/pyrolysis/coking/control de-volatilization mode.

The feed stocks the U E I Unit has successfully operated with are rice husks,lignite ,& corncobbs. The owner,Mr. Sirisak Suebsiri, (who incidentally has a masters degree in thermodynamics from the Univ. of Kansas and is currently aVP of Engineering for THAI-SCOTT Paper,Bangkok) has plans to operate this unit with wood wastes and municipal solid wastes ,also.

The unit is located at LATERITE's extensive facilities in Pak Chong, Thailand. The U E I UNIT is primarily utilized to produce heat/gas/ flame to 'fire' an existing vertical lime kiln thus eliminating the need for costly oil .

Laterite plans to add a small power generation package to the unit to demonstrate the units power generation potential for companies in Thailand. The U E I SYSTEM is operating successfully,the customer is happy,and in fact Mr. Suebsiri/LATERITE has commenced construction on a second and even larger U E I ROTARY KILN COMBUSTION SYSTEM.

Cordially,

J Frank Angelo,President/U E I ,Inc.

Basic Information on Agrilectric Rice Husks Powerplant

(1) Land requirements 1.2 - 1.6 Hectares

(2) 300 tons of hulls per day.

(3) Can produce: 122,000 pounds of steam per hour at 650 psig at 750ºF.

(4) Can generate 12 megawatts of power when operating a full condensing turbine.

(5) Power generation could be less depending on the amount and pressure of extraction steam taken for process use.

(6) Reliability for on-line operation at the Lake Charles Plant is 94 percent.

(7) Lake Charles Plant is very automated and employs 12-15 persons.

(8) Operating expense can be projected at 3 percent of initial investment per year.

Source: Agrilectric Power Partners, Ltd.
P.O. Box P
Lake Charles, Louisiana 70602