40092 PN-AAS-769

TECHNICAL ASSISTANCE IN PHILIPPINE COAL DEVELOPMENT

July 1, 1985

FINAL REPORT

Submitted to:

Agency for International Development
Office of Energy
Washington, D.C. 20523

Contract #PDC-1406-I-09-2166-00

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ACKNOWLEDGEMENTS

The authors wish to thank Charles Bliss of the Office of Energy, USAID Washington and Richard Stevenson, Energy Project Officer, USAID Manila, for their guidance and support during the period of this contract. Their assistance and direction contributed greatly to the accomplishment of this project.

A large number of Filipinos have provided technical direction for this project with their continuing participation. They include Gary Makasiar from the Planning Office of the Ministry of Energy, Mario Tiaoqui of the National Coal Authority, Rufino Bomesang of the Bureau of Energy Development, Benjamin Lim of the Bureau of Energy Utilization, Willie Mediavillo of the PNOC Coal Corporation, Lydia San Juan of the Philippine Cement Industrial Authority, and Jose Mari Delgado from the Philippine Chamber of Coal Mines.

This group, their member organizations, and many others from the coal mining and industrial sectors have played a major role in the development of this national program. The authors thank them all for their greatly appreciated assistance.

TECHNICAL ASSISTANCE IN PHILIPPINE COAL DEVELOPMENT

EXECUTIVE SUMMARY

The Republic of the Philippines has made a strong commitment to the use of indigenous resources in its program to replace oil imports. Domestic coal has been identified as a major component in this program with mandated targets in the power and cement industries. Recently, however, supply and quality problems have begun to interrupt this program and the country has been forced to expand imports of foreign coal. Without prompt attention to these problems, coal imports will continue to increase and long-term sales agreements will lead to a lowered demand and thus lowered production for domestic coal.

A national technical assistance program which expands the use of indigenous coal offers major benefits to the Philippines. First, it provides the opportunity of decreasing foreign exchange expenditures for oil. With a stated target for 1990 of 4.5 million MT of coal, over 13 million barrels of oil would be replaced with a gross annual foreign exchange savings of over $350 million. Since much of this coal-using equipment is already in place with the conversion of the cement plants and other industries and the completed construction of Calaca, more than half of the target presently is ready for domestic coal use at minimum investment.

Second, local coal abounds in the Philippines. It is the one natural resource available for development throughout the country and thus presents an excellent opportunity for the rural sector. Coal has traditionally been a major economic activity in those rural areas with a mining history, and its expansion with private investment for updated technology will offer more rural areas a strong development potential.

Third, coal mining requires coal miners, engineers, geologists and other associated job categories. Every million tonnes produced provides direct employment for three to four thousand individuals depending upon the mining technique. Every million tonnes utilized for power or industry similarly requires several hundred more for transport and handling, leading to an employment impact of close to 25,000 for the production target of 1990. Indirect service jobs for this group will then multiply these employment requirements; and, again, most of these jobs will be in the rural sector.

The national program needed to encourage this production requires five basic elements with selected technical assistance and training components.

MARKETS. Activities which identify and expand markets with their selected requirements.

MAPPING. Activities which produce resource information needed to increase coal development and supply.

QUALITY. Activities which increase economic production of quality coal appropriate for specific markets.

HANDLING. Activities which demonstrate the appropriate handling and use of indigenous coal to meet market specifications.

SYSTEM. Activities which facilitate creation of the coal sector economic structure with the required timing of events to support its competitive position.

These elements and activities are set into a three-year program with an appropriate Philippine coal clientele to provide counterparts for a contractor supported program.

Accomplishment of these program activities will strengthen the viability of the total coal sector and encourage investment by the private sector. This investment will finance the further expansion of the coal mines and additional industrial coal conversions. Failure to encourage indigenous coal use will lead to increased coal imports; thus minimizing this opportunity to save foreign exchange, increase rural development, and expand rural employment.

Immediate attention is required to solve the present problems of the cement and power industries and refocus the country's efforts on expansion of this indigenous resource.

INTRODUCTION

The Republic of the Philippines has traditionally depended upon imported petroleum as its major energy source. Through concentrated efforts, under the leadership of the Ministry of Energy (MOE), the country's dependence upon imported oil was decreased from 92 percent in 1973 to 60 percent by the end of 1984. During these years, indigenous energy production increased by more than four times its level in 1973. Particular expansion of local energy sources over the past several years has helped to reduce the oil import bill net of exports from $2.5 billion in 1981 to $2.1 billion in 1983.* In both electric power generation and industrial energy use, indigenous fuels are playing a major role in oil replacement.

Energy consumption in the Philippines presently includes the conventional indigenous sources of coal, hydro, and geothermal; the nonconventional indigenous sources of bagasse, agriwastes, and others; and the imported sources of oil and coal. Table 1, "Energy Consumption by Source", from the latest MOE planning document estimates the volumes in million barrels of Fuel Oil Equivalent and percents used in 1984 with projections for future years. Indigenous coal use for 1984 was estimated at approximately five percent with imported coal at less than two percent, as shown in the table. At the present time, however, indigenous coal is encountering serious handling and use problems with its major markets of power and cement and prompt attention to avoid its replacement with imported coal is required.

The primary purpose of this technical assistance (TA) project is the expansion of indigenous coal use through a national level program. The program is designed to create confidence in the applicability of Philippine coal to Philippine energy needs. As such, it includes startup activities which address the present handling and use problems of the cement and power sectors as well as a set of activities with strong emphasis on training for both the coal miner and coal user.

The program's ultimate goal is the saving of foreign exchange which occurs with the replacement of oil imports by indigenous coal. The secondary goal is expanding the rural economy through the high employment and peso benefits associated with coal development. Since Philippine coal is the most widespread natural resource available for rural development, it traditionally has provided the opportunity for local employment as well as local industry. Today as well, increasing indigenous coal use will similarly increase the rural economic benefits associated with its continued development.

The most recently available energy plan produced by the Ministry of Energy for 1984-1987 continues in the direction of reducing the country's dependence on imported energy and includes the following objectives:

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* Ministry of Energy, "Energy Program 1984-1987", October 1984.

Table 1

ENERGY CONSUMPTION BY SOURCE*

	1984		1985		1987		1989		1990		1995	
	VOLUME	PERCENT	VOLUME	PERCENT	VOLUME	PERCENT	VOLUME	PERCENT	VOLUME	PERCENT	VOLUME	PERCENT
INDIGENOUS ENERGY	38.29	40.08	48.14	49.62	60.09	57.24	67.92	58.84	70.38	58.12	87.56	58.87
I. Conventional	24.09	25.22	30.17	31.10	38.71	36.88	44.14	38.24	45.61	37.67	58.39	39.26
Oil	2.69	2.82	2.43	2.51	4.93	4.70	5.71	4.95	5.46	4.51	4.51	3.03
Coal	4.73	4.95	7.29	7.51	10.51	10.01	12.26	10.62	13.38	11.05	22.98	15.45
Hydro	9.27	9.70	11.29	11.64	13.61	12.97	14.82	12.84	15.32	12.65	18.55	12.47
Geothermal	7.40	7.75	9.16	9.44	9.66	9.20	11.35	9.83	11.45	9.46	12.35	8.31
II. Non-Conventional	14.20	14.86	14.80	15.25	15.95	15.19	17.44	15.11	18.43	15.22	22.83	15.35
Bagasse	5.47	5.73	5.63	5.80	5.98	5.69	6.34	5.49	6.54	5.40	7.58	5.10
Agriwaste	8.65	9.05	8.96	9.24	9.67	9.21	10.53	9.12	11.08	9.15	13.48	9.06
Other Noncon	0.08	0.08	0.21	0.21	0.30	0.29	0.57	0.50	0.81	0.67	1.77	1.19
NUCLEAR	--	--	3.17	3.27	5.43	5.17	6.34	5.49	6.34	5.23	6.34	4.26
IMPORTED ENERGY	57.24	59.92	47.97	50.38	44.88	42.76	47.51	41.16	50.71	41.88	61.17	41.13
I. Conventional												
Oil	55.66	58.27	45.49	47.82	43.27	41.22	45.65	39.55	48.69	40.21	58.03	39.02
Coal	1.58	1.65	2.48	2.56	1.61	1.54	1.86	1.61	2.02	1.67	3.14	2.11
TOTAL ENERGY	95.53	100.00	96.11	100.00	104.97	100.00	115.43	100.00	121.09	100.00	148.73	100.00
Growth Rate, % P.A. vs. Previous Year Shown		(2.99)		0.61		4.02		4.86		4.90		3.49
Power Use, %	35.44	37.10	39.08	40.28	46.29	44.10	53.06	45.97	56.68	46.81	71.82	48.29
Oil Share in Power Use, %	13.02	36.74	6.23	15.94	5.90	12.75	6.87	12.95	8.33	14.70	10.24	14.26

*Ministry of Energy, "Energy Program 1984-1987", October 29, 1984.

Reliable data on traditional fuels such as fuelwood and charcoal are not available.

One. Provide adequate, timely, and secure energy supplies to support priority activities in the social and economic factors;

Two. Promote a more efficient and judicious use of energy including shifting the consumption mix in favor or indigenous resources; and

Three. Ensure that the first two objectives are attained within limits of environmental acceptability.

Over these years, 1984-1987, four key targets in the energy sector have similarly been identified.

One. Growth in Energy Use: Not more than 3 percent per annum, given economic growth targets for the planning horizon;

Two. Oil Import Dependence: Down to 50 percent by 1985 and further to 42 percent by 1987;

Three. Investment Financing: Less dependence on government funds to finance expenditures; and

Four. Electrification Coverage: 62 percent of households by 1987.

The national level coal TA program designed in this paper reflects both the set of objectives and the set of targets as stated above in the Ministry of Energy's plan for 1984-1987. Appropriate development and use of coal is a major requirement for both the plan's objectives and targets.

This new TA project has its own set of work objectives calling for the description of a coal development program and the specification of an appropriate level of effort for the program which includes:

- Definition of current and potential markets,
- Identification of measures that stimulate and develop such markets,
- Assurance of rising coal production levels consonant with growth of this market,
- Promise of independence from importation of coal,
- Identification of personnel requirements and personnel development needs, and
- Retention of internally organized, consistent, and focussed project leading to downstream contractor services.

A systematic and sequential approach has been utilized for program design. The process starts by;

- Defining the ongoing coal sector components from the initial recognition of the resource through to the coal's utilization,

- Identifying issues which may represent specific barriers to effective expansion of coal's utilization in the Philippines,

- Developing a prospective set of program targets,

- Reviewing of other donor programs as filters,

- Addressing the three major problem areas of the resource base, potential markets and personnel requirements to fill in needed TA activities, and

- Selecting a set of program elements with specific TA activities for both the public and private participants in the coal sector to reduce the barriers.

These program elements of MARKETS, MAPPING, QUALITY, HANDLING, and SYSTEM with their respective sets of activities are designed to develop a Filipino coal clientele which will encourage the use of Philippine coal.

Project Justification

Following the program's purpose of expanding indigenous coal use, a set of results is anticipated which will provide a national impact. The first effect is in the balance of payments. Each million metric tons produced and used in the country can replace over three million barrels of oil at a gross savings of over eighty million dollars. Continuing careful attention to the coal sector by the country and its present donors, and the addition of a strong national program including these suggested elements, can lead to an annual production of close to five million tons of coal by 1990.

As shown in Table 1, "Energy Consumption by Source", the most immediate coal market comes from the replacement of coal imports. Since this requires the least capital expenditure of all markets with the coal conversion equipment in place, it should occur fairly rapidly depending upon the availability of investment capital for mine expansion. These markets are in the power, cement, mining, and other industrial sectors. The next targets are in other major industries with the capability for coal conversion, and these opportunities are more closely related to the country's total economic climate. A strong focus of the program is on the development of coal markets.

As described in Exhibit A, coal has been identified in all areas of the country and exploration/development activities are proceeding on every major island. It is, thus, a rural resource and as such provides an excellent opportunity for rural development. A manpower study commissioned by the Ministry of Energy has described job requirements for the various energy sub-

sectors and shown that, depending upon the mining technique, each ton of coal produced can require three to four thousand jobs. Logistics and downstream use of this tonnage will require several hundred additional personnel. New industrial uses for coal in these areas will similarly produce additional jobs. Peso benefits to these rural areas associated with mine operations will, thus, include direct employment from the mines and related industries as well as the multiplicity of service jobs related to the mines. Expansion of coal mines provides an excellent employment and peso benefit to the rural economy.

Policy Dialogue

The issues important in the coal sector include items requiring significant policy discussions in the Philippines. The expansion of domestic coal use provides an opportunity for increasing non-government investments and, as such, requires a reexamination of public/private relations. Actions such as financial incentive programs, reviews of service contract procedures, evaluations of capital efficiency vs. employment rates, etc., are appropriate for immediate discussion. The coal sector touches all of these issues and, thus, serves as a basis for dialogue leading to the goals of import substitution and rural development.

The report which follows includes five chapters. These chapters review ongoing coal sector activities and show the development of a national coal program.

Chapter One - Presents the status of the coal sector at the present time;

Chapter Two - Includes the initial coal sector data collection and evaluation efforts;

Chapter Three - Describes the set of technical assistance program elements;

Chapter Four - Describes the TA program's management and timing; and

Chapter Five - Presents the overall project conclusions.

Chapter One

CURRENT STATUS OF PHILIPPINE COAL SECTOR

Present and Projected Use of Coal

Extensive coal resources exist throughout the major islands of the Philippine archipelago.* At the end of 1983, the Bureau of Energy Development (BED), Ministry of Energy, estimated that the total coal potential was over 1.5 billion metric tons (MT). Of this potential, over 300 million MT have been proven by detailed exploration and 215 MT are estimated as mineable.

Approximately 50 percent of the currently proven reserves are located on the island of Semirara with 22 percent in the Cagayan Valley of northeastern Luzon and 18 percent in Mindanao. The remaining 10 percent is found on the islands of Cebu, Samar, Mindoro, Negros, Polillo, Batan, and Catanduanes. Coal quality ranges from large deposits of lignitic at Cagayan and sub-bituminous on Semirara to smaller deposits of varying sub-bituminous and some bituminous at the other locations. Specific details on coal reserves and quality may be found in Table 2, "Summary of Coal Resources", and Table 3, "Summary of Coal Quality".

The consumption of Philippine steam quality coal has increased from under 300,000 tons in 1977 to over one million tons in 1983/1984. Approximately one-half of this demand has gone to cement plants, one third to power generation on Cebu, and the rest to various industries. Over the period of 1984 to 2000, coal use was projected to increase from 1.7 million tons per year (mtpa) in 1984 to 5.9 mtpa in 1990, to 10.7 mtpa in 1995, and to 15.3 mtpa in the year 2000. In the earliest year, the largest consumer will continue to be the cement plants which have recently been converted to coal. With the completion and startup of Calaca I in 1985, the National Power Company (NPC) will become Philippine coal's major client. Table 4, "Forecast of Total Coal Demand", presents anticipated coal needs for this time period.

The continued development of the Philippine coal market over these years will depend upon its availability, cost, and quality or physical/chemical properties. All three requirements must be met because a series of contracts has been signed with Australia and other countries permitting the importation of coal to meet shortfalls due either to general unavailability of Philippine coal or unavailability of specified quality coal. The nationally mandated coal conversions of the country's cement plants now require a constantly available supply of specified quality coal. Similarly, the commissioning of Calaca I will require a constant supply, with appropriate quality and cost. Power and industry needs for quality are presented in Table 5, "Coal Quality Specifications by End User".

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* For more detailed description of Philippine coal resource, see Exhibit A, USGS Resource Assessment.

Table 2

SUMMARY OF COAL RESOURCES
(in Million metric tonnes)

Coal Areas/Basins	Resource Potential 12/83	Positive Reserves 12/83	Probable Reserves 12/83	In Situ Reserves Positive + 2/3 Probable 12/83	Mineable Reserves 12/83	Percent of In Situ Reserves	Percent of Mineable Reserves
Semirara Island	550.0	114.3	30.7	134.8	79.0	43.0	36.7
Cagayan Valley	336.0	40.4	38.2	65.9	58.7	21.0	27.2
Surigao	157.2	27.2	29.0	46.5	36.7	14.8	17.0
Samar-Leyte	27.0	4.4	4.4	7.3	6.2	2.3	2.9
Zamboanga	45.0	29.0	7.4	33.9	20.3	10.8	9.4
Southern Mindoro	100.0	3.1	1.4	4.0	2.4	1.3	1.1
Northern Cebu	50-100.0	1.5	0.4	1.8	1.1	0.6	0.5
Central Cebu	40.0	2.3	-	2.3	1.4	0.7	0.7
Southern Cebu	50.0	3.9	2.4	5.5	3.3	1.8	1.5
Batan Island	9.9	4.8	3.6	7.2	4.6	2.3	2.1
Polillo Island	5.0	0.3	0.3	0.5	0.3	0.2	0.1
Catanduanes	4.1	0.6	-	0.6	0.4	0.2	0.2
Negros	4.5	1.0	1.0	1.7	1.0	0.5	0.5
Davao	100.0	0.2	-	0.2	0.1	0.1	0.1
Masbate	2.5	0.3	-	0.3	-	0.1	-
	-	0.4	0.7	0.9	-	0.3	-
	1481.2 - 1531.2	233.7	119.5	313.4	215.5	100.0	100.0

SOURCE: Asean Coal Development Project, Interim Report, Volume I, Prepared for Asian Development Bank and ESCAP Regional Energy Development Program (funded by UNDP), Montreal Engineering Company, Limited (MONENCO), 31 May 1984.

Table 3

SUMMARY OF COAL QUALITY
(Air Dried Basis)

Coal Areas/Basins	Moisture %	Ash %	Volatile Matter %	Fixed Carbon %	Sulphur %	Heat Value Kcal/Kg	Coal Rank (ASTM Classification)
SEMIRARA ISLAND	17-18	2-9	37-38	37-41	0.5-0.7	4440-5550	Lignite to sub-bituminous
CAGAYAN BASIN							
Cauayan, Isabela	14-16	15-18	36-38	25-29	0.7-1.1	3780-4110	Lignite
Maddela, Quirino Prov	8-12	8-16	41-55	28-32	N/A	5170-5400	Lignite to sub-bituminous
SURIGAO							
Bislig	12-14	11-13	31-34	34-38	0.5-1.0	4900-5400	Sub-bituminous
Guigsquit	8-9	17-22	37-40	28-34	2.4-3.8	4780-5170	Sub-bituminous
SAMAR-LEYTE	N/A	N/A	N/A	N/A	N/A	4170-5280	Sub-bituminous
ZAMBOANGA	2-4	5-7	24-28	58-67	0.4-0.9	7060-7280	Bituminous to Semi-Anthracite
SOUTHERN MINDORO	6	2-3	50-53	36-39	3.0-4.1	6170-6280	Sub-bituminous
NORTHERN CEBU							
Danao-Compostela	6-9	5-8	40-41	38-44	0.3-1.0	5830-6400	Sub-bituminous
Toledo-Balamban	3-4	10-13	36-39	41-46	3 -5	5170-6780	Sub-bituminous to Bituminous
CENTRAL CEBU	11-12	5-6	38-40	39-42	0.3-0.5	5400-5780	Sub-bituminous
SOUTHERN CEBU	5-6	3-6	40	46-48	0.4-0.6	6670-6900	Bituminous
BATAN ISLAND							
East	16-19	5-6	36-37	34-36	1.7-2.0	4560-4940	Sub-bituminous
West	6-10	2-7	35-37	42-47	1.5-3.0	5830-6280	Sub-bituminous
QUEZON	5	4	48	42	0.4	7170	Bituminous
POLILLO ISLAND	11-14	1-6	30-35	36-42	0.3-1.3	5060-6110	Sub-bituminous
CATANDUANES	3-7	9-15	22-25	50-55	1.2-1.6	5720-6720	Bituminous
NEGROS (East)	17-19	12-13	32-34	35-37	1.5-4.4	4670-5060	Sub-bituminous
DAVAO	18	9	33-34	36	0.6-1.7	4560-6110	Lignite to Sub-bituminous
MASBATE*	4-15	5-35	20-36	36-45	0.7-3.2	4440-5110	Lignite to Sub-bituminous

* Data from report by Robertson Research International Limited

SOURCE: Asean Coal Development Project, Interim Report, Volume 1, Prepared for Asian Development Bank and ESCAP Regional Energy Development Program (funded by UNDP), Montreal Engineering Company, Limited (MOMENCO), 31 May 1984.

N/A - Data not available

Description of Coal Sector Policies and Activities

The coal sector includes a quantity of coal reserves which are undergoing exploration and development activities designed to produce a coal supply for the increasing coal demand. As Figure 1, "Description of Coal Sector," shows, there is a system of logistics and transport presently being planned and partially under development which will guarantee coal's arrival at a number of specific markets. This system includes a set of components which must function together in order to ensure delivery of the right coal at the right time and place.

National energy policy governs the availability and price of Philippine coal. The "Energy Program 1984-1987", prepared by the Ministry of Energy, as well as the earlier program prepared for 1982-1987, contain three key objectives of supply, efficiency, and environmental acceptability, as quoted earlier. With a goal of decreasing dependence on imported fuel oil, the development of coal and other indigenous energy resources is strongly encouraged. In particular, Presidential Decree (PD) 972 includes economic incencentives for industries to convert from oil to coal and for private coal developers to enlarge their production capacities. This PD has resulted in a total of 54 coal service contracts by the middle of 1984 including 48 which are held by the private sector.

Coal buying and selling procedures have changed over the last year with the phasing out of the National Coal Authority (NCA) and the change in actions of the Philippine National Oil Company (PNOC) and its subsidiary PNOC Coal Corporation. The NCA was created by PD 1722 in September 1980 and given the authority to "coordinate, integrate, systematize, control and regulate all activities relating to the procurement, purchase, sale, importation, exportation and handling of coal, including the pricing, receiving, storage, transport distribution, processing and delivery". Initially, coal prices were set on a Btu basis in relation to the price of oil. Such control practices put private coal companies into direct competition with the government.

These regulatory controls have been replaced recently, however, with a strongly free market situation permitting private coal companies to directly market their production. Similarly, PNOC Coal Corporation's guarantee of coal supplies to utilities and industries which accompanied the NCA's control measures has been dropped, and major coal users such as the cement plants now identify and purchase their own supplies, including in some cases imported coal.

The payment scale varies depending upon the seller and the buyer's needs. PNOC, for example, sells 9500 Btu/lb coal at 1200 pesos delivered to the cement plant site with 60 days for payment. Small mine companies, consequently, can only compete when the cement company is on the coast. Alternatively, the cement plant can import at a cost of $43/MT at the port site. The cement industry has recently received a proposal* to consider importing coal

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* Marcelino Soriano, "Proposed Plan for the Supply and Distribution of Coal for the Cement Industry". December, 1984.

Table 4

FORECAST OF TOTAL COAL DEMAND

(000's metric tonnes, run-of mine)

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
1. NATIONAL POWER CORPORATION (NPC)													
Calaca I & II (Luzon)	--	1000	1000	1000	1000	1000	2050	2050	2050	2050	2050	2050	2050
Isabella I, II & III (Luzon)	--	--	--	--	--	--	--	500	1000	1500	1500	1500	1500
Sto. Domingo I, II & III (Luzon)	--	--	--	--	--	--	--	--	--	--	--	1070	3210
Naga I, II & III (Cebu)	130	160	240	370	370	370	370	370	370	370	370	370	580
Bislig I & II (Mindanao)	--	--	--	--	--	300	620	640	700	720	740	780	800
Mindanao Coal Thermal	--	--	--	--	--	--	--	--	--	300	620	960	2920
Sub Total	130	1160	1340	1370	1370	1670	3040	3580	4120	4920	5280	6730	11060
2. CEMENT PLANTS													
Luzon	679	679	679	723	723	803	865	902	934	1055	937	1006	1160
Cebu	90	90	95	95	95	95	105	105	105	105	105	105	105
Mindanao	235	265	290	300	315	320	320	355	375	395	430	445	445
Sub Total	1004	1034	1064	1133	1133	1218	1290	1352	1414	2555	1472	1556	1710
3. OTHER INDUSTRIAL													
MMIC (Nonoc)	180	360	600	600	860	860	860	860	860	860	860	860	860
Atlas (Cebu)	240	240	300	300	400	400	400	400	400	400	400	400	400
Small Industrial	160	190	200	235	255	295	335	375	385	395	405	415	565
National Steel Corp. (Mindanao)	--	--	--	--	--	--	--	340	740	740	740	740	740
Sub Total	580	790	1100	1135	1515	1555	1595	2375	2385	2395	2405	2415	2565
Total Steam Coal	1714	2984	3504	3638	4018	4443	5925	7307	7919	8870	9157	10701	15335
Coking Coal, Anthracite	200	210	220	230	240	250	260	270	280	290	300	310	380
Total Coal Demand	1914	3194	3724	3868	4258	4693	6185	7577	8199	9160	9457	11011	15715
Total excluding MSC	1914	3194	3724	3868	4258	4693	6185	6837	7459	8420	8717	10271	14975

SOURCE: Asean Coal Development Project, Interim Report, Volume I, Prepared for Asian Development Bank and ESCAP Regional Energy Development Program (Funded by UNDP), Montreal Engineering Company, Limited (MONENCO), 31 May 1984.

Table 5

COAL QUALITY SPECIFICATIONS BY END USER

		Heating Value (BTU/LB)	Ash %	Moisture %	VCM %	Fixed Carbon %	Sulphur %	Ash Fusion Temp % °C	HGI	Size	Basis	Source	Remarks
POWER STATIONS													
Calaca I (300 MW)	- design	8000-9000	22 max	16-19	35-41	26-29	1.0 max	1350	40-50	-	a.d.	-	data transmitted to Mitsui
	- contract	8300-9300	16-22	11-15	38-44	24-30	0.4-1.3	1350	40-50	200 max	a.d.	Semirara	may require blending with higher grade coals
Calaca II (300 MW)	- design	7500-	-	-	-	-	-	-	-	-	-	Semirara	will be designed for low quality Cebu coals
	- contract	7900											
Naga I (55 MW)	- design	9760	8.5	16.5	44	31	3 max	1250	66	30 x 0	a.r.	Cebu	designed for higher grade coals
	- contract	10000	15 max	15.0 max	35 max	31 min	4 max	1110	-	-	a.r.		
Naga II (55 MW)	- design	7900	20	20	30	31	3 max	1110	66	30 x 0	a.r.	Cebu/ Semirara	designed for lower grade coals
Isabella (3 x 100 MW)	- design	6200-6620	20.3 21.7	20-25	32-34	22.5-24	-	1200-1350	47-55	-	a.r.	Cagayan	mine mouth future plant

Table 5
COAL QUALITY SPECIFICATIONS BY END USER
Page 2

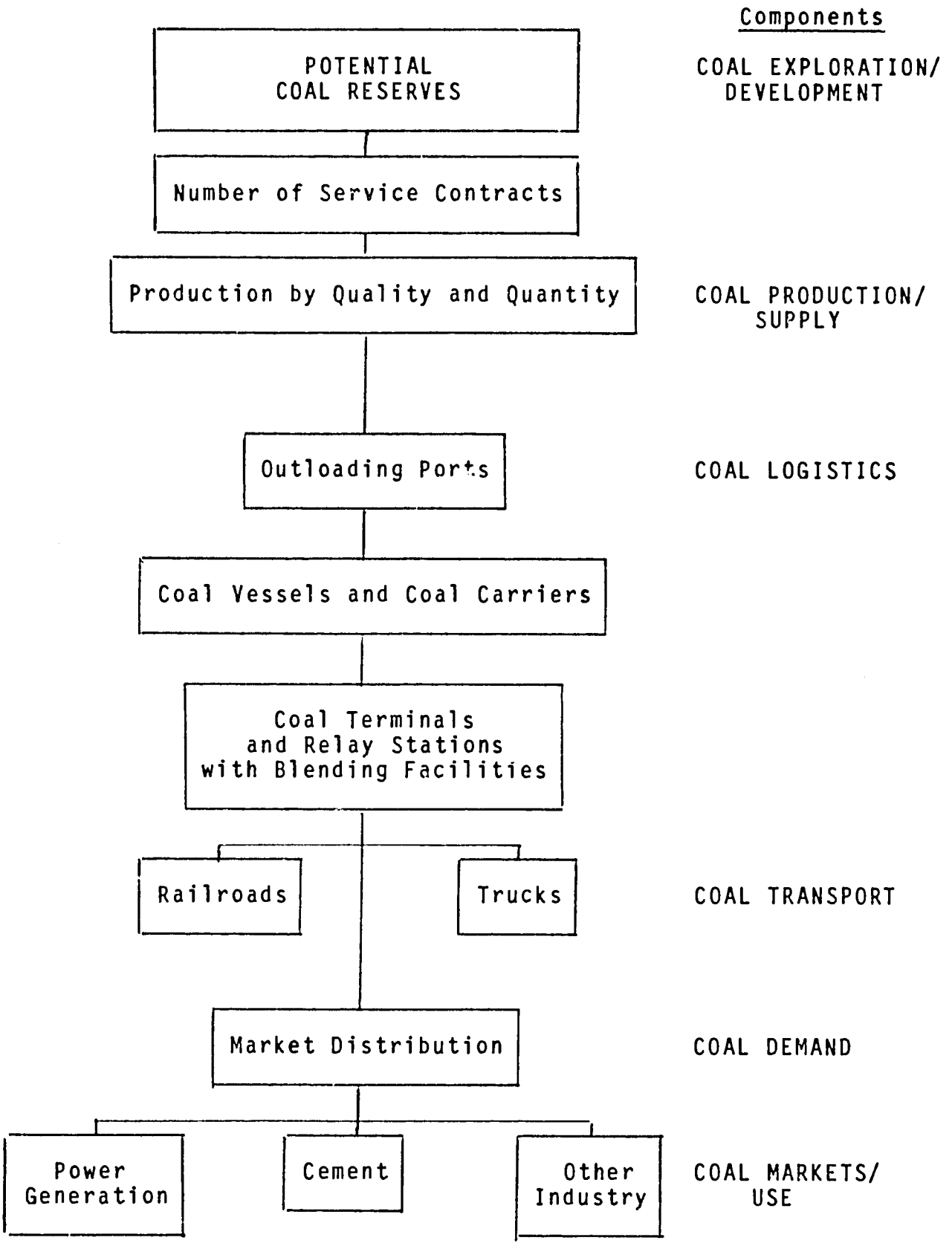
		Heating Value (BTU/LB)	Ash %	Moisture %	VCM %	Fixed Carbon %	Sulphur %	Ash Fusion Temp % °C	HGI	Size	Basis	Source	Remarks
Ilas	- design - contract	7200 min 8300-930C	20 20 max	22 15 max	10 10 min	- 24-30	- 3 max	1000 1000	40 40	20 x 0 100 max	a.r. a.r.	Semirara/ Batan	fluidized bed plant, designed to accept low grade coals
ITC	- design	1000	12	12.6	37.9	36.9	3.6	1200	39	50 x 0	a.d.	Import/ Semirara	blend of low and high grade coals
Bislig	- design	7500	22	17	10	-	4	1100	45		a.d.	Lianga area	coal supplied could be higher quality
Micemco (10 MW)	- design - contract	8800 7000 min	13.1 20 max	15.5 -	34.9 -	36.5 -	- -	- -	- -	25 x 0 15 x 0	a.r. a.r.	- Cebu	- plant not operating at full efficiency
NOC/NCA Power Spec.		10000	15 max	10 max	35 min	31 min	-	-	-	-	-	Various	excludes Calaca
NOC/NCA Cement Spec.		8500 min 9500 avg	18 max	18 max	20 min	-	3 max	-	45	25 x 0	-	Various	applies to converted plants
SC	- contract	8000 min	4-10	20	30-35	40 min	0.5	125.0	-	-	a.d.	-	-

SOURCE: Asean Coal Development Project, Interim Report, Volume 1, Prepared for Asian Development Bank and ESCAP Regional Energy Development Program (funded by UNDP), Montreal Engineering Company, Limited (MONENCO), 31 May 1984.

NOTE: Calaca, Naga, Isabella and Bislig are NPC power plants. Others are private.

Figure 1

DESCRIPTION OF COAL SECTOR



for all the Luzon plants and possibly the Mindanao plants as well. The proposal shows an annual savings to the industry based upon a selling price below PNOC's 1200 pesos.

From a market point-of-view, there has been, and will probably continue to be, a shortfall of indigenous coal with specific heat contents. Table 6, "Philippines: Steam Coal Supply/Demand Balance", illustrates one possible set of projections. The amount of shortfall will depend upon the continuing level of economic activity in the country as well as on a successful national program of encouraging appropriate quality indigenous coal use where feasible and practical.

Identification of Barriers to Coal Use

There are large quantities of coal in the Philippines as illustrated in Table 2, "Summary of Coal Resources". There are opportunities to use the coal, both in the present and in the future as shown in Table 4, "Forecast of Total Coal Demand". In addition, the past year's economic and political changes have encouraged a less regulated marketing system which assists the marketing of coal. There are still, however, many barriers which appear within the total coal system of exploration, production, transport, etc., and must be addressed before the coal system can function efficiently.

These barriers are associated with a series of issues which are raised repeatedly at coal producer and user meetings as well as in the local press. In a general sense, the issues start with a lack of confidence in Philippine coal, a lack of confidence in its ability to serve its markets. Questions are being asked about the coal's heat content, its moisture content, and its ash content. Problems are reported in the press about the cement manufacturers' inability to "burn" the coal, Calaca's difficulty in using the coal, Semirara's "history" of not meeting specifications, etc. Yet, as each story is checked out, the facts vary. The cement manufacturers do not report difficulty in using the coal in the kilns, they report a different problem with the wet coal in the new pulverizers. Calaca, similarly, has a handling/use problem; and there is little agreement on which specifications Semirara coal is supposed to meet for Calaca.

The lack of agreement on specifications is a common problem in just about every contract that presently exists between a coal producer or supplier and a coal user. Most of the agreements were drawn up with insufficient categories of specifications and limited knowledge of the various coal deposits' real quality; a common problem in the development of a new resource. The result, however, of these specific site difficulties is a lack of confidence in this new resource and a lack of confidence in the total system which should deliver the appropriate coal to its appropriate market at the appropriate time.

As one reviews the total coal system as previously shown with its components of exploration/development, production/supply, logistics, transport, demand, and markets/use, issues and potential barriers continue to multiply.

Table 6

PHILIPPINES: STEAM COAL SUPPLY/DEMAND BALANCE
(000's tonnes)

		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
STEAM COAL DEMAND														
Excluding National Steel														
Grade	9800 +	310	520	760	1020	1020	1020	1020	1020	1020	1020	1020	1020	1020
Grade	8500 - 9000 +	1164	1224	1264	1368	1388	1513	1625	1727	1799	1950	1827	1971	2275
Grade	7200 - 8300	240	1240	1480	1510	1610	1910	3280	3300	3360	3680	4020	5410	9800
Lignite	6200	-	-	-	-	-	-	-	500	1000	1500	1500	1500	1500
	Subtotal	1714	2984	3504	3638	4018	4443	5925	6547	7179	8150	8417	9961	14595
National Steel														
Grade	12000 +	-	-	-	-	-	-	-	400	400	400	400	400	400
Grade	7500	-	-	-	-	-	-	-	340	340	340	340	340	340
	Subtotal	-	-	-	-	-	-	-	740	740	740	740	740	740
	TOTAL DEMAND	1714	2984	3504	3638	4018	4443	5925	7287	7919	8890	9157	10701	15335
STEAM COAL PRODUCTION														
Grade	10000 - 11000 +	615	749	918	1106	1289	1405	1441	1464	1489	1516	1556	1596	
Grade	8500 - 9500 +	100	188	263	335	383	409	505	601	660	665	665	665	
	Subtotal	715	937	1181	1441	1672	1814	1946	2065	2149	2181	2221	2261	
Grade	7000 - 8000 +	-	-	60	120	200	490	749	917	1062	1162	1162	1167	
Semirara	7500	800	1300	1300	1300	1300	1300	2300	2300	2300	2300	2300	3300	
	Subtotal	800	1300	1360	1420	1500	1790	3049	3217	3362	3462	3462	4467	
Grade	6200	-	-	-	-	-	-	-	500	1000	1500	1500	1500	
TOTAL PRODUCTION		1515	2237	2541	2861	3172	3604	4995	5782	6511	7143	7183	8228	

Table 6
STEAM COAL SUPPLY/DEMAND BALANCE
Page 2

SUPPLY/DEMAND BALANCE: SURPLUS (SHORTAGE)

Excluding National Steel

Grade	9800 +	305	229	158	346	269	385	421	444	469	496	536	576
Grade	8500 - 9000 +	(1064)	(1036)	(1001)	(1033)	(1005)	(1104)	(1120)	(1126)	(1139)	(1285)	(1162)	(1306)
	Subtotal	(759)	(807)	(843)	(687)	(736)	(719)	(699)	(682)	(670)	(789)	(626)	(730)
Grade	7200 - 8300 +	560	60	(120)	(90)	(110)	(120)	(231)	(83)	2	(218)	(558)	(1003)
		(199)	(747)	(963)	(777)	(846)	(839)	(930)	(765)	(668)	(1007)	(1234)	(1733)

INCLUDING NATIONAL STEEL

Grade	8500 +	(759)	(807)	(843)	(687)	(736)	(719)	(699)	(1082)	(1070)	(1189)	(1026)	(1130)
Grade	7200 +	560	60	(120)	(90)	(110)	(120)	(231)	(423)	(338)	(558)	(898)	(1343)
	Total	(199)	(747)	(963)	(777)	(846)	(839)	(930)	(1505)	(1408)	(1747)	(1974)	(2473)

SOURCE: Asean Coal Development Project, Interim Report, Volume 1, Prepared for Asian Development Bank and ESCAP Regional Energy Development Program (Funded by UNDP), Montreal Engineering Company, Limited (MONENCO), 31 May 1984.

The issues which are suggested in Figure 2, "Identification of Potential Coal Sector Barriers", come from a series of meetings over a period of more than a year with key coal sector personnel. Both public and private sector representatives from many aspects of coal production, regulation, and use were interviewed to inform them of the potential Technical Assistance Program and request their assistance in providing data.

This list is not intended to be a complete compilation of all issues which could be associated with coal, but rather to serve as an indication of the key technical, institutional, and financial issues which presently tend to serve as barriers. Personnel and training barriers, for example, are not included here, but rather are discussed in a separate section at the end of Chapter Two. Identification and discussion of these issues has been helpful in preparing a national program, and will continue to be useful in its final definition.

As the use of coal on a large scale, such as for power generation or cement plants, is relatively new in the Philippines, it is important to identify these barriers as early as possible in order to resolve them as quickly as possible. The introduction of a new fuel requires a high level of local confidence in its ability to perform, otherwise all opportunities for substitution of either foreign coal or other fuels will occur. Generally, the most efficient way to develop solutions for the problems caused by these barriers is with a national program designed to preview them, or at least identify them as they occur, and then propose timely and cost effective resolutions.

Figure 2

IDENTIFICATION OF POTENTIAL COAL SECTOR BARRIERS

Coal Sector Components	Major Issues
EXPLORATION/ DEVELOPMENT	Need for Additional Drilling Lack of Quantity and Quality Data by Location Need for Agreement on Quality Standards Lack of Data Management System to Provide Accessibility
PRODUCTION/ SUPPLY	Assistance With Plans for Mine Preparation/Financing Studies to Demonstrate Pre-Feasibility/Feasibility Need for Mine Personnel Assistance with Mine Operation Need for Quality (Beneficiation)
LOGISTICS	Set of Infrastructure Facilities Units to Meet Capacity Locations to Match System
TRANSPORT	Knowledge of Present and Projected Needs Timing of Overall System and Units Information on Alternative System Costs
DEMAND	Identification of Markets/Market Needs Role of Regulatory Control Understanding of Sales/Pricing Practices Policy of Import Competition Competition with Other Solid Fuels Use of CWM
MARKETS/USE	Information on Techniques for Handling Coal Technologies for Coal Combustion Other Uses Including Briquettes Impacts on Local Environments

Chapter Two

PROCESS FOR DEVELOPMENT OF NATIONAL COAL SECTOR PROGRAM

Once the major issues which demonstrate the need for a national program are identified, work can proceed towards the development of the actual set of program elements and TA activities which meet the program's identified tasks, as previously listed:

- Defines current and potential markets,
- Identifies measures that stimulate and develop such markets,
- Assures rising coal production levels consonant with growth of this market,
- Promises independence from importation of coal,
- Identifies personnel requirements and personnel development needs, and
- Retains internally organized, consistent, and focussed project leading to downstream contractor services.

Development of a coal program, thus, requires a review of the national coal sector.

The first step in program development is a definition of issues which contain barriers to increasing coal use, as has been illustrated. These issues are major coal-related items which have been garnered from the public and private participants in the coal sector. Then this list is revised by filter eliminating issues which are presently being covered in other donor programs. For example, following Figure 3, "Identification of Donor Activities in the Coal Sector", it becomes apparent that there are overlaps in the Logistics and Transport Components, and, consequently, these items have been eliminated from major consideration at this time.

As the list becomes converted to major program elements, additional reviews of major problem areas such as coal markets, the resource base, and personnel requirements will continue and begin to fill in the TA activities, thus resulting in a preliminary program. The following sections will illustrate this process by reviewing the coal resource markets and personnel/training requirements and, thus, will lead to a preliminary list of program elements.

Set of Program Elements

Starting with the set of six coal sector components and their respective issues which may serve as barriers, one can separate those issues which meet both the TA program's tasks and the Ministry of Energy's key targets. This procedure can be described as follows: The TA program's stress is on an increase of coal markets with a corresponding increase of indigeneous supplies

Figure 3

IDENTIFICATION OF DONOR ACTIVITIES
IN COAL SECTOR
(March, 1985)

Coal Sector Components	Major Issues	Major Donor Activities
EXPLORATION/ DEVELOPMENT	Additional Drilling	World Bank-Surigao German Project-Cagayan
	Quantity and Quality Data Quality Standards Data Accessibility	British Program
PRODUCTION/SUPPLY	Mine Planning/Financing Pre-Feasibility/ Feasibility Studies Mine Personnel Mine Operations Quality and Beneficiation	ADB* Role Potential TDP**/ ADB Roles
LOGISTICS	Infrastructure Facilities	Australian/Canadian Programs
	Capacity Locations	Ongoing USAID for CWM***
TRANSPORT	System Projections System Timing Costs	Australian Program British Program
DEMAND	Markets/Market Needs Regulatory Control Sales/Pricing Practices Import Competition Solid Fuel Competition Use of CWM	Ongoing USAID
MARKETS AND USE	Coal Handling Combustion Briquettes/Other Environmental Impacts	(Limited Japanese)

* ADB - Asian Development Bank
** TDP - U.S. Trade and Development Program
*** CWM - Coal Water Mix Fuels Project, sponsored by USAID

through the use of the private sector, and the Ministry of Energy wishes to lower the oil import dependence through indigenous resources with less use of government funds. All relevant groups wish to increase the use of training activities. These key concerns, thus, call for a program which focusses on the private sector, looks carefully at markets and related production, and includes a strong training component.

With consideration of other donor activities it becomes appropriate to develop a program starting with four coal sector components as follows:

1. EXPLORATION/DEVELOPMENT. Activities which produce mapping information needed to increase coal development and supply,

2. PRODUCTION/SUPPLY. Activities which increase production of quality coal appropriate for specific markets,

3. DEMAND. Activities which identify and expand markets with their requirements, and

4. MARKETS/USES. Activities which demonstrate appropriate handling and use of indigenous coal to meet market specifications.

These four components of the coal sector with their corresponding activities will meet many of the technical, institutional, and financial issues previously listed, and, thus, can serve as program elements. There must still, however, be a synthetic element added which puts the total project together, and that can be identified as the fifth element of SYSTEM PLANNING. This element assists with the planning requirements of the Ministry of Energy which permit coal to participate competitively in the total sector.

Resource Assessment (USGS)

A coal resource assessment is an analysis of all data concerning an area's coal resources and reserves with the objective of reaching a judgment about the geologic nature and economic potential and sociological significance of the coal resources and reserves of the area. An assessment is not the same as an estimate, which is a determination of the amount of coal in an area. An estimate, or quantity judgment, is only one of the many types of data needed for assessment. For example, information about the quality of the coal is generally vital to assessment. Other information, particularly that of an economic nature such as market demand, transportation infrastructure, and the effect of the required labor supply on the affected regional rural economy (because essentially all mining, most mineral transportation, and much mineral utilization are rural-based, not urban) are basic inputs on affected derivations of resource assessments.

Because assessment is based on the data and projections, therefore, that are available at a particular time, a new assessment, or reassessment, may be needed when a sufficient amount of new data become available. For this reason, many, or most, assessments are dated.

The last attempt at assessment, though it fell short of the previous definition of a comprehensive assessment, was in 1977, at about the beginning of intensive commitment to the use of indigenous coal. An update of that older effort, essentially adding in newly created information to modify and change the older, non-comprehensive effort, is now underway. This present effort should result in a better appraisal of the coal resources and reserves of the Philippines than is presently available. In addition, this updating effort to gather, organize, summarize, and synthesize the newly created data is a necessary beginning phase in a detailed comprehensive assessment of the coal resources of the Philippines.

The description of the general objectives and specific tasks of the proposed, and required, coal resource assessment which follows in the next chapter, should be understood to include all the scientific, engineering and sociological factors involved in the attempt to aid the Philippines in modifying their present imported-oil-based energy budget.

Market Assessment

The major system components of coal demand and coal markets can be considered together. Two of the significant potential barriers to fulfilling the coal demand include a knowledge of the specific market requirements from a quantity and quality point-of-view and an appropriate pricing structure which encourages the competitiveness of coal. Then, two of the barriers to meeting the market requirements include an understanding of how to handle coal and how to use coal. The discussion of these barriers to expanding coal use which follows is based upon industrial opportunities for coal use, as a solid fuel, through conversion from fuel oil or as a new fuel and does not include power generation which is conducting its own coal evaluations. Coal use as a slurry fuel (CWM) will be discussed separately.

Market studies have been completed by PNOC Coal Corporation and the Philippine Chamber of Coal Mines, as well as by other groups both within the Ministry of Energy as well as independents such as the Economic Development Foundation (EDF). Generally, marketing techniques such as the development of industrial energy profiles showing industry characteristics and fuel oil use for specific purposes and occasionally questionnaires have been used for data collection and tabulation.

PNOC Coal Corporation's Marketing Services started in the late 1970s by surveying industries and developing questionnaires on fuel use, boiler characteristics and general plant information in order to develop a data base on potential coal users. Next, they visited plants and categorized individual companies by those who had converted to coal but needed help; those who were in a study phase and progressing; and those who were potential converters, but needed further assistance. Their best candidates for conversion included a fertilizer plant, pulp and paper, mining, sugar, textiles, and food processing plants including vegetable oils. Some progress was made with several conversions until the national economy began to falter in 1983 with a subsequent drop in most manufacturing output.

Similarly, the EDF reviewed major industrial fuel oil users with steam production as applicable candidates for conversion and investigated boiler size to identify potential targets. They found pulp and paper, mining, sugar, logging/wood products, textiles, vegetable oils, food processing, and chemicals as potential coal converters.

The Bureau of Energy Utilization (BEU) within the Ministry of Energy has been examining opportunities for energy conservation in the industrial sector where coal conversion is considered one alternative. This ongoing program* began with energy audits in 1982-1983 for industries across the country including coconut oil, sugar, mining, food, tobacco, textile, wood, pulp and paper, chemicals, fertilizer, petroleum, rubber/tire, ceramics, glass, cement, steel/ metal, appliance manufacturing., automotive manufacturing., power generation, and construction. Data were then developed for specific companies' annual petroleum consumption with additional information on boiler specifications and related plant descriptions.

In the Final Report of this ADB-sponsored Energy Conservation Project, Arthur D. Little (ADL) prepared an evaluation of the economics of fuel switching in boilers, based upon the use of either coal or waste fuel. To determine opportunities for coal conversion, ADL estimated a national potential for coal use based on varying prices of coal, varying boiler sizes, and varying yearly rates of operation. For example, with a coal price (CIF) of $35/MT and oil at $212/KL, ADL estimated that 300,000 KLOE/yr of oil could be saved with a net annual cost saving of $42 million. The estimated incremental investments for new coal-fired boiler capacity to replace oil-fired boilers would be about $107 million.

Development Sciences Inc. found, during a series of industry visits to discuss coal conversion in late 1983, that there was interest in replacing oil-fired boilers with solid fuel fired boilers that could combust either coal and/or waste fuels such as coconut husks and shells, rice hulls, and other miscellaneous agricultural wastes. At that time, the industries visited, including cement, textiles, coconut oil, sugar, and oil refining, were all evaluating coal use and considering co-generation also as electrical brownouts were frequent. Since late 1983, however, the situation has greatly changed and electrical demand has dramatically dropped with the lowered economic productivity.

To summarize, data are available at BEU, PNOC:CC and others for fuel oil use and boiler type; though, presently some are out of date with the changed economic climate. The potential for coal conversions can, thus, be estimated and evaluated. The lack of progress in completing industrial coal conversions, not including the cement plants, is due to four major causes.

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* Previously funded by the Asian Development Bank (ADB), new project is presently funded by AID and is entitled, "Technology Transfer for Energy Management".

- The economic climate precludes available investment capital.

- There is a lack of accurate information on industrial coal requirements including size, heat content, moisture, and ash; and on the appropriate technologies for combustion including their costs.

- There is competition from available nonconventional fuels including related agricultural residues such as wood waste, bagasse, coconut shells, and other biomass sources such as fuelwood, charcoal, etc.

- Poor logistics prevent the right coal from being at the right place at the right time; thus, leading to a lack of confidence in the use of Philippine coal.

Specific activities designed to ameliorate these marketing barriers are discussed in the following chapter under the elements of Markets and System.

Personnel and Training

Following Figure 1, "Description of Coal Sector", personnel with varying skill levels will be required for all the sector's components of exploration/development, production/supply, logistics and transport, demand, and markets/use. Most needed will be trained coal miners and trained coal handlers, depending upon the actual tonnage of coal produced and used.

Depending upon the specific mining methods and the various uses to which the coal is put, certain skills will be required in science and engineering, mining, related technologies, construction, and equipment operation. In the actual mining, numbers of personnel will depend upon the ratio between open pit and underground, with open pit which is less labor-intensive expected to dominate in the future.

A survey on energy sector manpower requirements has been completed by the Ministry of Energy Planning Service and is presented in Table 7, "Employment in Coal Production." These manpower estimates are based upon production of 4.5 million tons per year. Using Table 6, "The Steam Coal Supply/Demand Balance", presented earlier, a total production of over 4.5 million tons is projected for 1990.

The employment chart shows that approximately sixteen thousand workers are needed for this volume of coal production and related transport. Manpower increases will be needed in all categories with actual miners representing the largest group. In addition to this projection, additional personnel will be required for coal use at power plants and industries. The manpower study projected a total of almost 500 jobs for power generation needs associated with this tonnage and industrial coal conversions will require additional personnel. It can be estimated, for example, that an average industrial plant will require an additional three persons per shift for coal handling and new coal-fired plants, of course, would represent new employment opportunities.

Table 7

EMPLOYMENT IN COAL PRODUCTION*

	Pre-Project and Project Management	Production Operations and Maintenance	Downstream Logistics	Total
Scientist	205	54		259
Engineer	151	328	28	499
Aides, sci.	14	199		213
eng.	338	195		533
Other prof/techn		93		93
Supervisors, prd/techn		338	7	345
Draftsman	227	50		277
Mining Workers	116	7,476		7,592
Mechanics, Electricians, Plumbers, etc.	173	1,161	10	1,344
Construction workers		282		282
Other production, construction workers	192	1,370	19	1,389
Operators, Eqpmt.	754	917	29	1,700
Other non-techn.	33	849	24	906
TOTAL	2203	13,405	109	15,717

* Based on 4.5 million tons/year.

Source: Ministry of Energy Planning Service Study on Energy Sector Manpower Requirements, 1982.

There are two issues which should be addressed in this program. First, will all these skilled personnel be available as needed; and, second, what types of training could this program provide. Following the list of skills presented in Table 7, it appears that the availability issue is one which can be easily solved. The Philippines has traditionally operated a large number of metal mines, and in these economically poor times, a transfer of personnel from metal related activities to the coal sector can be anticipa-ted.

The subject of training should be addressed specifically by the coal sector component. Following Figure 2, "Identification of Potential Coal Sector Barriers", many major issues which require training have been presented. They include training activities for the specific components such as the following:

- Exploration/Development: How to assemble quantity and quality resource data, how to prepare quality standards, and how to organize a data handling system for easy access.

- Production/Supply: How to plan and finance a mine, how to prepare feasibility studies, how to operate an underground mine safely, and how to beneficiate or prepare quality coal.

- Demand: How to identify markets and market needs.

- Markets/Use: How to handle and use coal at industrial and power sites.

These and similar activities will be explored as potential training items within the total program.

Chapter Three

DESCRIPTION OF PROGRAM ELEMENTS

Introduction to Program Elements

A systematic process of reviewing the Philippine coal sector and identifying ongoing activities and major issues associated with its expansion has been followed. This design process has resulted in a set of five program elements or targets for further development into a national coal program. They include:

- The requirement for coal mapping information to increase development (MAPPING),
- The development of production techniques which yield quality coal (QUALITY),
- The identification and expansion of coal markets (MARKETS),
- The demonstration of appropriate handling and use for indigenous coal (HANDLING), and
- A planning system to establish timing and control over coal sector activities (SYSTEM).

These five targets or elements of mapping, quality, markets, handling, and system now appear to cover all of the major issues which were listed earlier in Figure 2, "Identification of Coal Sector Barriers". In addition, they are general enough to include the training activities which have been outlined earlier in the section on personnel. This chapter will present the five elements and their newly developed activities.

The most attention has been paid to an early startup activity on cement (HANDLING) and the training activities under QUALITY. It appears that this combination of solving the cement problem and assisting the private coal miners in the production of quality the private coal miners in the production of quality coal is the key to successful development of the coal sector.

As a check on coverage of issues, Figure 4, "Development of Coal Program Elements," illustrates how the issues can be grouped to fit the targets. The issues under Logistics and Transport have not been included as program items at this time as they already have strong donor activities and, thus, do not now appear to be good candidates for this program. Since the focus of the program's tasks is on markets, the order of the elements will now be changed with markets identified as element number one.

The following sections include descriptions of each of the elements along with materials on specific activities. In addition, several of the activities have detailed task structures to assist with overall program development.

Figure 4

DEVELOPMENT OF COAL PROGRAM ELEMENTS

Coal Sector Components	Major Issues	Program Targets
EXPLORATION/ DEVELOPMENT	Additional Drilling	(Non-USGS Activity)
	Quantity and Quality Data	Mapping and System
	Quality Standards	Mapping
	Data Accessibility	Mapping
PRODUCTION/SUPPLY	Mine Planning/Financing	Quality and System
	Pre-Feasibility/ Feasibility Studies	Quality
	Mine Personnel	Quality
	Mine Operations	Quality
	Beneficiation	Quality
LOGISTICS	Infrastructure Facilities	(System)
	Capacity	
	Locations	
TRANSPORT	System Projections	(System)
	System Timing	
	Costs	
DEMAND	Markets/Market Needs	Markets and System
	Regulatory Control	System
	Sales/Pricing Practices	System
	Import Competition	Markets
	Solid Fuel Competition	Markets
	Use of CWM	Markets
MARKETS AND USE	Coal Handling	Handling
	Combustion	Markets and System
	Briquettes/Other	Markets
	Environmental Impacts	Markets

Element One. The Identification and Expansion of Coal Markets (MARKETS).

At the present time, as shown in Table 4, "Forecast of Total Coal Demand", most of the coal demand is in the cement industry. Since this is mandated by law, and the conversions are just about completed, there is no need to address this industry as a new market. There have, however, been problems encountered in the conversions which, if left unsolved, will act to slow down future industrial use. The issue, therefore, of the difficulties in the use of coal for cement is addressed separately under the fourth element of HANDLING.

The power sector is presently the second largest user of coal and will become the largest user as Calaca comes on line. Various forecasts have been made for the increased use of coal in power generation as the Naga site at Cebu is increased and new sites in Mindanao come on stream. Similarly, industrial use of coal is anticipated to increase from the present limited use which includes Nonoc Mining Company (MMIC) at Nonoc Island, Atlas Corp. on Cebu, and several smaller installations. Before any plans are developed for marketing strategies, one must first determine where the markets are.

Accordingly, the first activity in this element is to identify the candidate industries; first, from potential conversions and, second, from new installations. Along with the industries, specific technologies including fluidized bed combustion must similarly be evaluated. Then, a more complete marketing program can be developed addressing the specific candidates. There are several approaches which have been used in the past and can be continued. One can examine the boilers themselves and look for potential conversion candidates based upon boiler size; or one can evaluate the industries themselves and look at them economically in terms of expansion potential, availability of capital, and competing solid fuels. Then, the issue of specific locations is also important as there are opportunities for self-generation and/or cogeneration which may be more applicable in some areas than in others. In many cases, detailed analyses are required before the use of coal can be assumed.

Following the identification of candidates, there is a need for close coordination with the fifth program element of system planning, to recognize the role of regulatory practices and sales and pricing practices. The following materials include a list of proposed activities with information dissemination for relevant industrialists and consulting engineers, a training program, for selected engineers, and an industrial demonstration of coal use at a chosen industrial site. If there appear to be enough suitable candidates for coal conversion, the site should be selected as one applicable to as many companies as possible.

One of the issues which has arisen at recent industrial plant tours is the potential use of coal in combination with other solid fuels, specifically agricultural residues including coconut husks. It may prove worthwhile to consider demonstrating a type of grate applicable to a combination of solid fuels including coal.

The issue of various environmental impacts which can be associated with the use of coal has been mentioned at many industrial meetings. Both air pollution from combustion and solid waste and water pollution from ash disposal are items for review and evaluation. Existing environmental regulations must be reviewed to determine how new installations can best meet present and/or future regulations.

SPECIFIC TA ACTIVITIES IN COAL MARKETS

A. General Description

1. Requirement to identify candidate industries with present use of coal

2. Need to develop confidence in use of Philippine coal by Philippine industries

3. Cement problems will be addressed in separate element with early startup activities

4. Similarly, if Calaca problem with Semirara coal is not solved, this too will be addressed with early startup activities

B. Objectives

1. Develop set of growth curves for total use including utilities and industries

2. Encourage expanded use of coal through program activities

3. Identify opportunities for capital-required demonstration(s)

C. Scope of Work

1. Develop specific work plan including activities which cover the three major regions of the country

2. Identify and select appropriate group of counterparts from relevant public and private groups to participate in activities

3. In coordination with Element 5, System Planning, review regulatory practices, sales and pricing practices, and competitiveness with other fuels

4. Identify opportunities for coal use: Based upon conversions and economic growth projections for new installations, consider both use of solid coal and CWM as appropriate

   a. Accept values and projections for utilities from MOE

b. Accept values and projections for cement from cement association

c. Develop set of curves using various assumptions and industries with and without use of CWM

d. Prepare economic format with criteria for selection process

e. Evaluate and select best opportunities for solid coal conversions as target of program element

5. Encourage opportunities

a. Develop list of client industries with names of representatives to participate in activities

b. Organize format and materials for seminars

c. Provide information through seminars

d. Develop on-site training program appropriate for candidate industries

e. Assist with conversions through training program

f. Develop set of criteria including economic analyses to use for demo site selection

g. Demonstrate conversion at one site

h. Evaluate environmental impacts through several site-specific studies

6. Develop set of follow-on activities for industrial use of CWM in accordance with results of Sucat program and CWM

D. Outputs

1. Two counterparts trained in industrial coal conversion analysis and appropriate technologies

2. Group of engineering consultants trained in conversion installations

3. Replicable demonstration of industrial installation designed to show the application of appropriate technology

4. Preview of applicable industries for use of traditional coal fuel and CWM

Element Two. The Requirement for Coal Mapping Information to Increase Development (MAPPING).

At the present time, there does not appear to be a mechanized process for coal resource data collection and storage retrieval. The lack of a process can impede the orderly flow of quantity and quality information needed to locate and establish future mine sites. It is, thus, difficult to determine which data are missing and needed; and concurrently more difficult for potential mine operators to plan their next steps. From a national point-of-view, it becomes a tedious process to identify mining alternatives and develop a coal sector strategy.

Several types of TA activities can overcome many of these deficiencies and also provide the long-term training required for more appropriate data management. The following materials on a Coal Resource Inventory include three proposed activities: Coal Resource Assessment, Coal Quality, and Coal Data Management System. Scopes of work are provided to accomplish the following items:

- Institution building;
- Assessment of existing data;
- Training in resource assessment, data computerization, and data management;
- Development of quality standards procedures; and
- Provision of a resource systems management framework.

Successful completion of the proposed TA activities will lead to a long-term national resource strategy for planning, policy, and decision-making.

SPECIFIC TA ACTIVITIES IN MAPPING

Coal Resource Inventory (USGS)

Effective growth of coal production in the Philippines can be significantly enhanced and be made more responsive to market growth if the country's coal resource inventory is up-to-date, detailed and uniform, and readily accessible and otherwise modernized to increase its credibility. This modernization will be achieved by development of:

1. A new national coal quantity and quality evaluation;
2. National standardization for coal sample collection, handling, preparation, analysis; and
3. A coal data management system to store, retrieve, manipulate and make available all of the collected coal geology, resource, reserve,

chemical and physical data and other engineering and sociological information.

Scope of Work

Specialists in coal resource assessment, geochemistry of coals, and computerization and mineral resource data systems will provide technical assistance to the Government of the Philippines (GOP) through work with, and training of, GOP and academic and private sector counterparts to achieve the goals of the three specific, but interrelated, elements that are responsive in aggregate to the objectives above. The results will provide a basic planning tool for further exploration, development, extraction, and utilization of coal resources in the Philippines and a basic public technical data source and set of practices upon which a Philippine coal industry can depend and rely in the formulation and implementation of its coal mining projects, in the commercial transactions of sale and purchase of coal supplies, and in prediction of the effect on the society of the Philippines.

Specific Tasks (USGS)

Activity I - Coal Resources Assessment of the Philippines

1. Estimate the quantity of coal resources in the fields, districts, basins, and provinces of the Philippines.

2. Evaluate and integrate all parts of the final report on coal resources with emphasis on relationship of scientific, engineering and sociological truths and interrelationships.

3. Interpret the tectonic relationships of the Philippines with emphasis on their impingement on coal resources distribution, extraction, and utilization.

4. Gather, organize, and integrate the known data on quality of Philippine coal.

5. Evaluate the quantity and quality relationships of Philippine coals and their effect on potential markets and utilization.

6. Interpret quality of coal data from the environmental and utilization standpoints.

7. Gather, organize and interpret pertinent statistics on mining and production and evaluate their relationship to future activities. Examine infrastructure relative to potential future exploration activities. Consult with and integrate findings of experts in development relative to people resources necessary for mineral resource development.

8. Organize and prepare data for entry into coal data management systems so as to ensure retrieval in multiple manipulated forms for future management use.

9. Train two or more geologists for several months in U.S. so that future coal resource studies can be conducted and coordinated by GOP personnel.

Activity Two - Philippines Coal Quality

1. Establish and implement procedures for identifying, organizing, documenting, verifying, and computerizing existing coal quality data.

2. Establish and publish written standards for the collection and geologic documentation of all exploration and production coal samples.

3. Establish and publish written standards for packaging, handling, and shipping of coal samples derived from exploration and production activities.

4. Establish and publish written standards for grinding, crushing, pulverizing, sizing and splitting of exploration and production coal samples submitted for chemical analyses.

5. Establish and publish written standards for analyzing exploration and production coal samples including ultimate and proximate analyses, heating value, ash fusion temperatures, coking properties, forms-of-sulfur, Hardgrove grindability index, and major, minor, and trace element concentrations.

6. Establish inter- and intra-laboratory quality control procedures for all analytical laboratories.

7. Establish standard reporting scheme which states the confidence limits for analytical determinations and provides the reporting format for all chemical determinations.

8. Establish procedures for computerizing all new chemical and physical data on Philippine coal and for making these data available to all users.

9. Establish training program for chemists and geoscientists to become familiar with all written standards, analytical methods, and sample collection and preparation procedures. Train four to six geochemists and chemists for several months in US.

10. Establish procedures for exchange, collection, and analysis of 20 to 30 Philippine exploration coal samples per year with USGS.

Activity Three - Coal Data Management System

1. Develop coal resource classification scheme with Philippine government requirements.

2. Define and prioritize data bases to be developed with GOP requirements.

3. Define data sources and responsibilities with GOP and develop system flowchart.

4. Define data elements and associated internal computer storage format to be included in the five data bases listed below, including development and installation of prototype.

5. Define and install coal geology DBMS and graphics/mapping and analysis software on VAX 11-780.

6. Develop data entry format/software on available micros for:

   a. stratigraphic/geologic data base
   b. analytical/coal quality data base
   c. resource inventory data base
   d. production inventory data base
   e. utilization data base
   f. infrastructure including sociological inputs

7. Develop interfaces from existing micro computers (e.g. Cebu data base on Osborne) to VAX and provide user documentation.

8. Training in use of data base system and analysis software for general users (in Philippines only).

9. Training in design and installation of new data bases; e.g., mine plans, logistics, marketing, and all software and technical support for GOP Energy EDP group in Philippines and four or more counterparts in periods of one month at a time in the US.

Element Three. The Development of Production Techniques Which Yield Quality Coal (QUALITY).

In the short-term, most coal will be sold and used as run-of-mine (ROM) coal. If the immediate problems of Calaca and the cement plants are not solved shortly, however, there will be a very limited market for this ROM coal, even in the short-term. In the long-term, there will definitely be a need for quality coal in order to meet the potential for expanded coal markets.

The production of quality coal includes more attention to the mining techniques and more consideration of coal preparation alternatives. The purpose of coal preparation is to improve the quality by, (1) cleaning it to

remove inorganic impurities, (2) sizing it through crushing or screening or both, or (3) using special treatments such as dedusting. Preparation can be very simple with crushing and sizing only, or very complex where all size fractions are processed by gravity separation and deep cleaning through flotation. The concept of improving quality generally includes removing the ash constituents and the sulfur-bearing minerals in order to produce a constant quality, higher BTU value coal with less need to resolve ash and sulfur problems after combustion.

It should be noted that the use of coal in producing cement is a different issue in terms of quality requirements for kilns and, therefore, coal in cement making is discussed separately in the fourth element, HANDLING.

Both coal mining and coal preparation activities contribute to the production of quality coal and, therefore, TA activities must address both sides of the problem. A set of suggested TA activities designed to improve the production of quality coal is included in this section. These activities result from a review of all steps included in mine planning and operation from the development of feasibility studies to attract financing through to the beneficiation alternatives for coal preparation.

One proposed TA activity, Evaluation of Philippine Coal Beneficiation Alternatives, is unique in that it is considered important as a coal program startup activity and, therefore, is discussed first. The proposed TA activities include the following:

- Evaluation of Philippine Coal Beneficiation Alternatives,
- Training in Completion of Coal Mine Feasibility Studies,
- Training Program in Underground Coal Mining including Mine Operation and Safety and Health,
- Training Program in Cost Accounting for Underground Coal Mining, and
- Training Program in Coal Preparation and Handling (Beneficiation).

All activities in this Coal Quality Element, except the first startup activity, are training programs, because the concepts of the need for and the production of quality coal are new in the Philippines and are best understood through training.

SPECIFIC TA ACTIVITIES IN QUALITY OPERATION AND PRODUCTION

I. EVALUATION OF PHILIPPINE COAL BENEFICIATION ALTERNATIVES

A. General Description

There is an important requirement in the coal sector for an understanding of mining and preparation techniques which lead to the production of quality coal. Two activities are proposed to cover this need. The first is a short

startup activity to assist with the present use of coal for cement and power plants. The second is a more in-depth activity including training planned to occur later in the program which is described as Training in Coal Preparation and Handling. The first startup activity is described here.

In order to solve some of the immediate handling problems which are occuring with cement and power plant operation, it is recommended that standardized beneficiation procedures be established for two or three coals which are encountering market resistance. These could include Semirara and others as appropriate.

B. Objective

Develop a standardized beneficiation process or processes applicable to Semirara and one or two other coals as required in order to assist the coal mining companies with the production of a uniform quality coal output with maximum coal recovery.

C. Scope of Work

1. Select two or three coals which are major fuel sources at the present time and encountering difficulties in meeting cement plant and/or power plant requirements.

2. Select US institution or consulting company with appropriate experience in coal beneficiation to prepare program of work which results in determination of set of procedures for each coal's beneficiation to meet market requirements.

3. Prepare and follow test procedure such as the enclosed diagram for each submitted coal. Sample of each coal should be approximately 600 kg or one drum.

4. Complete test work with analyses, calculations, recovery curves, etc., to determine preferred flow sheet for each submitted coal.

5. Prepare technical and financial plan for implementation of suggested beneficiation program for each coal.

D. Output

1. Set of optimized beneficiation procedures for each submitted coal.

II. TRAINING IN COMPLETION OF COAL MINE FEASIBILITY STUDIES

A. General Description

In developing coal mining projects, a number of phases are involved which can be summarized as follows:

- The deposit is discovered by geologists and others doing field work with probably only a few drill holes.

- These data often reveal that the discovery looks promising and that further additional work to develop the project is justified.

- Such work usually consists of a systematic drilling program on a grid system, analysis of samples, test work on samples (Heavy Media tests on small samples) and a more thorough study of geology.

- The data from the above are analyzed and, if it appears that there are several millions of tons of a potentially mineable and valuable resource, then a feasibility study is required.

- The feasibility study will estimate the economics and potential profitability of a project based on this resource.

- If the results are favorable (usually at least a 15 percent rate of return), then the report would state to go ahead; and the report would then be used to convince bankers and others to provide funding.

- Also, the report could show the project to be marginal and additional drilling be done to locate additional reserves, or describe other properties. Also, the report could be negative and then the project would be put on hold until some important factor changes.

A feasibility study consists of the following major segments:

- Assessment of reserves - quantity and quality and determination of a project size.

- Determination of a mining method and its investment and operating costs.

- Need for a washing plant and its components and investment and operating costs.

- Assessment of present and future markets for the product and probable product prices.

- Assessments of transportation costs and probable FOB mine value of the coal.

Information from all of these studies is put together in a tabular form for a 25 - 30 year projection of the operation to determine the probable cash flow and potential profitability.

B. Objective

1. Prepare Filipinos to carry out mine feasibility studies.

C. Scope of Work

- Prepare work plan and designate instructors for training and carrying out feasibility studies and a financial analyst with computer experience.

- Select 10 - 12 Filipino candidates for training program from mining companies with mining engineering and financial analysis capabilities. Marketing assistance could come from Element One.

- Program could consist of case studies at coal deposit sites in the pre-development stage. Each would include a set of steps such as the following:

  a. A visit to the field where the deposit is located to see the site and obtain maps, reports, analyses and all pertinent data. Also, discussions with the geologists and engineers who did the exploration on the deposit are needed. This is done by the mining engineer consultant and the 5-6 Filipino mining engineering counterparts. Time required is one week.

  b. With the data obtained, assess the reserves, devise mining plans, estimate a tonnage to be mined, calculate mining equipment costs, mine operating costs, surface facilities required and their cost, and assess the desirability and need for a washing plant and its investment and operating cost. Also, prepare tables of the proposed construction schedule, depreciation schedule, management requirements and costs, etc. This would require about seven weeks and would be jointly accomplished by the mining engineering candidates under the guidance of the consultant.

  c. While the above is being done by the mining group, the financial/computer expert will be working with his 5-6 Filipino counterparts to learn the financial aspects of the study and to prepare cash flow computer programs for mining situations. Also, devise computer programs for ore reserve calculations and summations.

  d. A final get-together of both teams to prepare the complete 25-30 year projection of the feasibility of the project which results in a final report. This requires the last month.

D. Outputs

1. Set of 10-12 trained analysts.

III. UNDERGROUND COAL MINING: TRAINING PROGRAM IN MINE OPERATION, SAFETY AND HEALTH

A. General Description

Coal production has increased over the years, rising to 557,983 MT in 1982. Privately owned mines contributed 74 percent of this production. In 1982, 78 percent of the production was from underground operations. Most private mines are small (10-100 ton/day). Mining technology ranges from "gophering" (Camote Mining) in the small mines to a hand operated longwall operation at Malangas, operated by PNOC:CC (800 MT/day). The bulk of the coal in the Philippines is low quality (lignite and sub-bituminous) and usually occurs in thin seams that can be difficult and costly to mine.

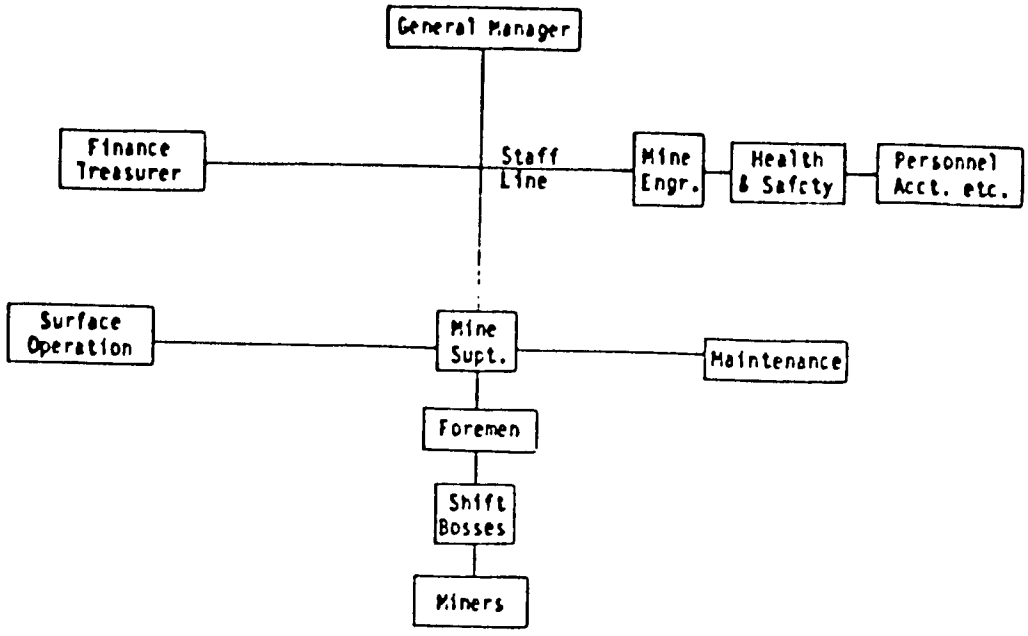
In 1981, about 90 percent of the coal produced was from underground mines; but since many developing coal mines will be open-pit, production from underground mines will drop to about 40 percent by 1986, and 20 percent by 1990. Production from underground mines, however, will expand and the number of underground mines and miners employed will increase. Hence, there will likely be a continuing need for underground miners and specialists in all phases of this industry.

In 1982, there were about 7,500 employees in underground coal mines in the Philippines. Of this amount, perhaps 3,500-4,000 are engaged as actual underground miners. Knowledgeable people in the industry believe that underground coal production will likely double in about 15 years; hence, there will be a continuing need to provide and train about 250 new miners per year. Smaller numbers of engineers, shift bosses, and health and safety men will be required.

Another important fact about the Philippine mining industry is that there is an existing base of experienced underground miners from the metals industry which is at low production and not likely to improve substantially. These miners would require only a brief orientation and training to be taught the changes and important differences related to underground coal mining.

Because of the nature of Philippine coal deposits amenable to underground mining (thin seams - steeply dipping - often fractured) only certain mining methods are applicable and underground miners should be trained in those particular methods. For example, it would be futile to train miners to operate continuous miners, shuttle cars, automated longwall systems, etc., since such practices will not likely ever be used in Philippine underground coal mines. The methods can consist of room and pillar and longwall systems on seams that do not dip severely (0-20°) to chute and battery and breast and pillar systems in steeply dipping seams. The need is to stress hand operated systems with as much mechanization as is possible. These systems, with the proper design and operation, can provide safe and productive mines.

The proper and safe operation of underground coal mines requires an organization of competent trained people of various types. A simplified organization chart is as follows:



B. Objectives

1. Train personnel for the operation of underground coal mines.

2. Train foremen, shift bosses, engineers, and miners in health and safety practices.

C. Scope of Work

1. Prepare work plan and designate instructors for training program using one experienced underground coal mining engineer and one coal mine health and safety expert. It is recommended that there be visits to a number of underground coal mines to determine the details of the training needed, the numbers of individuals to train, location(s) of training centers, specific details of curriculum, course timing, etc. It is anticipated that the indoctrination course could run for one month, the advanced course for three months, and the health and safety course for two months.

2. Select candidates for all three courses. There is a need for approximately 250 newly trained miners per year, approximately 100 foremen and shift bosses, and approximately 10 health and safety individuals. Select Filipino counterparts to participate in health and safety course and to become health and safety representatives upon completion of training program.

It is understood that training is required for the spectrum of technical people needed in the underground parts of this organization. Hence, training is needed for foremen, shift bosses, miners, and health and safety people. This can be accomplished by having a series of three courses which are progressive and increasingly more intense to be taken by different categories of personnel. These would be as follows:

a. Orientation/Introductory Course: To be taken by all candidates and the only course for miners. Course could last approximately 3-4 weeks and consist of lectures, films, discussions, demonstrations of equipment, etc., to cover the following areas:

- Nature of underground coal mines and differences with hard rock mines. General geology, etc.
- Problems peculiar to coal mines (methane gas, bad roof conditions, explosions, dust, etc.)
- Underground method of mining adoptable to Philippine mines. General way of mining, equipment used, etc.
- Discussions of how to mine safely, how to work safely, how to recognize problems, conditions to be aware of, etc.

After taking this course, miners, many of whom would have had hard rock underground experience, would be assigned to mines where they would start work underground for several months working with an experienced miner. They then can work as trained miners.

b. Advanced Course: For candidates to become mine engineers, foremen, shift bosses, and health and safety men. To last approximately three months and consist of lectures, discussions, demonstrations, case studies, etc. To cover the following areas:

- A more detailed study of subjects discussed in the first course.
- A case study of a typical mine, how it is developed, engineering decisions to make, how design is made, etc.
- Mine surveying and engineering.
- Design of ventilation systems (air flow principles, quantity needed, tons, etc.).
- Mine drainage, water influx, pumping, etc.
- Roof and ground control.
- Electrical systems and problems.

This course would complete the training of engineers, foremen, and shift bosses.

c. Special Course: A final specialized course for candidates to be health and safety engineers. To last on the order of two months. Will consist of a detailed study of underground coal mine health and safety and cover the following:

- Mine environment - gases, health hazards, etc.
- Mine accidents - causes, prevention, etc.
- Methane detection and control, explosive limits of methane and air, etc.
- How to gather, summarize and interpret accident statistics.
- How to set up and operate a safety department.
- How to handle accidents and make plans for mine rescue, etc.

D. Outputs

Sets of trained individuals as identified in specific training courses.

IV. TRAINING FOR COST ACCOUNTING

A. General Description

Cost accounting for a coal mine is no different than accounting for a regular business, except that different cost and expense categories are required. In addition, an understanding of reserves and the depletion of a non-renewable resource and how these are costed is necessary. It appears that 10-15 students per session could be accommodated. Hence, 20-30 candidates could be trained in two sessions. This should be adequate to initiate a coal cost accounting capability in the Philippine coal industry.

B. Objective

1. Train Filipino accountants from government agencies, mining industry consulting companies, and private coal mining companies in techniques of coal mine cost accounting systems.

C. Scope of Work

1. Prepare work plan and designate US specialist(s) in coal mine cost accounting.
2. Select 10-15 Filipino accountants who would be willing to return to their respective companies and establish coal mine cost accounting systems and then train others in the use of the systems.

3. Program could consist of the following:

   a. One week of lectures, discussions, and explanations of coal mine cost accounting systems.

   b. A second week of carrying through a case study of an actual coal mine cost accounting practice.

D. Outputs

1. Set of 10-15 trained coal mine cost accountants.

V. TRAINING IN COAL PREPARATION AND HANDLING

A. General Description

One of the major problems with regard to the utilization of indigenous Philippine coal is the matter of coal quality. The majority of the coal in the Philippines is of a sub-bituminous or rather poor quality, with a few exceptions such as the Malangas bituminous coal of good quality, the lignite at Cagayan of poorer quality, and the better quality Cebu coals. In most of the other areas including Semirara, Mindoro, Samar, Mindanao-Bislig-Lianga, the coal is of sub-bituminous quality.

A second problem with the quality of many of these coals is that they have in-seam partings and impurities so that when the whole seam is mined, as is necessary, the product is of poorer quality than the pure coal portions of the seam. A third problem has to do with waste introduced by the mining technology. Generally, careful mining can usually produce clean coal, seam material, only. However, in the Philippines, it appears that this is a problem; for instance, bucket-wheel excavation in Semirara, unless carefully controlled, will dig into the waste below the seams. Also, it is not known if the top of the seam is cleaned before digging. At Malangas, a good deal of waste goes into the ROM product, but is washed out in a jig washing plant. The result of all these problems is that the quality of coal from the Philippine mines is, at times, extremely variable and can cause complaints from customers and users.

One solution to these problems is to process, wash-beneficiate-clean, etc., the ROM coal to produce a cleaner and more consistent product. Coal cleaning can be, and often is in various parts of the world, a processing technique consisting of numerous stages of sizing, separations of coal and waste, and handling and preparation of products. General practice involves crushing, sizing into coarse, medium, and fine sizes and handling each size by a different and special separation technique, best suited for that size. Using all three steps is called "deep" cleaning and modern plants using these techniques often recover 95 percent of the coal in high quality products.

Cleaning of low quality coals is difficult to do with high recoveries of the coal. It is easy to wash these coals and remove mining waste. Improve-

ments could be made, however, and qualities could be improved as well as recoveries if fine sizes were separated and processed. There is some information about what washing will do with Philippine coals as follows:

1. Unong Coal, Semirara Small-Scale Test Work

From a 23.6 percent ash feed coal, simple cleaning, separation of -1mm, would result in a 14.5 percent ash product with an 82.8 percent recovery. Further separation of waste and coal at two sizes would recover 66.6 percent in a product with 8.2 percent ash. Similar results would be expected on other Semirara coals. No work has been done on testing and devising the best cleaning process. No one, for example, has evaluated flotation on the fine fraction, or heavy media separation (HMS) cyclones or other processes for recovering coal from fine sizes.

2. Malangas Coal

A jig washing plant is operated at the Malangas mine which makes a crude separation on coarse sizes of material. It easily separates rock (S.G. 2.8) from coal (S.G. 1.3-1.5), but is not efficient and does nothing on medium or fine sizes. The recovery at Malangas is ±75 percent. Much coal is lost in the 25 percent rejects.

3. Work was done on processing Cebu coals in a central washing plant (Norwest Study) and was shown to be successful. Nothing has happened to implement this project at this time.

B. Objectives

1. Inform Filipino coal producers including public and private sector coal mine engineers, plant managers, and management personnel of the need for producing quality coal.

2. Train Filipino coal producers in the use of available techniques for both mining and beneficiation.

C. Scope of Work

1. Two week training program including lectures, discussions, films, etc.

First week: General discussions of coal preparation.

- Reason(s) for need for coal preparation
- Examples of flow sheets and what they accomplish
- Discussion of what one might expect from washing of Philippine coals
- Incentives needed by the coal industry to do preparation and washing

- Coal handling -- generally practice problems and how they are controlled. Specific examples and particular problems with Philippine low quality coals

- Environmental impacts associated with coal preparation alternatives

Second Week: More detailed technical discussion of coal preparation and handling processes and applications.

- Detailed discussion of coal testing and evaluation of Heavy Media Separation (H.M.S.) test work

- Preparation of washability curves and their interpretation

- Design of plants from washability data

- Selection of equipment and discussion of individual parts of flow sheets

- Discuss and show different flow sheets and what they accomplish with different coals

- Discussion of how to make investments and operating costs

- Coal Handling -- details of handling, stock-piling, reclaiming and transportation systems, dust, wet coal problems, lignite storage, spontaneous combustion, etc.

- Environmental impacts -- discussion of ameliorative steps

2. Set up a test program where Philippine coals could be tested. Depending upon the outcome from the first activity, three or four different samples could be sent to a facility such as the EPRI Coal Cleaning Test Facility at Homer City, Pennsylvania or an appropriate private company site. This procedure would test Philippine coals in order to determine an appropriate set of preparation procedures.

The potential for particular washing plant flow sheets on any coal can be determined by sampling and by float and sink analyses and flotation tests on various fractions of each sample. Such tests are usually performed on every exploration drill hole sample. Coal washability studies are conducted to determine how much coal of what quality can be produced at a given specific gravity and with what separation difficulty. In other words, one determines what the separation gravity should be for a desired coal quality. It is generally known that as coals decrease in rank, they become more difficult to clean and still obtain improved quality products and good coal recoveries.

3. Send Filipino coal producing engineers to coal cleaning facilities such as the one at Homer City in order to see how they operate and what they can accomplish.

D. Outputs

1. Training program would produce group of 20-30 individuals with understanding of technical and economic aspects of appropriate coal mining and preparation techniques.

2. On-site testing at US facility would permit selection of appropriate set of preparation techniques for specific Philippine coals.

3. US visit would permit group of 3-5 Filippinos to have thorough understanding of appropriate coal preparation techniques for Philippine coals.

Element Four. The Demonstration of Appropriate Handling and Use for Indigenous Coal (HANDLING).

The technical assistance activities in this element are different from the others previously discussed, as two and possibly three are startup activities. In other words, this element of coal handling and use is so important to meeting the country's goal of expanded coal use that it must be considered early. Ongoing use of coal by both the cement plants and power generation has been replete with many problems, leading to a lack of confidence in Philippine coal. In order to overcome what has been seen as a hesitation to both continue and expand its use, a set of early activities is planned.

Two items in particular are recommended at the start. The first is a cement plant project designed to define the ongoing difficulties that the majority of plants are encountering with their pulverizers and set in motion a solution or set of solutions, as required. An outline of possible work steps is presented in this section.

The second proposed startup activity is a review of the ongoing use of Semirara coal at the Calaca power plant. There are difficulties in the combustion of this coal related to the design of the power plant which appear to prohibit the required production of 300mw of power. When this national coal program is more completely defined, it would be appropriate to consider an activity designed to ameliorate Semirara coal use at Calaca including either the handling or the combustion, or both. There may be steps that can be taken to smooth the path to successful combustion at Calaca. Semirara coal is presently burned in a small power plant on the Island of Semirara to pro-vide local power for the mine, and it may be possible to adapt some of the coal handling procedures utilized on the Island to the plant at Calaca. Both of these startup activities are designed to ease the transition process from oil to coal for the cement and power industries.

At the present time, there is an ongoing companion AID project which is evaluating the introduction of Coal Water Mix (CWM) to the Philippines through the retrofitting of the Sucat power station. If it appears that there are specific industrial opportunities for use of this fuel which might relate to the retrofitting of Sucat, they could be evaluated as part of the overall

national coal program. CWM may offer retrofit potential to major Philippine industries.

SPECIFIC TA ACTIVITY IN HANDLING

Startup Activity for Cement Plants

The government-mandated conversion of all cement plants from oil to coal had started to provide a significant market for Philippine coal in Luzon, the Visayas, and in Mindanao. During the past year, however, difficulties encountered in handling and grinding the Philippine coal have resulted in increasing imports of foreign coal with a subsequent decrease in the use of Philippine coal.

Oil to coal conversions in the cement industry were required as a significant opportunity of minimizing foreign exchange expenditures. The yearly use of approximately one million MT of coal by the country's 17 cement plants replaced approximately 3 million barrels of oil with a yearly foreign exchange saving of over $80 million. More recently, however, imports of coal from Australia, Canada, and the Soviet Union for the cement plants have allowed the expansion opportunities for the Philippine coal mines; thus, decreasing the foreign exchange savings originally promised by the oil to coal conversions.

Recent imports for the cement industry, for example, of coal ranging in price from $40 to $43 per MT have provided stockpiles of up to 500,000 MT at a foreign exchange cost of over $20 million. In addition, these imported coal shipments represent lost job opportunities for Filipino coal miners.

SOLUTION. At a representative meeting of the cement industry held last November, 1984, it was suggested that there were technical alternatives available for the cement plants which would minimize the problems associated with the handling and grinding of Philippine coal.

These technical alternatives to facilitate the use of Philippine coal can be prepared and discussed at a workshop for the cement industry. A series of six steps is proposed for the first phase.

One. Prepare general meeting for the cement industry to discuss issues and suggested approach.

Two. Review coal mining and transport procedures to establish nature of activities affecting surface moisture content and other properties which relate to handling and grinding problems.

Three. Visit appropriate number of cement plants to determine precise nature of problems relating to use of Philippine coal.

Four. Collect and analyze available data to develop range of technical alternatives with estimated capital and operating costs.

Five. Prepare brief report for cement plants suggesting technical and financial means for implementation of alternatives to solve coal problems.

Six. Develop workshop and present report with proposed solution to cement industry.

These steps concluding with a cement industry workshop will start a process of handling and grinding changes designed to facilitate the use of Philippine coal by the cement industry. A second capital requiring phase including one or more retrofit demonstrations can be considered after this first phase is completed.

CONCLUSIONS. The preparation of a workshop delineating technical alternatives to the problems the cement industry are encountering can expand the Philippine coal market. This will reduce coal imports with their high foreign exchange requirements and accelerate the development of new coal mines which will provide additional jobs in the rural coal areas. Similarly, sales of one million MT of indigenous coal to the cement industry will result in the distribution of over 700 million pesos to the rural economy.

Element Five. A Planning System to Establish Timing and Control Over Coal Sector Activities (SYSTEM).

The Republic of the Philippines has set objectives in its national energy plan to provide adequate, timely and secure energy supplies with the use of indigenous resources and environmental acceptability. As has been noted earlier, there is an existing coal market which is anticipated to expand. It primarily includes the use of steam coal for both the power and industrial sectors. At the start, this implies a choice between two different sets of market needs, namely electricity and cement. Next, the use of coal for electricity generation within a region competes with other thermal, hydro, geothermal, and nuclear options. Finally, individual coal mines producing in some cases somewhat different quality coal compete with each other for coal markets. Setting these coal use opportunities in an economic framework of pricing and sales practices, technical unfamiliarity with market needs, regulations and subsidies, and internal/external fuel source competitiveness, and the requirement for national investment opportunity information becomes quickly apparent. From the coal point-of-view, with limited available capital, one should understand market priorities for coal mine development.

Three sets of activities are suggested. The first is definition, collection, and evaluation of the data required for system development. These include both the mine and market inputs in an appropriate time frame. The second is the production of computerized programs which will permit evaluations of alternative coal mine development schemes to fit market projections. Coal mine variables including development time and quality requirements must be included. The third activity includes the testing of the system using financial variables to encourage or discourage the action requirements. At

this time, it is recommended that the Luzon grid be used as an example of the system for this planning process.

* * * * *

These five elements are now recommended as the basis for a national coal sector program. With the proposed activities as outlined in Figure 5, "The Technical Assistance in Coal Development Program: Elements and Activities", the program now provides a response to the barriers identified earlier and meets the Phillipine's strategic requirements for increasing coal production.

Figure 5

THE TECHNICAL ASSISTANCE IN COAL DEVELOPMENT PROGRAM:
ELEMENTS AND ACTIVITIES

One. Identification and Expansion of Coal Markets (MARKETS)

- Review of Present Coal Use Impediments
- Identification of Candidate Industries for Coal Conversion
- Coal Conversion Seminars
- Coal Conversion Training Program
- Industrial Demonstration
- Environmental Impact Review

Two. National Coal Mapping (MAPPING)

- Coal Resource Assessment
- Philippine Coal Quality Standards
- Coal Data Management System

Three. Production of Appropriate Quality Coal (QUALITY)

- Evaluation of Beneficiation Alternatives
- Coal Mine Feasibility Studies
- Underground Coal Mining: Training Program in Mine Operation Safety, and Health
- Underground Coal Mining: Training in Cost Accounting
- Training in Coal Preparation and Handling

Four. Coal Handling and Use (HANDLING)

- Cement Plant Demonstration
- (Calaca Power Plant)
- (CWM Industry Use)

Five. System Planning (SYSTEM)

- Analytical Structure for Comparison of Coal/Other Fuels
- Alternative Strategies for Sequence and Timing of Development of Coal Fields with Computer Programs
- Institutional Evaluation of Coal Development Schemes

Chapter Four

MANAGEMENT AND TIMING OF PROGRAM ELEMENTS

A set of five elements has been proposed as the basis of this program. The set includes:

- The identification and expansion of coal markets (MARKETS),
- The requirement for coal mapping information to increase development (MAPPING),
- The development of production techniques which yield quality coal (QUALITY),
- The demonstration of appropriate handling and use for indigenous coal (HANDLING), and
- A planning system to establish timing and evaluation for coal sector activities (SYSTEM).

In addition, each of the elements has its own set of technical assistance activities designed to accomplish specific objectives as shown in the last chapter.

Public and Private Participants in Coal Sector

Three major groups must be recognized as participants in any coal sector activities. They include the Ministry of Energy with its specific divisions, the various public and private coal mining companies with their representatives, and the many present and potential industrial users with their trade groups. Accordingly, these groups have been considered as probable "clients" for the many program activities and the program activities have been designed to fit their needs. Figure 6, "Relation of Program Activities to Clients", illustrates these groups and their relation to the program.

Within the Ministry of Energy there are four specific groups who will play key roles in this program. They include the Planning Service who will participate most closely with Element Five, the Planning System; the Bureau for Energy Development who serves as the client for Element Two, the Coal Mapping Program; and the Bureau for Energy Utilization who will participate in both Element One, the Identification and Expansion of Coal Markets, and Element Four, the Demonstration of Appropriate Handling and Use.

The fourth group within the Ministry of Energy is the PNOC Coal Corporation which has already been assisting with industrial coal conversions, and has been assuming responsibility for the provision of coal, as well as for actual mining. Although their mandate for providing coal has become limited in this past year, they can best serve as one of the clients for the first element on Markets, the third element on Quality Production, and the fourth element on Handling and Use.

Figure 6

RELATION OF PROGRAM ACTIVITIES TO CLIENTS

Elements and Activities	Public/Private (P/P) Participants
One. Identification and Expansion of Coal Markets	
- Review of Present Coal Use Impediments	All Participants
- Identification of Candidate Industries for Coal Conversion	PNOC:CC & P/P Industry Groups
- Coal Conversion Seminars	P/P Industry Groups
- Coal Conversion Training Program	PNOC:CC, BEU, P/P Ind. Grps. & Cons. Eng.
- Industrial Demonstration	PNOC:CC, BEU, P/P Ind. Grps. & Cons. Eng.
- Environmental Impact Review	PNOC:CC, BEU, P/P Ind. Grps. & Cons. Eng.
Two. National Coal Mapping	
- Coal Resource Assessment	MOE:BED
- Philippine Coal Quality Standards	MOE:BED & P/P Coal Prod. and Coal Laboratories
- Coal Data Management System	MOE:BED & P/P Coal Prod.
Three. Production of Appropriate Quality Coal	
- Evaluation of Beneficiation Alternatives	BED, P/P Coal Producers
- Coal Mine Feasibility Studies	Private Coal Producers
- Underground Coal Mining: Training Program in Mine Operation, Safety, and Health	BED, P/P Coal Producers
- Underground Coal Mining: Training in Cost Accounting	BED, P/P Coal Producers
- Training in Coal Preparation and Handling	BED, P/P Coal Producers
Four. Coal Handling and Use	
- Cement Plant Demonstration	PCIA & Cement Companies
- Calaca Power	P/P Coal Prod. & NPC
- CWM Industry Use	PNOC:CC,BEU, P/P Ind. Grps. & Cons. Eng.
Five. System Planning	
- Analytical Structure for Comparison of Coal/Other Fuels	MOE: Planning Service
- Alternative Strategies for Sequence and Timing of Development of Coal Fields (Computer Programs)	MOE: Planning Service
- Institutional Evaluation of Coal Development Schemes (Prioritization)	MOE: Planning Service

In addition to the actual coal mining companies, there is a strong trade association to participate in the program, the Philippine Chamber of Coal Mines (PHILCOM). The public and private companies as well as PHILCOM are clients for Element Three, the Production of Quality Coal. In particular, the startup activity of Beneficiation Alternatives is designed for these groups.

Similarly along with the present and future coal-using industrial companies in cement, metals, sugar, wood, food, and textiles, there are the many trade organizations such as the Cement Authority, the Coconut Oil Processors, and the Sugar Commission. These groups will be clients of the First Element of Markets and the Fourth Element of Handling and Use with particular attention to the startup activity for the cement plants. All of these trade groups, both coal producing and coal using, have been contacted and are aware of the potential program and strongly wish to participate in its activities.

Project Management

In order to further define the program, a management structure is needed to meet the operating requirements of both the donor group and the prospective clients as previously identified. At this time, it is anticipated that a contractor will be selected capable of providing both long- and short-term personnel to fulfill the program requirements. Figure 7, "Program Client Structure", illustrates a relationship among the program's clients and the future contractor. This proposed structure is based upon participation by all the groups identified as clients, and it is anticipated that project management will be carried out by an advisory council made up of specific representatives from each of the groups.

Project Time Schedule

The overall program consists of activities or groups of activities under the five elements of markets, mapping, quality, handling, and system. In many cases, specific activities fit in more than one element, but for simplicity's sake, they are shown only in one category. The activities are grouped by phase as shown in Figure 8, "Flow Diagram of Program Elements."

At this time, several activities are proposed as startup activities designed to overcome the lack of confidence in Philippine coal. These three (and possibly four) activities are considered in a separate phase designated as Phase 0. They include the Cement Plant Demonstration, the Review of Coal Use at Calaca, the Evaluation of Beneficiation Alternatives, and the potential activity, A Review of Present Coal Use Impediments to update the actual coal use situation at the start of the program.

Then, there are three phases which follow designed to cover a two and one-half year time period. All of the sets of activities are balanced in terms of their respective clients in order to establish a pattern of continuity over the full time period. Consequently, there is always an ongoing level of activity with the three major clients: the Planning Service of the

Figure 7

PROGRAM CLIENT STRUCTURE

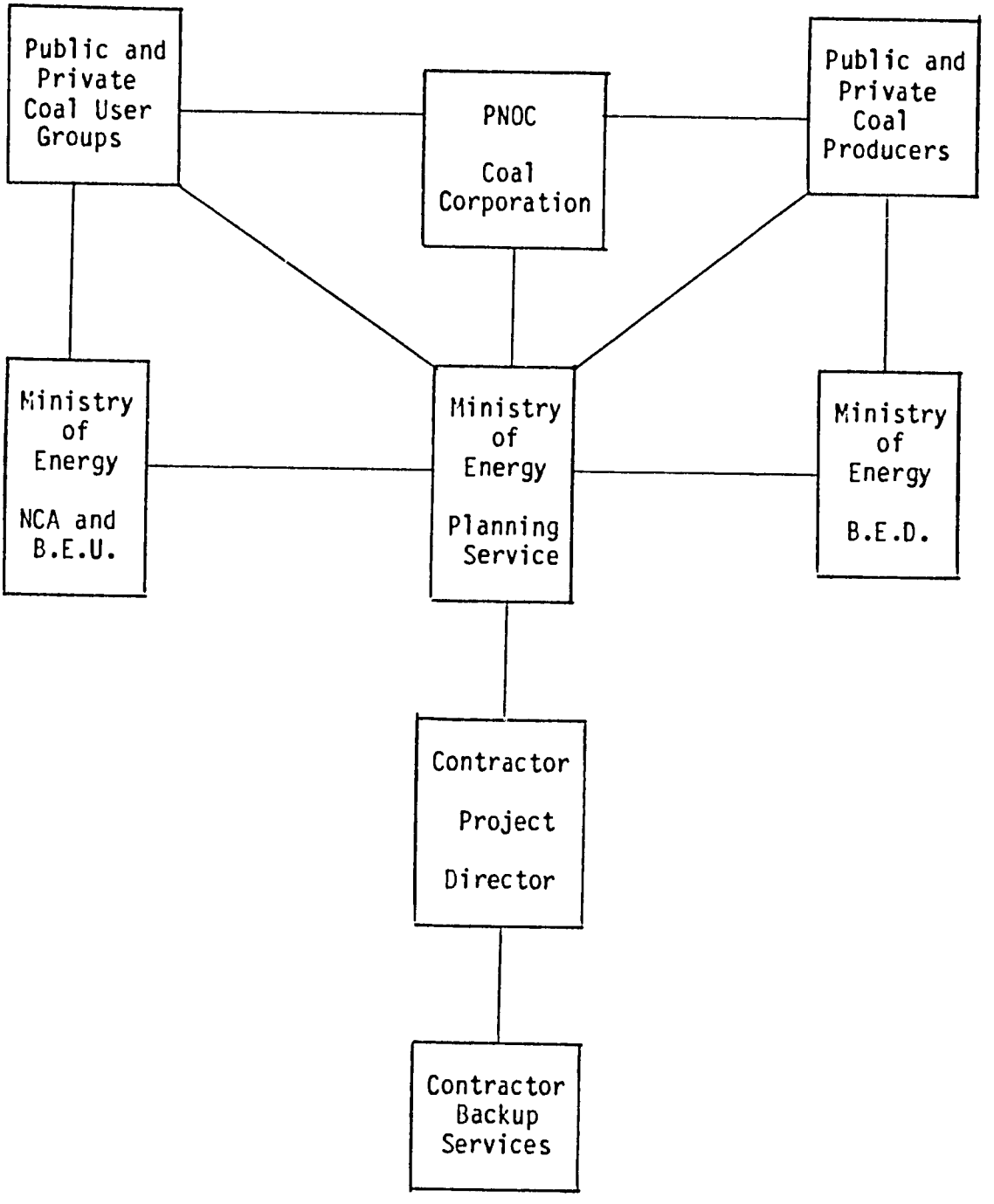
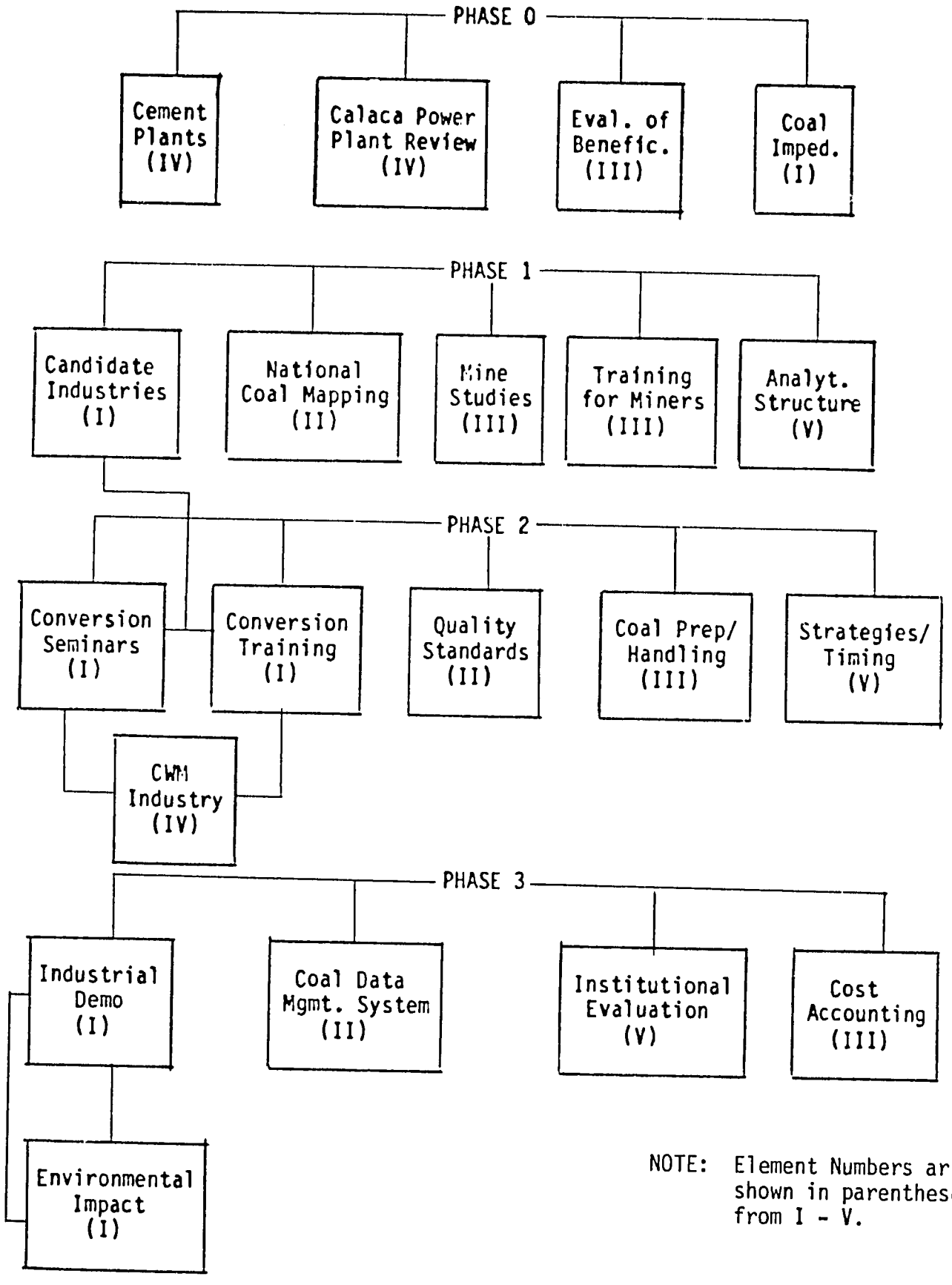


Figure 8

FLOW DIAGRAM OF PROGRAM ELEMENTS



NOTE: Element Numbers are shown in parentheses from I - V.

Ministry of Energy, the Public/Private Coal Producers, and the Public/Private Coal User Groups.

Finally, a schedule of tasks is proposed in Figure 9, "Time Schedule". Each of the activities is arranged by element so that its length of time and overlap with other relevant activities can be seen. A three year long total program is suggested in order to permit a six month startup period and then a two and one-half year long project. This will facilitate strong counterpart development and ensure a continuing national coal program.

Estimated Cost Structure

As proposed in the project management section, contractor support will be required for completion of the five program elements of MARKETS, MAPPING, QUALITY, HANDLING, and SYSTEM. At this time, it is anticipated that two full time individuals including one energy engineer and one energy economist will be needed for eighteen months each. They will serve as project manager and assistant project manager for complete contract supervision. The energy engineer will assume responsibility for element one, MARKETS, and the energy economist will assume responsibility for element five, SYSTEM. They will be assisted by short-term training and other personnel as required to develop and implement the proposed twenty activities. At this time it is assumed that USGS personnel will be responsible for implementing the three activities of the element MAPPING.

Figure 10, "Time and Cost Estimates," presents the estimated manpower loadings for the five elements. It should be noted that the program includes two opportunities for demonstration activities. Element One, MARKETS, includes an option for an industrial demo showing the use of coal with perhaps an additional solid fuel. Element Four, HANDLING, similarly provides an option for a cement plant demo illustrating a retrofit design for handling high moisture coal.

This national coal program of five elements can be carried out using appropriate contractor support for the public and private coal clients previously identified. The Philippine coal resource base exists. Philippine coal markets, similarly, exist. The purpose of this project is to develop a national coal program which brings them together.

Figure 9

TIME SCHEDULE

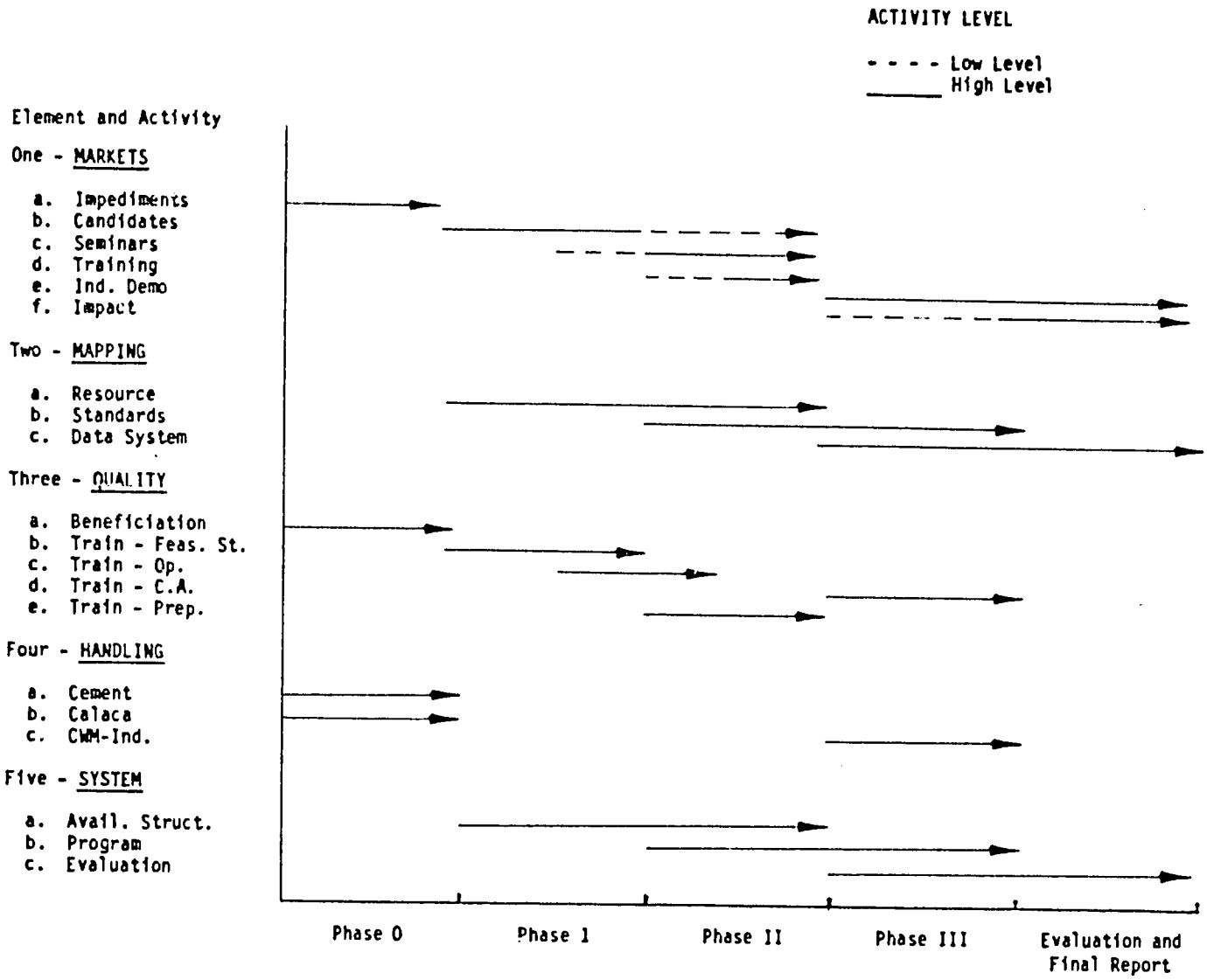


Figure 10

TIME AND COST ESTIMATES

	Estimated Manpower
Element I - MARKETS	
Coal Impediments Candidate Industries Conversion Seminars Conversion Training Industrial Demo Environmental Impact	Total Element Without Demo - 24 Man-Months
Element II - MAPPING	
National Coal Mapping Quality Standards Coal Data Mgmt. System	Total Element (USGS) 122 Man-Months
Element III - QUALITY	
Eval. of Benefic. Mine Studies Training for Miners Cost Accounting Coal Prep/Handling	Total Element Without Samples - 50 Man-Months
Element IV - HANDLING	
Cement Plants Calaca P.P. Review CWM Industry	Total Element Without Demo - 8 Man-Months
Element V - SYSTEM	
Analyt. Structure Strategies/Timing Instit. Evaluation	Total Element Without Computer - 24 Man-Months
	Total Man-Months = 228

Chapter Five

SUMMARY AND CONCLUSIONS

Philippine coal development to decrease foreign exchange expenditures for oil has been a national priority since the 1970s. Coal production has actually increased from an average annual rate of less than 300,000 tons during that decade to over one million tons in 1984. Demand, however, in 1985 will require approximately three million tons. The reasons for this imbalance are many, and it is not the intention of this report to document them. It is the intention of this report, rather, to propose a solution, based upon immediate action. Continued inaction on the part of the donor community will lead to a greater supply/demand imbalance and an expansion of coal imports, again increasing foreign exchange expenditures.

The refusal of the cement industry to use Semirara coal and the difficulties in the operation of the Calaca power generating plant have brought the coal sector to a crisis situation. Without these two major markets, indigenous coal utilization falls to substantially less than one million tons, and the outlook for the total coal sector as a serious energy source for both power and industry is in doubt. Action must be taken now.

On the user side, assistance must be provided to the cement industry to complete their mandated conversion from oil to Philippine coal. In many cases, the industry has become dependent upon imported coal and changes at the cement plants must be accomplished soon to maximize the use of indigenous coal. Similarly, the Calaca-Semirara impasse which requires control of coal quality at Semirara and engineering modifications at Calaca must be resolved. These two solutions will assist the nation in regaining confidence in the use of its coal and continuing expansion of the coal sector.

Developing solutions to this two-sided market problem of providing the user with a quality coal he can handle confidently and assuring the producer of a quality coal he can supply economically require a full-scale national program. Such a program must include attention to activities which scan the coal chain from mine identification and development to coal handling and utilization. The program must start with ameliorative actions for the identified problems and quickly lead to training and other technical assistance activities which are supportive of the problem solutions. In this way, the coal sector can be a continuing force in the drive to expand the use of indigenous energy sources.

Such a national coal program is described in the preceding chapters. Its justification is based upon Philippine coal's dual role as a foreign exchange benefactor and as the local resource most capable of strengthening the rural economy through additional development and related employment. There is a present demand for three million tons per year with a Ministry of Energy target for 1985 Philippine production of two million tons. Meeting the 1990 target of 4.5 million tons for total consumption would replace over 15 million barrels of oil at an estimated foreign exchange savings of almost half a billion dollars per year.

Annual sales for this coal would total over three billion pesos with much returning to the rural mine areas. Employment rates in the rural mine areas would similarly increase by three to five thousand jobs per one million tons mined, depending upon mine technique. The indirect job impact would be several times this estimate. There is no doubt that this rurally located national resource, coal, presently offers the best resource development opportunity in the Philippines.

Action Steps

In order to assure continuity of indigenous coal development and use in the Philippines, a series of action steps is required now.

One. Implement cement plant activity designed to increase use of Philippine coal in the cement plants before the onset of 1985's rainy season.

Two. Review Calaca power plant operation and Semirara mining techniques to determine optimum procedures for expanding use of Semirara coal for power generation at the Calaca site.

Three. Prepare strategy and documentation for implementation of national coal program designed to expand indigenous coal use.

Exhibit A

USGS RESOURCE ASSESSMENT

PROPOSAL FOR COAL SECTOR PROGRAM IN PHILIPPINES

By

J. H. Medlin, M. D. Carter and E. R. Landis
U.S. Geological Survey

The project report series presents information resulting from various kinds of scientific, technical, or administrative studies. Reports may be preliminary in scope, provide interim results in advance of publication, or may be final documents.

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Introduction

Coal consumption in the Philippines basically falls into four areas of usage: cement, power generation, process heat in industrial plants, and metallurgical/chemical. At present, most of the Philippines coal production is sold to coal-fired cement and power plants. With the imminent completion of the conversion of most of the cement plants to coal, the future large growth of coal demand will come from new coal-fired power plants.

Coal Supply and Coal Demand in the Philippines

Dames & Moore Study

To attempt to predict and anticipate the coal supply and demand markets in the Philippines between 1984-1995 various studies have been undertaken by several groups. One of the studies and one of the publications is that prepared by Dames and Moore and PN Consultants entitled "ASEAN Coal: The future of the Industry"(1983). This publication attempts to project the Philippines coal demand between 1983-1995 as shown in table 1. This table gives the projections on the basis of probable (possible) demand and likely demand. Likewise, the Dames and Moore/PN study projects the coal supply for 1983-1995 in the context of probable and likely coal supply. These projections of supply are reproduced in table 2. If data in tables 1 and 2

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Table 1. Projected Philippines coal demand, 1983-1995('000 metric tons). Dames and Moore(1983) table 2.13.

	Probable	Likely
1983	1,000	450
1984	1,500	1,200
1985	3,000	2,000
1986	5,000	4,000
1987	9,331	8,081
1988	9,581	8,081
1989	9,831	8,331
1990	10,081	8,331
1991	10,331	8,581
1992	10,581	8,581
1993	10,831	8,831
1994	11,081	8,831
1995	11,331	9,081

Table 2. Projected Philippine coal supply, 1983-1995('000 metric tons). Dames and Moore(1983) table 2.15.

	Possible	Likely
1983	1,972	1,833
1984	3,368	3,146
1985	4,467	3,798
1986	5,829	4,977
1987	8,744	6,807
1988	8,744	7,147
1989	8,744	7,402
1990	8,744	7,402
1991	9,181	7,772
1992	9,640	8,160
1993	10,122	8,568
1994	10,626	8,997
1995	11,160	9,447

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are combined to produce the overall supply/demand balance between 1983-1995 for Philippines coal, table 3 results. This table projects the coal supply and coal demand balance in terms of possible and likely categories. A brief study of table 3 reveals that from 1983-1986, the supply of Philippines coal appears to be adequate to meet the demand. Beginning in 1987 and onward to 1995 (table 3), the Philippines could have a deficit in production and could be a net importer of coal. The maximum import level will be reached in the late 1980s; the country could reach coal self-sufficiency in the 1990s.

Assumptions

According to the Dames and Moore study several developments could impact these projected demands. The first is the rate that various new power plants are brought on stream. Also, affecting these projections is the rate that existing power plants, if converted, are brought on stream. A third factor is the plan by the National Power Authority, to accelerate its national power program in the various islands to provide additional electric power for steel production and metal mining industries.

The coal supply projections given in tables 1 and 2 are based, especially from 1986 onward, on major additions to the local coal supply market from Semirara Island and the Isabella area of the Cagayan Valley in northern Luzon. These projections assume, according to the Dames and Moore study, that the Panian

Table 3. Supply/Demand balance, 1983-1995('000 metric tons)
Dames and Moore(1983) table 2.16.

	Possible	Likely
1983	972	1,383
1984	1,868	1,946
1985	1,467	1,798
1986	829	977
1987	(587)	(1,274)
1988	(837)	(934)
1989	(1,097)	(989)
1990	(1,337)	(989)
1991	(1.150)	(809)
1992	(941)	(421)
1993	(709)	(263)
1994	(453)	163
1995	(171)	366

Note: The numbers in parentheses indicate supply shortfalls.

deposit on Semirara Island will be producing 1.7 mtpa and the Isabella deposit will be producing 2.1 mtpa. In addition both the probable and likely supply numbers assume a 5 percent coal production increase per year on an industry wide basis after about 1990.

Constraints

The Dames and Moore study indicates that one of the major constraints to expanded coal development in the Philippines is financial, the same as in most developing countries. The financial constraint results primarily from the fact that expansion and development of coal mines, the establishment of transportation and logistical facilities, and the construction of coal-fired power plants are all capital intensive and require costly equipment, mostly imported. This financial constraint has been and can be eased somewhat by participation of foreign companies, with adequate financial resources, as is the case of Northern Strip Mining Company at Isabella and the Voest Alpine Company at Semirara Island. However, this participation requires or is accelerated by access to credible, abundant, and reliable coal resources data.

Another critical constraint, according to the Dames and Moore study, is the lack of trained technical personnel for an expanded coal industry in the Philippines. This constraint will disappear with possibly the retraining of the existing metal mining people to do coal mining or training of new miners.

Several other critical constraints of equal and paramount importance are the difficult geologic conditions in which most of the coal deposits in the Philippines occur. These conditions include lack of detailed data on the geologic distribution and occurrence and, indeed, the quantity and quality of the coal beds in the Philippines. Current data indicate that many of the beds are highly fractured, faulted and folded; some are steeply dipping; some are thin and some are thin and discontinuous. These geologic factors create obvious problems in the introduction of new mining technology into the mines to increase mine productivity.

Associated with the difficult and unknown geologic conditions is another constraint, the lack of information on the geographic location of many of the coal deposits in the Philippines. This lack of information leads to coal being mined and transported from Islands that are far from the major cities and industrial users and therefore areas of energy demand. It also leads to a need to construct coal logistic facilities such as ships, ports, and terminals. Likewise, this lack of information hinders foreign investment, and creation of local employment.

Asian Development Bank Study

A later study on ASEAN coal "ASEAN coal development" sponsored by the Asian Development Bank(ADB) and conducted by Montreal Engineering Company, Limited(MONENCO) is scheduled for

completion in October 1984. This report reviews the various coal demand and coal supply projections for each of the ASEAN countries, including the Philippines. It also examines the entire coal infrastructure such as--resources, reserves, quality, transportation, logistics, usage, ports, and finances within each ASEAN country.

A review of the tables 4 and 5(taken from the ADB report) reveals that there will be a shortfall in the total coal production in the Philippines from 1984-1995. A comparison and summary of these data are given in table 4. This table is derived from data on total coal production/total demand(with three alternatives) given in the ADB study. The table shows clearly the magnitude of the coal supply shortfall and, when compared to the Dames and Moore data, it is obvious that both studies agree that there will be a shortfall between coal supply and coal demand from the mid 1980s through 1995 and maybe beyond. The differences in the numbers presented by the ADB and Dames and Moore studies can be attributed to the different assumptions and scenarios used by the two groups in their investigations. However, these differences should not detract from the conclusions that both studies project coal supply shortfall of some magnitude in the Philippines(tables 6 and 7).

Discussions by U.S.G.S. personnel with Bureau of Energy Development(BED) staff and a review of the ADB report by Bureau of Energy Development personnel indicate that BED does not concur with the ADB and Dames and Moore conclusions concerning a coal shortfall.

Table 4. Philippines total coal production/total demand, 1983-1995.

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Total Production[1] (Supply)	1009	1515	2237	2541	2861	3172	3604	4995	5782	6511	7143	7183	8228
Total Demand[2] Alt. I	1384	2572	3972	4063	4123	4244	4817	5519	7061	8000	8650	9850	11100
Total Demand Alt. II	1384	2572	3972	4063	4123	4244	4817	5519	7061	7400	7750	8950	10200
Total Demand Alt. III	1384	1532	3108	3199	3259	3380	3931	4231	5152	5224	5574	6774	8024
Surplus/(Shortfall)													
Alt. I	(375)	(1057)	(1765)	(1522)	(1262)	(1072)	(1203)	(524)	(1279)	(1489)	(1507)	(2667)	(2872)
Alt. II	(375)	(1057)	(1765)	(1552)	(1262)	(1072)	(1203)	(524)	(1279)	(889)	(607)	(1767)	(1972)
Alt. III	(375)	(17)	(871)	(658)	(398)	(208)	(327)	764	630	1287	1569	409	204

1. '000 metric tons, run-of-mine. According to ADB study the figures should be increased by 10 percent to normalize to 10,000 Btu/lb basis(Source ADB, Table 2-22).

2. Forcast of coal demand, all sectors at 10,000 Btu/lb, '000 metric tons(Source ADB, p. 2-17, Inception Study).

Alt. I: Includes all coal options for National Power Authority(i.e. Isabella I, II, III).
Alt. II: Geothermal option for National Power Authority(excludes Isabella I, II, III).
Alt. III: As per alternative II but excludes NSC expansion and MMIC,

All sectors include NPC, NPC-National Steel Corp., NSC-Non energy, Atlas, Philphos, cement industry, others, MMIC.

Table 5. Forecast of Philippine coal production.
(ADB Report, 1984, Table 2-22)

op = open pit operation
um = underground operation

('000 metric tonnes - Run of Mine)

	mine type	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
I. SEMIRARA	op	800	1300	1300	1300	1300	1300	2300	2300	2300	2300	2300	2300	2300
II. MINDANAO														
PNOC														
Bislig - run of mine	um	59	130	200	250	300	300	300	300	300	300	300	300	300
- washed coal		47*	104*	160*	200*	240*	240*	240*	240*	240*	240*	240*	240*	240*
Malangas - run of mine	um	217	250	275	300	300	300	300	300	300	300	300	300	300
- washed coal		195*	225*	250*	270*	270*	270*	270*	270*	270*	270*	270*	270*	270*
Uling (Cebu)	um	13	20	20	20	20	15	10	5	-	-	-	-	-
Lalat - run of mine	um	-	-	30	100	200	300	300	300	300	300	300	300	300
- washed coal				27*	90*	180*	270*	270*	270*	270*	270*	270*	270*	270*
Subtotal (washed coal)		225	349	457	580	710	795	790	785	780	780	780	780	780
Surigao (private)														
Atlas - PODCO	op	-	-	-	-	-	20	100	180	225	225	225	225	225
BCI - diversified	op	-	-	-	-	-	60	100	160	200	200	200	200	200
Montagria	op	-	-	-	-	-	40	90	90	90	90	90	90	90
Piedra Negra	op	-	-	-	-	-	75	150	150	150	150	150	150	150
Subtotal		-	-	-	-	-	195	440	580	665	665	665	665	665
Zamboanga (private)														
Inimaco	um	30	42	54	60	60	60	60	60	60	60	60	60	60
III. BATAN														
ACR - Batan	op	15	60	100	150	180	180	180	180	180	180	180	180	180
Bicol Coal	um	-	5	5	10	15	15	15	15	15	15	15	15	15
Coal Fields	op	36	36	36	40	40	40	40	40	40	40	40	40	40
Panama	op	3	5	8	10	10	10	10	10	10	10	10	10	10
Subtotal		48	106	149	210	245	245	245	245	245	245	245	245	245
IV. POLILLO														
Pilipino Cathay	um	12	15	24	30	30	30	30	30	30	30	30	30	
Tantuco	um	-	-	2	5	5	5	5	5	5	5	5	5	
Subtotal		12	15	26	35	35	35	35	35	35	35	35	35	
V. NEGROS	um													
Tindalo	um	-	-	-	3	6	8	15	20	25	30	30	30	
Others	um	-	-	-	-	5	5	5	10	10	10	10	10	
Subtotal		-	-	-	3	11	13	20	30	35	40	40	40	
VI. SAMAR														
IEC	op	-	-	-	-	-	60	100	200	300	400	400	400	
MMIC	op	-	-	60	120	200	250	300	300	300	300	300	300	
Subtotal		-	-	60	120	200	310	400	500	600	700	700	700	
VII. CAYAGAN														
Northern Strip	op	-	-	-	-	-	-	-	500	1000	1500	1500	1500	1500
Others	op	-	-	-	-	-	-	-	-	5	5	5	5	5
Subtotal		-	-	-	-	-	-	-	500	1005	1505	1505	1505	1505
VIII. Other areas														
Mindoro	um	-	-	-	-	-	-	5	10	10	10	10	10	
Masbate	um	20	20	25	30	40	40	40	40	40	40	40	40	
		20	20	25	30	40	40	45	50	50	50	50	50	
IX. CEBU														
With PNOC Contract														
Almendras	um	25	25	25	25	25	25	25	25	25	25	25	25	
Bacaltos	um	-	1	3	5	5	8	10	10	10	10	10	10	
Argonaut	um	2	3	5	10	12	14	15	17	20	20	20	20	
D.G. Sanchez	um	25	30	40	50	50	50	50	50	50	50	80	100	
Il Rey'c	um	15	15	15	15	15	15	20	20	20	20	20	20	
Lovinia	um	40	40	50	70	100	120	140	150	170	190	200	220	
Manguerra	um	12	13	15	15	20	25	30	40	45	45	45	45	
Manto'	um	5	7	10	10	10	10	10	10	10	10	10	10	
Cebu Coal	um	20	20	20	20	20	20	20	20	20	20	20	20	
Edmann Mining	um	25	30	30	35	35	35	35	35	35	35	35	35	
Subtotal		169	184	213	255	292	322	355	377	405	425	465	505	540
Without PNOC Contract														
Argonex	um	5	7	9	10	10	10	10	10	10	10	10	10	
Aznac	um	-	-	-	-	-	-	5	10	10	10	10	10	
CRDC	um	-	1	3	5	5	5	5	5	5	5	5	5	
Durano	um	115	120	120	120	120	120	125	125	130	130	130	130	
Filcarbon (Inimaco)	um	16	40	60	60	60	60	60	60	60	60	60	60	
J.D. Almendras	um	25	25	30	30	35	35	35	35	40	40	40	40	
Cebu Alpaco	um	4	5	7	9	10	12	12	14	15	15	15	15	
Jeston	um	10	12	12	12	12	15	15	18	18	20	20	25	
JLB Coal	um	-	1	1	2	2	2	2	2	2	2	2	2	
Kinway	um	2	5	10	15	20	25	30	35	35	40	40	40	
Providence	um	4	5	5	5	5	5	6	6	6	6	6	6	
Subtotal		181	221	257	268	279	289	305	320	331	338	338	343	370
Total Cebu		350	405	470	523	571	611	660	697	736	763	803	848	
TOTAL PRODUCTION		1515	2237	2541	2861	3172	3604	4995	5782	6511	7143	7183	8228	

Table 6. Philippines - Steam coal supply/demand balance.
(000's tonnes)

		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
STEAM COAL DEMAND														
Excluding National Steel														
Grade	9800 +	310	520	760	760	1020	1020	1020	1020	1020	1020	1020	1020	1020
Grade	8500 - 9000 +	1164	1224	1264	1368	1388	1513	1625	1727	1799	1950	1827	1971	2275
Grade	7200 - 8300	240	1240	1480	1510	1610	1910	3280	3300	3360	3680	4020	5410	9800
Lignite	6200	-	-	-	-	-	-	-	500	1000	1500	1500	1500	1500
	Sub Total	1714	2984	3504	3638	4018	4443	5925	6547	7179	8150	8417	9961	14595
National Steel														
Grade	12000 +	-	-	-	-	-	-	-	400	400	400	400	400	400
Grade	7500	-	-	-	-	-	-	-	340	340	340	340	340	340
	Sub Total	-	-	-	-	-	-	-	740	740	740	740	740	740
	TOTAL DEMAND	1714	2984	3504	3638	4018	4443	5925	7287	7919	8890	9157	10701	15335
STEAM COAL PRODUCTION														
Grade	10000 - 11000 +	615	749	918	1106	1289	1405	1441	1464	1489	1516	1556	1596	
Grade	8500 - 9500 +	100	188	263	335	383	409	505	601	660	665	665	665	
	Sub Total	715	937	1181	1441	1672	1814	1946	2065	2149	2181	2221	2261	
Grade	7000 - 8000 +	-	-	60	120	200	490	749	917	1062	1162	1162	1167	
Semirara	7500	800	1300	1300	1300	1300	1300	2300	2300	2300	2300	2300	3300	
	Sub Total	800	1300	1360	1420	1500	1790	3049	3217	3362	3462	3462	4467	
Grade	6200	-	-	-	-	-	-	-	500	1000	1500	1500	1500	
TOTAL PRODUCTION		1515	2237	2541	2861	3172	3604	4995	5782	6511	7143	7183	8228	
SUPPLY / DEMAND BALANCE : SURPLUS (SHORTAGE)														
Excluding National Steel														
Grade	9800 +	305	229	158	346	269	385	421	444	469	496	536	576	
Grade	8500 - 9000 +	(1064)	(1036)	(1001)	(1033)	(1005)	(1104)	(1120)	(1126)	(1139)	(1285)	(1162)	(1306)	
	Sub Total	(759)	(807)	(843)	(687)	(736)	(719)	(699)	(682)	(670)	(789)	(626)	(730)	
Grade	7200 - 8300 +	560	60	(120)	(90)	(110)	(120)	(231)	(83)	2	(218)	(558)	(1003)	
		(199)	(747)	(963)	(777)	(846)	(839)	(930)	(765)	(668)	(1007)	(1234)	(1733)	
INCLUDING NATIONAL STEEL														
Grade	8500 +	(759)	(807)	(843)	(687)	(736)	(719)	(699)	(1082)	(1070)	(1189)	(1026)	(1130)	
Grade	7200 +	560	60	(120)	(90)	(110)	(120)	(231)	(423)	(338)	(558)	(898)	(1343)	
	Total	(199)	(747)	(963)	(777)	(846)	(839)	(930)	(1505)	(1408)	(1747)	(1974)	(2473)	

Source : Summarized from Tables 2-29 and 2-31

Table 7. Philippines - Forecast of total coal demand.

(000's metric tonnes, run-of mine)

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	2000
1. NATIONAL POWER CORPORATION (NPC)													
Calaca I & II (Luzon)	-	1000	1000	1000	1000	1000	2050	2050	2050	2050	2050	2050	2050
Isabella I, II & III (Luzon)	-	-	-	-	-	-	-	500	1000	1500	1500	1500	1500
Sto. Domingo I, II & III (Luzon)	-	-	-	-	-	-	-	-	-	-	-	1070	3210
Naga I, II & III (Cebu)	130	160	240	370	370	370	370	370	370	370	370	370	580
Bislig I & II (Mindanao)	-	-	-	-	-	300	620	640	700	720	740	780	800
Mindanao Coal Thermal	-	-	-	-	-	-	-	-	-	300	620	960	2920
Sub Total	130	1160	1340	1370	1370	1670	3040	3580	4120	4920	5280	6730	11060
2. CEMENT PLANTS													
Luzon	679	679	679	723	723	803	865	902	934	1055	937	1006	1160
Cebu	90	90	95	95	95	95	105	105	105	105	105	105	105
Mindanao	235	265	290	300	315	320	320	355	375	395	430	445	445
Sub Total	1004	1034	1064	1133	1133	1218	1290	1352	1414	1555	1472	1556	1710
3. OTHER INDUSTRIAL													
MMIC (Nonoc)	180	360	600	600	860	860	860	860	860	860	860	860	860
Atlas (Cebu)	240	240	300	300	400	400	400	400	400	400	400	400	400
Small Industrial	160	190	200	235	255	295	335	375	385	395	405	415	565
National Steel Corp (Mindanao)	-	-	-	-	-	-	-	340	740	740	740	740	740
Sub Total	580	790	1100	1135	1515	1555	1595	2375	2385	2395	2405	2415	2565
Total Steam Coal	1714	2984	3504	3638	4018	4443	5925	7307	7919	8870	9157	10701	15335
Coking Coal, Anthracite	200	210	220	230	240	250	260	270	280	290	300	310	380
Total Coal Demand	1914	3194	3724	3868	4258	4693	6185	7577	8199	9160	9457	11011	15715
Total excluding NSC	1914	3194	3724	3868	4258	4693	6185	6837	7459	8420	8717	10271	14975

Quality of Philippines Coal Deposits

General Quality

Coal quantity and coal quality are inseparable factors when assessing the coal resources of any country or region. According to the ADB study "...coal supply issues in the Philippines are not so much a matter of increasing coal total production to meet total demand but rather of producing coal to match the quality requirements of the market..." One could add to this the fact that so much has been reported about the low quality of Philippines coal deposits that many now just assume that all Philippine coal is of low quality. Considering how little is actually known about the distribution, occurrence, quantity and quality of the Philippines coal deposits, this assumption is premature and likely incorrect. This conclusion is supported by the wide ranges in values for existing coal quality parameters (table 8); wide ranges very commonly indicate insufficient data.

The essence of the coal quality issue is that coal quality requirements of each end user are by their very nature different. Those coal quality requirements for the power plant sector are different than those for the steelmaking sector(tables 9 and 10); are different than those of the cement industry(tables 9 and 11); and are different than those of the industrial users(table 10).

Table 8. Summary of coal quality.

(Air Dried Basis)
Source : BED

Coal Area / Basin	Moisture %	Ash %	Volatile Matter %	Fixed Carbon %	Sulphur %	Heat Value Kcal / Kg	Coal Rank (ASTM Classification)
SEMIRARA ISLAND	17 - 18	2 - 9	37 - 38	37 - 41	0.5 - 0.7	4440 - 5550	Lignite to subbituminous
CAGAYAN BASIN							
Cauayan, Isabela	14 - 16	15 - 18	36 - 38	25 - 29	0.7 - 1.1	3780 - 4110	Lignite
Maddela, Quirino Prov	8 - 12	8 - 16	41 - 55	28 - 32	N/A	5170 - 5400	Lignite to subbituminous
SURIGAO							
Bislig	12 - 14	11 - 13	31 - 34	34 - 38	0.5 - 1.0	4900 - 5400	Subbituminous
Guigaquit	8 - 9	17 - 22	37 - 40	28 - 34	2.4 - 3.8	4780 - 5170	Subbituminous
SAMAR - LEYTE	N/A	N/A	N/A	N/A	N/A	4170 - 5280	Subbituminous
ZAMBOANGA	2 - 4	5 - 7	24 - 28	58 - 67	0.4 - 0.9	7060 - 7280	Bituminous to Semi-Anthracite
SOUTHERN MINDORO	6	2 - 3	50 - 53	36 - 39	3.0 - 4.1	6170 - 6280	Subbituminous
NORTHERN CEBU							
Danao - Compostela	6 - 9	5 - 8	40 - 41	38 - 44	0.3 - 1.0	5830 - 6400	Subbituminous
Toledo - Balamban	3 - 4	10 - 13	36 - 39	41 - 46	3 - 5	5170 - 6780	Subbituminous to Bituminous
CENTRAL CEBU	11 - 12	5 - 6	38 - 40	39 - 42	0.3 - 0.5	5400 - 5780	Subbituminous
SOUTHERN CEBU	5 - 6	3 - 6	40	46 - 48	0.4 - 0.6	6670 - 6900	Bituminous
BATAN ISLAND							
East	16 - 19	5 - 6	36 - 37	34 - 36	1.7 - 2.0	4560 - 4940	Subbituminous
West	6 - 10	2 - 7	35 - 37	42 - 47	1.5 - 3.0	5830 - 6280	Subbituminous
QUEZON	5	4	48	42	0.4	7170	Bituminous
POLILLO ISLAND	11 - 14	1 - 6	30 - 35	36 - 42	0.3 - 1.3	5060 - 6110	Subbituminous
CATANDUANES	3 - 7	9 - 15	22 - 25	50 - 55	1.2 - 1.6	5720 - 6720	Bituminous
NEGROS (East)	17 - 19	12 - 13	32 - 34	35 - 37	1.5 - 4.4	4670 - 5060	Subbituminous
DAVAO	18	9	33 - 34	36	0.6 - 1.7	4560 - 6110	Lignite to Subbituminous
MASBATE *	4 - 15	5 - 35	20 - 36	36 - 45	0.7 - 3.2	4440 - 5110	Lignite to Subbituminous

* Data from report by Robertson Research International Limited

N/A Data not available

Table 9. Philippines - coal quality specifications by end user.

		Heating Value (BTU/LB)	Ash (%)	Moisture (%)	VCM (%)	Fixed Carbon (%)	Sulphur (%)	Ash Fusion Temp % °C	HGI	Size mm	Basis	Source	Remarks
POWER STATIONS													
Calaca I (300 MW)	- design	8000-9000	22 max	16-19	35-41	26-29	1.0 max	1350	40-50	-	a.d.	-	- data transmitted to Mitsui
	- contract	8300-9300	16-22	11-15	38-44	24-30	0.4-1.3	1350	40-50	200 max	a.d.	Semirara	may require blending with higher grade coals
Calaca II (300 MW)	- design	7500-7900	-	-	-	-	-	-	-	-	-	Semirara	- will be designed for low quality coals.
Naga I (55MW)	- design	9760	8.5	16.5	44	31	3 max	1250	66	30 x 0	a.r	Cebu	- designed for higher quality Cebu coals
	- contract	10000	15 max	15.0 max	35 max	31 min	4 max	1110	-	-	a.r		-
Naga II (55MW)	- design	7900	20	20	30	31	3 max	1110	66	30 x0	a.r	Cebu/Semirara	- designed for lower grade coals
Isabella (3 x 100 MW)	- design	6200-6620	20.3-21.7	20-25	32-34	22.5-24	-	1200-1350	47-55	-	a.r	Cagayan	- mine mouth future plant
Atlas	- design	7200 min	20	22	10	-	-	1000	40	20 x 0	a.r	Semirara/	- fluidized bed plant, designed to accept low grade coals
	- contract	8300-9300	20 max	15 max	10 min	24-30	3 max	1000	40	100 max	a.r	Batan	
MMIC	- design	1000	12	12.6	37.9	36.9	3.6	1200	39	50 x 0	a.d	Import/ Semirara	- blend of low and high grade coals.
Binalig	- design	7500	22	17	30	-	4	1100	45		a.d	Liangga area	- coal supplied could be higher quality
Unicemco (10 MW)	- design	8800	13.1	15.5	34.9	36.5	-	-	-	25 x 0	a.r	-	-
	- contract	7000 min	20 max	-	-	-	-	-	-	15 x 0	a.r	Cebu	- plant not operating at full efficiency.
Ludo & Luym		8000	-	-	-	-	-	-	-	30 x 6	a.r	Cebu	- coal mixed with biomass.
PNOC / NCA Power Specification		10000	15 max	10 max	35 min	31 min	-	-	-	-	-	Various	- excludes Calaca
Other Industrial													
Universal Cement	- design	10800	-	10	-	-	-	-	-	15 x 0	a.r	-	-
	- contract	7000	20 max	-	-	-	-	-	-	20 x 0	a.r	Cebu	- operating below design capacity
Apo Cement	- design	8500	15	18	20	-	-	-	45	25 x 0	a.r	-	-
	- contract	9500 avg.	15 max	10 max	20 min	-	-	-	45	25 x 0	a.r	Cebu	-
PNOC/NCA Cement specifications		6500 min 9500 avg.	18 max	18 max	20 min	-	3 max	-	45	25 x 0	-	various	- applies to converted plants
Philphos		7500 min	22 max	25 max	23 max	-	4 max	-	-	-	a.d	-	-
NSC	- contract	8000 min	4-10	20	30-35	40 min	0.5	125 0	-	-	a.d	-	-

Table 10. Coal quality requirements for selected power generation facilities in the Philippinese. Basis: air dried.

Station	Heat.Val. Btu/lb	Ash %	Moist. %	Sulf. %	Vol. Mat. %	Ash Fus. C
Naga I	8000-9500	15max.	16.5max.	.3-.8	35	>1250
Luzon I	8300-9300	16-22	11-15	4-1.3	-	>1250
Atlas	8300-9300	20max.	15max.	3.0max	10min.	>1000

Note: Naga I is located at Naga, Cebu. Luzon I is located at Calaca, Batangas. Atlas is located at Toledo City, Cebu.

Table 11. Coal quality specifications for potential users of Philippines coal (Dames and Moore, 1983).

Characteristics	Specification
General Cement Conversion	
Heating value, as-received, Btu/pound	8500-9500
Ash content, air dried, ave. percent	15
Residual moisture, air dried, percent, max.	10
Volatile matter, air dried, percent, max.	20
Sulfur, air dried, air dried, percent	3
NONOC Nickel Refinery (basis not given)	
Heating value, Btu/pound	8500-12500
Ash, percent	15
Moisture, percent	24
Volatile matter, percent	25-50
Sulfur, percent	0.5-1.5
Ash fusion termperatures	1300C (dryers); 1200C (boilers).
Pacific Cement Company Plant (basis not given)	
Heating value, Btu/pound	8500-12500
Ash, percent	14.1
Sulfur, percent	1.1
Moisture, percent	12.1
Biophile Food-Processing Plant (basis not given)	
Heating value, Btu/pound	9000-10000
Ash, percent	10-15
Sulfur, percent	(1
Moisture, percent	15-20

Specific Quality - Semirara Island

Table 2-20 in the ADB study provides a summary of the coal quality of Philippines coal on the basis of coal area or basin(table 8). These chemical analyses are on an air-dried basis. According to table 2-20, Semirara Island coal has an ash content which ranges from 2 to 9 percent. A discussion in the ADB study accurately points to the uncertainties of coal quality values for Semirara Island coal. According to the ADB report the air-dried ash values for Semirara coal are 2 to 9 percent, however during a cursory scanning by the ADB consultants of laboratory reports, it was evident that the ash content for Semirara coal was much higher and that the range was from 2.99 to 48.2 percent. Moreover, a review of coal analyses found in feasibility studies on Semirara Island coal indicates wide ranges similar to those quoted in table 2-20 of the ADB report. For example, the Himalian deposit shows an ash content range from 9.8 to 25.8 percent.

Studies by Dames and Moore of the Hamilian deposit show an ash content range from 5.1 to 39.4 percent. . For the Panian deposit the reange in ash content may be from 19 to 23 percent. Several analyses given by Austromineral Inc., for the Unong mine indicate that the range in ash content may be from 16 to 19 percent. Other data from the Unong deposit indicates a range in ash content from 6 to more than 24 percent. These wide differences in just the ash content from one area in the

Philippines emphasizes the problem faced in dealing with coal quality. There are also large ranges in the moisture, fixed carbon, and heating values. We believe that these wide variations are sympotomatic of any coal quality values reported about any coal from any coal basin or coal area in the Philippines. Enough is simply not known about the distribution, occurrence, quantity, and quality of the deposits.

Origin of Coal Quality Problems in the Philippines

The coal quality problem of the Philippines has as its origin at least several factors. The first is that little is known concerning the coal sampling techniques that were used in sample collection of many of the Philippine coal samples. Very little information is known about the coal drill core recoveries, the sample intervals, whether the sample represents part or all of a coal bed; little is known about the treatment of coal partings during the sample collection, whether there were partings, if so, how many and how thick; little is known of the make up of the composite samples; little is known about how the samples were packed and shipped; little is known about how the samples were dried, pulverized, crushed, and analyzed. The conclusion: are the samples representative and what standards were followed?

A second problem with the Philippines coal quality data is that there does not seem to be any consistency in standards used to determine the chemical composition of the coal samples. If

standards are used, the procedures are normally followed but the recommended equipment is not used. Moreover, there does not appear to be any organized effort for blank samples to be analyzed during the analyses of a group of coal samples. There do not appear to be procedures for interlaboratory comparisons between laboratories in the Philippines or with laboratories in other countries such as Australia, Japan and the U. S. So for all of the above reasons, it is difficult to make any valid judgement and evaluation of what the coal quality is of the coal in the various Philippines coal areas or basins. Indeed, because of the absence of a systematic exploration program, we do not know how representative the analyses are of Philippines coal deposits and whether there are better coal deposits elsewhere in the Philippines coal basins.

Need for Additional Analytical Data

At present most coal analyses reported in the Philippines are proximate analysis. Proximate analyses were the standard in most large coal producing countries through the early 1960s. With the introduction of more sophisticated technology, environmental controls, and the ever-increasing effort to increase coal conversion efficiency has come the need for additional tyupe of analyses. Proximate analyses are now recognized as not sufficient for coal quality characterization. Additional data such as ultimate analysis, free swelling index, ash fusion temperatures, forms-of-sulfur, Hardgrove grindability

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index, and chemical composition of the coal and coal-ash are all data that are needed in making assessments and judgements on the suitability of a coal for electric power generation, cement making, and steelmaking in the Philippines. These chemical and physical data allow the development of many mining, blending, and cleaning options to extraction and usage. This is currently not done and must become standard if the end users are to use Philippine coal efficiently and without operational problems. The generation of these data must follow recognized, credible standards and must be reproducible if to be of any use to the end users of Philippines coal.

Resolution of Philippine Coal Quality and Coal Quantity Problems

There are several ways to approach the coal quality and quantity problems. The first is to initiate an ongoing resources assessment of Philippines coal. Using this approach one can begin to discover and delineate additional coal deposits in which the coal quality may be better than that currently projected for existing mines or for mines in the planning stages. A second approach, which must be used in combination with the first, is to begin to introduce modern coal preparation, coal beneficiation or coal cleaning techniques into the Philippines. These techniques go beyond just washing coal with water and include a variety of other physical and chemical methods for cleaning coal. Cleaning coal in general reduces the ash content of the coal thereby on a per ton basis increasing

the relative Btu per pound content of the coal. However, for it to operate at maximum efficiency, the coal resources must be characterized sufficiently. This characterization remains to be done and should be done cooperatively by government and industry.

Recommended Approach to Coal Quantity and Coal Quality Problems

A cursory examination and analysis of existing Philippine coal quantity and coal quality data indicates problems of

- o inconsistency
- o credibility
- o reliability
- o incompleteness
- o general availability
- o lack of detail

The inconsistencies arise from the application and use of different methodologies in the calculation and estimation of resources by various workers in the Philippines. The coal quality data suffers from inconsistencies and credibility in the collection, handling, preparation, and analyses of coal samples. Most of the existing coal geology data are incomplete, incompatible, and lack detail in its coverage. Indeed, few of the coal basin margins are known precisely(figure 1); little is known of the lateral and vertical distribution, number of coal beds and thickness are imprecisely known, and the basin and national coal quality is incomplete and not reliable.

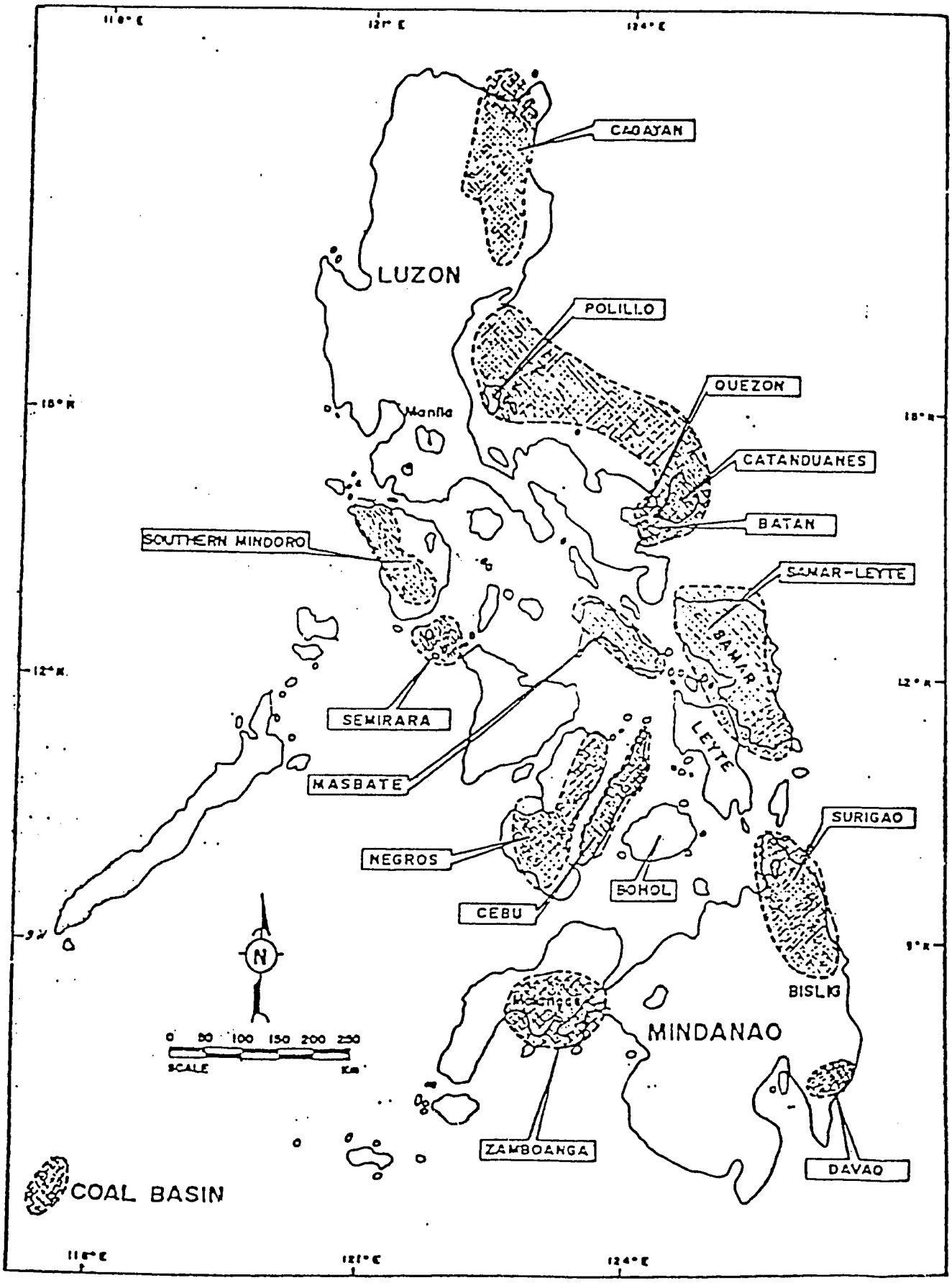

FIGURE 1. COAL AREAS / BASINS IN THE PHILIPPINES

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Examples of Deficiencies in Coal Data

Several examples of the above and the state of knowledge are reflected in the Robertson Research International report (1977), moisture problems encountered in the conversion of the cement plants to coal, and the recent attempts to identify quality and quantity of coal to support the introduction of the Coal Water Mixture technology(CWM) into the Philippines. The Robertson Research International report provides only generalized, aggregate estimates of Philippine coal resources and the generalized quality of these resources. When one attempts to disaggregate and validate the resources numbers and to understand the coal quality variability, one discovers that the basic data(drill holes, measured sections, methodology of resource estimation, coal quality determinations, etc) are unavailable, lack detail, are inconsistent and thus not very credible.

The conversion of the Philippines cement plants to coal has been difficult as a result of a lack of consistent coal quality data. Most of this problem results from a lack of detailed, credible and comprehensive coal moisture data for all the Philippine coal basins--the national and basin coal quality data are incomplete and not systematically and routinely determined.

The recent exercise to identify both quantity and quality of coal supply for the CWM technology in the Philippines

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revealed that only one option was really available--the use of Semirara Island coal. A search for other coal supply options revealed scant and incomplete data, revealed uncertainity in the quantity and quality estimates, revealed an inability to disaggregate the basic data, and revealed that data are concentrated in small areas of larger basins about which little is known. Much exploration is focussed on reserve definition rather than basin and national resource delineation, estimation, and assessment. Confusion exists over the difference between assessment and estimation, both of which are entirely different activities, but part of a logical progression in coal resource studies.

The lack of general availability to the private sector to much of the exploration data hinders the development of Philippines coal resources and does not encourgage and expedite investiment in the exploration and development of Philippine coal. This difficulty is exemplified in our difficulties in obtaining Semirara Island coal data during the CWM activities.

To correct many of the deficiencies and to encourgage development of the Philippine coal resources the following program is proposed. This program is divided into three interrelated, but integrated elements which will provide an ongoing assessment of the coal resources of the Philippines. This program does not duplicate existing ongoing activities with other countries in the Philippines, but rather is of much larger scope, addresses medium- and long- term constraints to an expanded coal sector in the Philippines, and provides training

and institutional building of both the public and private sector in the Philippines as well as academic institutions. The program seeks to foster growth in those areas not normally filled by the private sector as well as to develop and enhance those areas that must be shared jointly by the public and private sector.

Proposed Coal Resources Assessment in the Philippines

Effective growth of coal production in the Philippines can be significantly enhanced and be made more responsive to market growth if the country's coal resource inventory is updated, made more detailed and uniform, and readily accessible and otherwise modernized to increase its credibility. This modernization will be achieved by development of:

1. A new national coal quantity and quality assessment,
2. National standardization for coal sample collection, handling, preparation, and analysis, and
3. A coal data management system to store, retrieve, and manipulate and make available all of the collected coal geology, resource,. and chemical and physical data.

Scope

Specialists in coal resource assessment, geochemistry of coals, and computerization and mineral resource data systems

will provide technical assistance to the Government of the Philippines(GOP), through work with, and training of, GOP and academic and private sector counterparts to achieve the goals of the three specific but interrelated elements that are responsive in aggregate to the objectives above. The results will provide a basic planning tool for futher exploration, development, extraction, and utilization of coal resources in the Philippines and a basic public technical data source and set of practices upon which a Philippine coal industry can depend and rely in the formulation and implementation of its coal mining projects and in the commercial transactions of sale and purchase of coal supplies.

Specific Tasks

Element 1 - Coal Resources Assessment of the Philippines

1. Estimate the quantity of coal resources in the fields, districts, basins, and provinces of the Philippines.
2. Evaluate and integrate all parts of the final report on coal resources.
3. Interpret the tectonic relationships of the Philippines with emphasis on their impingement on coal resources distribution, extraction, and utilization.
4. Gather, organize, and integrate the known data on quality of Philippines coal.

5. Evaluate the quantity and quality relationships of Philippines coals and their effect on potential markets and utilization.
6. Interpret quality of coal data from the environmental and utilization standpoints.
7. Gather, organize and interpret pertinent statistics on mining and production and evaluate their relationship to future activities. Examine infrastructure relative to potential future exploration activities.
8. Organize and prepare data for entry into coal data management systems so as to ensure retrieval in multiple manipulated forms for future management use.
9. Train two or more geologists for several months in U. S. so that future coal resource studies can be conducted and coordinated by GOP personnel.

Element 2 - Philippines Coal Quality

1. Establish and implement procedures for identifying, organizing, documenting, verifying, and computerizing existing coal quality data.
2. Establish and publish written standards for the collection and geologic documentation of all exploration and production coal samples.
3. Establish and publish written standards for packaging, handling, and shipping of coal samples derived from exploration and production activities.

4. Establish and publish written standards for grinding, crushing, pulverizing, sizing and splitting of exploration and production coal samples submitted for chemical analyses.
5. Establish and publish written standards for analyzing exploration and production coal samples including ultimate and proximate analyses, heating value, ash fusion temperatures, coking properties, forms-of-sulfur, Hardgrove grindability index, and major, minor, and trace element concentrations.
6. Establish inter- and intra-laboratory quality control procedures for all analytical laboratories.
7. Establish standard reporting scheme which states the confidence limits for analytical determinations and provides the reporting format for all chemical determinations.
8. Establish procedures for computerizing all new chemical and physical data on Philippine coal and for making these data available to all users.
9. Establish training program for chemists and geoscientists to become familar with all written standards, analytical methods, and sample collection and preparation procedures. Train four to six geologist/chemists and chemists for several months in U. S.
10. Establish procedures for exchange, collection, and analysis of 20 to 30 Philippine exploration coal samples per year with USGS.

Element 3 - Coal Data Management System

1. Develop coal resource classification scheme with Philippine government requirements.
2. Define and prioritize data bases to be developed with GOP requirements.
3. Define data sources and responsibilities with GOP and develop system flowchart.
4. Define data elements and associated internal computer storage format to be included in the five data bases listed below, including development and installation of prototype production/utilization data base.
5. Define and install coal geology DBMS and graphics/mapping and analysis software on VAX 11-780.
6. Develop data entry format/software on available micros for:

   a. stratigraphic/geologic data base
   b. analytical/coal quality data base
   c. resource inventory data base
   d. production inventory data base
   e. utilization data base
7. Develop interfaces from existing micro computers, e.g. Cebu data base on Osborne, to VAX and provide user documentation.

8. Training in use of data base system and analysis software for general users(in Philippines only).

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9. Training in design and installation of new data bases, e.g. mine plans, logistics, marketing, and all software and technical support for GOP Energy EDP group(in Philippines and four or more counterparts in periods of one month at a time in U. S.).