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Charles Bliss
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ASEAN

COAL DEVELOPMENT PROJECT

prepared for

ASIAN DEVELOPMENT BANK

and

ESCAP REGIONAL ENERGY DEVELOPMENT PROGRAM (funded by UNDP)

VOLUME 1: SUMMARY

asean

prepared by:

MONTREAL ENGINEERING COMPANY, LIMITED (MONENCO)

in association with

SWAN WOOSTER ENGINEERING CO. LTD.
(subconsultant on coal transportation)

FINAL REPORT MARCH 1985

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$ 700 000 Budget First half of 1984

PRINCIPAL FINDINGS

Economics of Coal Use

The economics of the use of coal are examined with both high and low forecasts of energy prices. The assumptions concerning future energy prices, in terms of 1984 U.S. dollars, are:

Low Energy Price Scenario

- Oil prices decline from $29 to $20/bbl in the second half of the 1980's and increase at 1% per annum after 1990.
- Coal prices (for long-term contracts in the international market) remain flat at $37/tonne fob Australia and $49/tonne cif ASEAN until 1990 and thereafter the fob price increases at 1% per annum.

High Energy Price Scenario

- Oil prices decline to $25/bbl and increase at 2% per annum after 1990.
- Coal prices increase from $37 to $45/tonne fob Australia by 1990 (and $57/tonne cif ASEAN) and the fob price increases at 1% per annum thereafter.

The expected fuel prices after 1990 will have a major influence on future decisions on fuel sources. The average "levelized" fuel prices for the period 1990-2010 and the resulting costs of electric power based on a 12% interest rate and a residual oil to crude oil price ratio of 0.85 are presented below in 1984 U.S. dollars:

	Levelized Fuel Prices (1990-2010) for: Physical Units	Heating Units $/million Btu	Resulting Cost of Electricity mills/kWh
Low Energy Price Scenario			
Crude Oil	$21.50/bbl		
Residual Oil	$18.25/bbl	$2.92	39 mills
Coal (cif ASEAN)	$52.00/tonne	$1.97	38 mills
Coal/Oil Price Ratio (%)		67%	97%
High Energy Price Scenario			
Crude Oil	$29.00/bbl		
Residual Oil	$24.65/bbl	$3.95	49 mills
Coal (cif ASEAN)	$60.00/tonne	$2.27	41 mills
Coal/Oil Price Ratio (%)		57%	84%

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On a heating value basis, the cost of coal is projected to be 57% to 67% of the cost of oil but the cost differentials for power generation, which is the principal market for coal in ASEAN, are considerably less because of the higher capital cost of the coal-fired facilities. The major alternative fuel for power generation in ASEAN is natural gas. In the low energy price scenario, natural gas is more economic than coal at gas prices below $3.50/MMBtu, and in the high energy price scenario, gas is economic below $3.80/MMBtu.

Coal Demand

Coal consumption in ASEAN is projected to increase from 4 million tonnes per annum (mtpa) in 1983 to approximately 24 mpta by 1990 and to between 36 and 44 mtpa by 1995. The distribution of coal demand by country and by use is shown below.

	1983	1990	1995
	- million tonnes per annum -		
Coal Demand By Country			
Philippines	1.0	4.3	5.7 to 6.5
Thailand	2.3	9.2	13.4 to 17.0
Malaysia	0.3	2.7	3.2
Singapore	0.0	0.0	0 to 1.7
Indonesia	0.3	7.9	13.5 to 15.7
Total	3.9	24.1	35.8 to 44.1
Coal Demand By Use			
Power Generation	2.2	16.4	24.8 to 33.1
Cement Production	1.4	6.0	8.4
Other	0.3	1.7	2.6
Total	3.9	24.1	35.8 to 44.1

The forecast demand of 24 mtpa in 1990 is considered to be fairly firm since the new coal-fired power plants that account for most of this demand are under construction. The increase in use by the cement industry results from the ongoing conversions of existing oil-fired plants and construction of new coal-fired plants.

The projected increase in demand for coal for power generation from 16.4 mtpa in 1990 to between 24.8 to 33.1 mtpa in 1995 is based on the choice of the principal fuel for new power plants being coal in the Philippines and Indonesia and natural gas in Malaysia. Either coal or gas may be used in Thailand, and coal, gas or oil may be used in Singapore. Energy prices are one of the factors that will influence the choice of fuel and whether demand reaches the low or high end of the indicated range. In Singapore, and to a certain extent in Thailand, lower oil prices and the influence lower oil prices will have on natural

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gas prices will reduce the likelihood of coal being selected as the fuel source for new power generation. In Indonesia, the choice of fuel for new generation is expected to be coal in both fuel price scenarios because of domestic resources and a commitment to use coal. However, because of the influence that Indonesia's oil revenues will have both on its economic growth and its ability to finance new projects, a lower demand for coal is more likely with lower oil prices. Conversely, in the Philippines, an oil importing country, lower prices will tend to stimulate economic growth and power consumption.

Coal Supply

Coal supply from the ASEAN countries is projected to increase to levels similar to coal demand in ASEAN.

Coal Supply by Country	1983	1990	1995
	- million tonnes per annum -		
Philippines	1.0	3.3 to 3.8	4.5 to 5.9
Thailand	2.0	8.8	12.9 to 13.3
Malaysia	-	-	-
Singapore	-	-	-
Indonesia	0.7	12.6	18.9 to 25.0
Total	3.7	24.7 to 25.2	36.3 to 44.2

The indicated range in production for the Philippines reflects the preliminary planning stage of some of the proposed new mines and the possible lower level of domestic demand. Although no production is shown from Malaysia, the potential exists and production is quite probable in 1995, particularly in the high energy price scenario.

The major increases in coal production will be on Sumatra and Kalimantan in Indonesia and at the Mae Moh mine in Thailand serving the mine mouth power plant. The mines on Sumatra are now being developed whereas development is just about to start on a major scale in Kalimantan.

Mining costs in Kalimantan and at the Ombilin mine in Sumatra are expected to be competitive with internationally traded coal in both the low and high coal price scenarios. Costs of production from most of the other mines in ASEAN will be similar to the high price scenario of $60/tonne cif and will be used to serve domestic markets.

The range of coal production in Indonesia reflects the possible range of domestic and international demand that may occur and the possible range of coal prices. As in the case of demand, there is a greater likelihood that the higher end of the range of 36.3 to 44.2 mtpa will be achieved if oil and coal prices increase as outlined in the high energy price scenario.

Coal Trade

The Philippines, Thailand and Malaysia, and Singapore in the high forecast, are all projected to be coal importers. Although a net importer in the medium term, Indonesia is projected to be a major exporter by 1990. The projected quantities of imports and exports are:

	1990	1995
	- million tonnes per annum -	
Imports		
Philippines*	0.3 to 0.6	0.4 to 0.9
Thailand	0.4	0.5 to 3.7
Malaysia	2.7	3.2
Singapore	0.0	0.0 to 1.7
Total	3.3-3.6	4.6-9.0
Exports		
Indonesia	4.7	5.4 to 9.3

* Based on Philippine demand and supply figures from previous tables adjusted for heating values. The higher figure of 0.9 mtpa in the Philippines in 1995 is considered more likely to occur in the lower energy price scenario. Figures may not add due to rounding.

Although Indonesia's exports closely match the required imports of the other ASEAN countries, it is unlikely that Indonesia will serve all, or even most of those markets. Indonesia will be serving other markets in northern Asia and the importing countries will, in general, prefer some degree of diversity in coal supply.

Required Investment

The projected investment required to mine, transport and utilize the coal will total some $9.4 billion to 1990 and between $4.2 and $7.8 billion between 1990 and 1995. A large portion of the facilities making up the 9.4 billion by 1990 are under construction. The breakdown of the investment requirements is shown below in 1984 U.S. dollars.

	1984 to 1990	1990-95	Total
		- $ millions -	
Philippines	810	470 to 830	1280 to 1640
Thailand	1970	890 to 2010	2860 to 3980
Malaysia	960	630	1590
Singapore	-	0 to 800	0 to 800
Indonesia	5610	2250 to 3550	7860 to 9160
Total	9350	4240 to 7820	13590 to 17170
Coal Consumption	5550	3510 to 5780	9060 to 11330
Coal Mining	2760	470 to 1380	3230 to 4140
Coal Transportation	1040	260 to 660	1300 to 1700

Policies and Institutions

The policies with respect to coal utilization in the ASEAN countries specify either that coal is the major source of fuel for thermal power generation and cement production or that the fuel sources for these uses are diversified to include coal. Subsidies on oil, which previously inhibited coal use, have now been removed in all ASEAN countries and in some instances there are substantial taxes on fuel oil.

Policies with respect to coal production, particularly the role of government and the incentives to domestic and foreign private sector companies, vary from country to country. In a number of instances, clarification and improvement in such policies are required to achieve production potential.

Although the institutions are in place to develop, transport and utilize coal in the ASEAN countries, the absence of adequate timely information, cumbersome project implementation procedures and the lack of co-ordination between the institutions within each country, are potentially the largest constraints to coal development in ASEAN. In particular, there is the need for more co-ordination in the planning and implementation of coal mines and facilities required to transport and use coal.

ASEAN Co-operation

The two main areas for co-operation within ASEAN are coal trade and the exchange of information and experience. Coal trade may take the form of the four importing countries importing part of their requirements from Indonesia or possibly making a joint investment in a mine in Indonesia.

The opportunities for the exchange of information stem from the similarity of the facilities that each country will be installing and the relative timing of these installations. Two of the countries are presently commissioning coal-fired power plants in the 300 to 400 MW range and over the following ten years the other three countries will potentially be commissioning similar facilities. Similarly, the Philippines is well advanced in the types of transportation facilities the other countries will need. There are major opportunities for the countries which are more advanced in a given field to provide training to the others.

CONSULTING AND TECHNICAL SERVICES FOR UTILITIES AND INDUSTRY

Agreement for Consulting Services Between
Fuel Supply Service, Inc. and Economic Development
Foundation, Inc. Effective February 11,1985

Final Report

Agreement for Consulting Services Between

Fuel Supply Service, Inc. and Economic Development

Foundation, Inc. Effective February 11, 1985

Final Report

I. Summary of Meetings/Presentations

Tuesday, February 26, 1985, at Brookhaven National Laboratory

The purpose of this meeting was to review the presentations, by the various contractors, of the results of the comprehensive assessment, prior to the final presentations at the Philippines, later in April.

Specific Comments

1. The rheological work that was done by Brookhaven shows that the Power Law Indices (PLI's) were in the range of 0.5 - 0.6. This shows a high degree of pseudoplasticity, which is very desirable. To date, almost all of the slurries analyzed by FPL tended to be dilatant (PLI greater than 1.0), with the exception of a no additive, lower concentration (approximately 54% solids, by weight) slurry. The PLI of this particular slurry was approximately 0.8.

2. The economics presented assumed a capacity factor of 75%. In our economics, we have assumed a 65% capacity factor. In our opinion, a 75% capacity factor may be difficult to achieve.

3. The most critical item, or the area that seems to have the greatest degree of uncertainty, is the coal sourcing. The overall project economics will depend on the availability of a sufficient quantity of coal feedstock with a consistent quality for the CWM preparation process.

Headquaters Meeting - Miami, Florida 3/1/85

A meeting was held with Mr. M. C. Cook, FPL Group Vice President and other FPL representatives and representatives from the NPC, EDF, and the Project Team. The meeting was unstructured in format which allowed for a free exchange of information between the parties. The following summarizes the views expressed by FPL in the meeting.

- FPL's system was described and the role of a CWM conversion vs. other near term energy options was discussed. These other energy options include:

  - Capability to buy coal power from other companies, although additional transmission lines would be required;
  - Use of more natural gas;
  - Conversion to pulverized coal (PC).

- The differences between CWM and PC were compared. These include:

- Coal handling for CWM is by someone else,
- CWM plant operates at a higher capacity factor than power plant and can serve several power plants,
- CWM plant is financed by someone else,
- Environmental considerations are in favor of CWM,
- On a long-term basis, economics are about the same, PC is a higher capital investment (approximately two to three times the initial capital requirement) while CWM has a higher processing cost,
- Coal sourcing for either fuel is not a problem since many suppliers can provide the needed type,
- Many CWM suppliers can make a technically acceptable fuel; the price, terms and conditions would be the deciding factors.

- The need for a CWM demonstration was discussed and the current status presented. Specifically,

  - The question on how well CWM will burn in our boilers has not been resolved; although it should perform satisfactorily, and we believe it will, it still needs to be demonstrated through an actual test burn,
  - FPL would not commit to a full permanent conversion without doing a test demonstration burn first,
  - The basis for a CWM demonstration burn test was to describe minimum boiler and plant modifications, using all rail delivery of CWM to plant,

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- The CWM producer will be responsible for purchasing the coal, not FPL, although we would still be involved with the selection, especially for the permanent conversion,
- The concept of a "zero cost to the customer" demonstration was discussed,
- As of this time, no producer has a processing plant big enough to meet the test requirements, thus, the demonstration will also test a producer's ability to scale up his facilities,
- A turnkey arrangement, whereby a producer would modify FPL's plant and supply fuel, is being investigated.

- The permanent conversion of some of FPL's units to CWM was discussed, specifically:

  - FPL would have to make a decision on permanent conversion by 1987,
  - For the permanent conversion, we would still need to retain oil capability, but not simultaneously with CWM,
  - Future coal prices in the U.S. are expected to be based on production costs and will move with inflation while oil prices in the U.S. are expected to be based on market conditions with fluctuations in price according to supply and demand conditions,
  - The economic benefits from a conversion to CWM in 1989, will begin in the early 1990's,
  - FPL will probably contract with only one producer for the

total CWM supply for the permanent conversion of a plant, rather than use multiple suppliers,

- Another possibility is for FPL to produce CWM fuel itself. However, from FPL's financing and regulatory viewpoint, it is better to have an independent buyer and seller relationship for the fuel supply,
- We also discussed FPL's thoughts on a type of pricing formula for the permanent conversion with a guaranteed maximum price and some type of "banking" arrangement.

- Ideas on a Philippine demonstration were discussed. The risks and benefits of a turnkey type arrangement were addressed. This approach, if pursued with several suppliers, could keep options open as long as possible.

- Several other ideas that should be considered were addressed. These include:

  Quality control is a problem that must be dealt with in CWM production,

  Cleaning of coal to get a higher quality coal, including benefication and mine preparation, were discussed,

  Overall economics, on an overall integrated project basis, must be considered and evaluated,

  Until a contract is signed, the element of competition should be maintained.

Monday, April 15, 1985, Morning at the Economic Development Foundation (EDF) Office

1. The consulting team discussed the agenda and schedule for the week, planned last minute details for the presentations and decided on who was to attend which meetings.

2. The proposal follow-on organization was presented by Mr. Bliss and discussed by the team.

Specific Comments

1. The proposed follow on project organization is quite adequate for the work to be done. In fact, it is very similar to the one that FPL developed for our own Phase II CWM evaluation which was the basis of the report presented at Brookhaven and Manila.

2. In my opinion, the most critical area to be addressed in the follow on work is that of refining the coal source data and CWM specifications. Thus, the development of the mine plan, sampling, etc., and further work with slurry manufacturing should be a first priority item.

3. The necessary follow on work for the engineering work required in the area of slurry transportation, boiler and plant conversion and operation, cannot be done until the specifications of the slurry fuel are definitely known. Thus, this engineering work would be a second priority item.

4. Although the mine plan and development work could be awarded to a contractor at this time, it is my opinion that it is too early to award the slurry preparation work to a single contractor. More work in the area of experimentation and slurry formulation work by various producers using the Semirara coal is definitely recommended before a producer is selected.

5. During the follow on work, the boiler manufacturer should be part of the team. This can be done via a direct contract or through a sub-contract from the Architect Engineer. Since the work of the boiler manufacturer has to be closely coordinated with that of the A/E, my recommendation would be that it be sub-contracted through the A/E.

Monday, April 15, 1985, Afternoon, at the National Power Corporation (NPC) Office

Format of the meeting was an unstructured Question and Answer period to allow the NPC personnel to familiarize themselves with the project and get clarification of any issues they thought important.

Specific Comments

1. Question and answer sessions are a good way of sharing information, but should be done after the group or audience has been pre-directed through a presentation, which sets the tone and purpose of the meeting.

2. However, unstructured Q/A sessions can be used to find out what concerns the audience has and what pre-conceived ideas it may have, before a presentation is made. This will allow the presenter to take these concerns and ideas into account and factor them into his presentation.

3. Thus, although somewhat frustrating at the time, I thought this meeting at NPC was valuable since it allowed the team to discuss the issues informally, from an at times critical point of view, and thus modify its presentation and prepare a better presentation for the other meetings and the formal, public presentation on Wednesday.

Tuesday, April 16, 1985, Morning, at the Asian Development Bank (ADB) Office.

Presented FPL's Phase II CMW Evaluation Project results. The consulting team presented the results of the assesment done on the introduction of CMW fuels to the Philippines. This was a well organized, structured meeting at which the key points and conclusions were discussed with ADB personnel. The presentation was followed by a Q/A session during which the more relevant points of the presentation were discussed. This was in my opinion, a good, rewarding meeting at which the team was able to get its point accross to the audience regarding the feasibility, desirability and advantages of CMW fuels in the Philippines.

Tuesday, April 16, 1985, Afternoon at the Development Bank of the Philippines (DBP) office.

This meeting was very similar in context to the one at ADB. Present in the audience were the Deputy Minister for Energy and Industry, other key government personnel and key personnel from NPC. Again, this was a well organized, structured meeting at which the key points and conclusions of the assessment were discussed. From the audience reaction and Q/A session afterward, it was apparent the team had gotten its point across to the audience.

Wednesday, April 17, 1985, Morning Public Presentation at the Manila Peninsula Hotel.

The consulting team, including FPL, presented its findings to the public forum. The audience consisted of a cross-section of Philippine government, industry, private enterprise, public sector and international representatives interested in energy matters. The session was opened by the Deputy Minister for Energy and Industry.

Specific Comments

This was an extremely well organized and run presentation. The EDF team did an outstanding job of organizing the presentation and other related functions, including press coverage. The consulting team, including FPL, presented its findings in a simple, concise manner with an adequate level of detail for the

general audience. The general presentation was followed by a Technical Q/A session in the afternoon. During the time I was at the Q/A session, there was an enthusiastic exchange between the panel and the audience.

In my own opinion, the team achieved its objective of presenting the results of its assessment of introducing CWM fuels to the Philippines and demonstrating the feasibility and desirability of doing so, including the very significant economic advantages that would result from doing so.

Unfortunately, there could have been more open support of the assessment by slurry producers. This was one area which was somewhat weak in the presentation. It would have been much more convincing to have more slurry producers express their interest for the project in a public manner. However, this lack of aggressiveness seems to be part of the way the slurry producers are operating their business, which makes little overall sense from a marketing point of view.

Another statement which did not help much was the one by the Semirara Coal Co. president. If possible, it would have been desirable to have him on the team's side and get him to make a positive statement.

Wednesday, April 17, 1985, Afternoon with Energy and Industry Minister Velasco

This meeting was an informal exchange of information with the Minister, to appraise him of the results of the assessment. Main presentation was by Dr.

Gorden, on the overall economics of the project, followed by a Q/A session with selected team members participating.

Thursday, April 18, 1985, Morning at the National Power Corporation (NPC) Offices

This was a meeting with the NPC department heads to appraise them of the main points of the assessment and give them an opportunity to discuss them. Presentations were made by the Team, including FPL, then the meeting was opened for Questions and Answers.

Specific Comments

This was a more structured meeting than the one on Monday afternoon. The presentation enabled the team to inform the audience in reference to what the assessment had considered and the findings. Thus, the questions were more directly related to key points of the assessment.

II. General Observations/Commentary in Reference to EDF's Assessment of the Introduction of CWM Fuels to the Philippines

This assessment is similar, in many respects to the one done by FPL to determine the feasibility of using CWM fuels as a fuel in oil fired boilers/plants. However, although the results of both are similar, i.e., that CWM fuels are feasible and viable, financially attractive means of replacing fuel oil, there are, as would be expected, certain basic differences between the FPL proposed project and the one being proposed for the Philippines. These differences, the considerations that they dictate, as well as the similarities between the projects will be addressed in the following comments.

- In the U.S., there are a great number of high rank coals, with known reserves, quality and expected price which can be used as coal supplies for the production of 70% coal, 30% water (by weight) CWM (highly loaded CWM). Thus, FPL's program concentrated on evaluating the performance of various CWM production processes with three pre-selected coals, rather than evaluating the ability to produce an acceptable slurry from a particular coal as is the case in the Philippines.

- What this does is make it absolutely a high priority item that all unknowns relating to the coal to be used as feedstock be determined, with a high degree of confidence, prior to proceeding with additional work on the project. Items that must be addressed are:

  Recoverable Coal Reserves and their quality,

- Mining requirements to obtain the delivered quality coal,
- Availability of fresh water at the process plant location,
- Operation and transportation related logistics and cost from mine to process plant.
- Specification(s) of the slurry that can be made from the available coal, obtained by supplying various CWM producers with enough coal of consistent quality such that they can experiment with it to determine the best and most economical CWM their process can make from the available coal.
- Laboratory test work on the most desirable CWM samples to determine their properties, their behavior under various operating conditions, and atomization and combustion properties.

- Once the CWM characteristics and specifications are known with a dependable certainty, then the rest of the work such as CWM transportation logistics, and boiler and plant conversion related engineering, all of which use the CWM fuel specification as a primary input, can proceed. To do any kind of detailed engineering analysis at this time, beyond the preliminary assessment already done, with the currently available CWM information, would be premature.
- The economic evaluation presented gave a good, conservatively based, indication of the desirability and advantages of introducing CWM to the Philippines. Naturally, as some of the suggested follow-on work is done, more definitive answers will be available. Thus, some of the extra conservatism (contingency) included in some

of the numbers may potentially be reduced thus, further enhancing the benefits of the project.

One specific area regarding the economic evaluation which needs to be further investigated, is the one relating to operation of the units when using CWM. This acquires special importance due to the fact that their nuclear unit, which would be base loaded, is nearing completion. In my opinion, the currently used 75% operating capacity factor is too high for a CWM fired plant (it is high even for a pulverized coal fired plant). An operating capacity factor of 60% to 65% is much more realistic, even for a base loaded unit. Thus, the economics should be run with a lower (62% is suggested) operating capacity factor. Although this would probably lower the overall economic benefits, it would result in a more accurate representation of the benefits.

As part of the follow-on work, sensitivity studies should be done, over a range of expected values for key parameters such as coal costs, CWM costs, transportation costs, capital and operating costs, fuel oil or avoided fuel costs (if more than fuel oil is being replaced due to system operating characteristics, etc.). This sensitivity study will help determine the range of values over which these key parameters may vary and the impact on the overall economics which such variations may cause.

As previously mentioned in this report, the work done during the assessment and the results themselves, closely approximate parts

of our own assessment and the results we obtained. The assessment program was well thought out, planned and it covered the necessary and essential factors that had to be considered. Thus, in my opinion, the findings resulting from this assessment are valid and clearly indicate that CWM introduction into the Philippines is desirable from an economic point of view. Although such economics can clearly be refined as a result of the follow-on work, it is my opinion that after such refinement, they will continue to clearly show that the project is viable and would be of measureable economic benefit to the Philippines.

III. Recommendations

The suggested follow-on organization needs to be discussed further and refined according to user needs and suggestions. One area where some "streamlining" or simplification of the proposed organization could be made is to have only one Steering Sub-committee to handle both the coal supply CWM fuel issues as well as the boiler/unit conversion issues, under the leadership of the Steering Committee. Although this may be more work for the Sub-committee, it would provide for closer coordination between fuel supply and unit conversion due to one sub-committee being responsible for both areas. The close coordination between CWM supply and unit conversion being essential to a successful project.

The consulting team should now concentrate the project work on refinement of Sucat Unit 2 conversion plan, design and costs. The current assessment data, refined only where necessary, should be used to justify proceeding with the conversion of Sucat 2 as a low cost, low risk way of proving the findings of the assessment. If Sucat 2 conversion and operation on CWM is successful, then it would have proven the assessment accurate and conversion of the rest of the units can be considered.

The team should refine the data, design and cost of the Sucat 2 conversion and make it clear to the decision makers that approval is being requested for only a first phase , at a small cost and risk (relative to the overall conversion of Sucat plant), with a definite goal and a clear cut go/no go milestone at the end of the first conversion.

IV. Summary of Findings from FPL's CWM Study Project

Rheology and Fuel Handling

The lower concentration fuels (less than 68% solids, by weight) are easier to handle than the higher concentration fuels (68-71% solids, by weight). In fact, the slight dilution of some of the high concentration fuels, as received, resulted in a major decrease in the apparent viscosity of the fuel.

There are two major types of dispersants or surfactants being used in the formulation of coal-water mixtures - ionic and nonionic. The ionic dispersants are generally less expensive than the nonionic and can withstand higher temperatures. CWM's formulated with nonionic dispersants tend to form gels when heated to between 40 and 60 degrees Celsius. This could be critical when considering storage in a hot climate.

Unit Conversion

A detailed engineering study is essential prior to conversion in order to identify the required boiler modifications and the expected unit performance after conversion.

CWM Production

The simpler process designs seem to result in lower capital requirements, greater reliability and ease of operation, and easier expansion and replication.

Quality control could become a problem, however, if there are major fluctuations in feed quality, since both operation and formulation and thus, CWM product quality, are dependent on the properties of the coal.

We feel that any coal cleaning should be done at the mine for several reasons. First, it is easier to dispose of the ash at the mine than at the CWM preparation plant. By separating the cleaning from the CWM production, the process design for the CWM production could be simplified considerably. Finally, some of the frothing and collecting chemicals used particularly in froth flotation may interfere with those chemicals used in CWM preparation. This could increase the cost of the CWM preparation and the complexity of the process itself.

Environmental Considerations

CWM is more environmentally desirable than pulverized coal since it is a liquid fuel which can be transported and stored much like residual fuel oil. This eliminates the problems associated with noise from train unloading, dust and runoff from coal piles, etc. A conversion to CWM also requires less space, which, when combined with the superior environmental qualities, is an ideal conversion fuel for plants in land-locked urban areas.

Demonstration

A CWM demonstration or test prior to a permanent coversion is necessary and advisable. The permanent conversion costs can be potentially decreased

through better equipment design and specification which would result from the refinement of the design based on the performance data gathered during the demonstration.

To be forwarded

FINAL REPORT OUTLINE

COAL WATER MIX FEASIBILITY STUDY IN THE PHILIPPINES

VOLUME I

PROJECT FEASIBILITY ANALYSIS

SEPTEMBER 28, 1984

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2. DISCUSSION OF OPTIONS UNDER INVESTIGATION
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      - Mine Construction Requirements - The location and expansion and/or construction requirements of mines which will be required to provide the coal to be used in the CWM.
      - Coal Transporation Requirements - The shipping or possible slurry pipeline requirements which will be necessary to transport the coal from the mine source to the coal-water mix plants.
      - Coal-Water Mix Plant Requirements - The location and construction requirements of the coal-water mix plant that will be used to provide coal-water mixture for the tests or conversion of facilities.
      - Coal-Water Mix Transportation Requirements - The shipping or possible slurry pipeline requirements which will be necessary to transport the CWM from the CWM Plant to the end-use boiler or electric facility.
      - Boiler/Electric Plant Requirements - Possible requirements in the testing, conversion, or construction of boilers, electric plant, or associated facilities which will be required under each option.
      - Other Requirements - Other requirements (such as the construction of a transmission line, etc.) which may be necessary to implement each option.
   C. Major variations of Each Option Under Consideration: A description of each of the major variations that may also be considered under each base case option.

DESCRIPTION OF CONTENTS
(Continued)

3. Evaluation of Each Option: Each option and variation of the option is quantitatively analysed over time according to its capital and operating costs, revenues, financial and economic indicators, foreign exchange impact, employment impacts, the risks associated with the ptions, and the sensitivity of the results in the following manner:
   - Capital and Operating Costs - Capital costs investment requirements in each option include costs such as equipment costs, installation costs, contractor's fees, contingency fees, royalties, etc.while operating costs include costs such as the fixed, variable, and fuel costs of the project.
   - Revenues and Avoided Costs include the revenue streams which are associated with each project when applicable and may include items such as electricity sales, shipping fees, pipeline charges or CWM sales etc. while avoided costs represent the cost savings which are achieved by not having to proceed with other investments (i.e. the Isabella Station) because of the implementation of this option.
   - Financial and Economic Indicators - Typical indicators used in this analysis will include: NPV, IRR, ROE, ROI, and payback periods.
   - Foreign Exchange Impact - The analysis will also evaluate the foreign exchange benefits and outflows which are associated with each of the options, including the cost of imported equipment and consulting advice as well as savings associated with decreased oil imports.
   - Employment Impact - the impact includes the net gain or or loss in jobs in the domestic labor force associated with each option.
   - Risk Assessment and Sensitivity Analysis - Risks associated with the implementation of each option will be addressed and the sensitivity of the outcome of each option will also be evaluated according to the impact of, and variations made in, the assumption of key variables.

4. CONCLUSIONS AND RECOMMENDATIONS
Conclusions will be drawn from the analysis of the options and recommendations will be offered regarding appropriate courses of action for the client to follow.

FINAL REPORT OUTLINE

COAL WATER MIX FEASIBILITY STUDY
IN THE PHILIPPINES

VOLUME 2

TEST DESIGN AND PLAN

OCTOBER 4, 1984

FINAL REPORT OUTLINE

COAL WATER MIX FEASIBILITY STUDY IN THE PHILIPPINES

VOLUME 3

COAL WATER MIX FACILITY

OCTOBER 4, 1984

(DS 209.04)

IDENTIFICATION AND DESCRIPTION OF A TECHNICAL ASSISTANCE PROGRAM IN COAL DEVELOPMENT FOR THE GOVERNMENT OF THE PHILIPPINES

FINAL REPORT

Contract No. PDC-1406-I-04-2166-00
Work Order No. 4

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Submitted to:

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by:

Development Sciences Inc.
Sagamore, MA

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EXECUTIVE SUMMARY

The following document describes the technical assistance project for enhancing the production and encouraging the consumption of coal as a means to replace imported petroleum. The project consists of seven activities which make an integrated package of technical assistance for the development and use of coal in the Philippines. The use of domestic coal provides a major opportunity to save foreign exchange and create employment, with lower costs anticipated for the consumer.

In order to meet the objectives of increasing production and consumption of coal, the government and private sector in the Philippines have taken a series of measures over the last few years. The activities described below are designed to complement and amplify those measures. The proposed activities cover a series of needs in the area of coal development, the object of six of the seven activities, and the introduction of coal water mix technology, the object of one of the activities of the integrated package.

The coal development activities include market analysis, training in various aspects of coal mine feasibility, mining and safety, cost accounting, and coal preparation. Coal development also requires better resource assessment and updating techniques as well as measurement of coal quality. These activities then will be followed with a method for the prioritization of coal development and utilization. These six activities touch on the most essential needs of the country to fill gaps in technical knowledge that would otherwise inhibit the production and consumption of coal.

The implementation program for the coal development activities is recommended to be placed under the jurisdiction of the Ministry of Energy of the

Government of the Philippines. The procurement of a technical assistance contractor to support the activities is also recommended.

An additional activity for the introduction of coal water mix (CWM) technology provides the potential for a much needed reduction of costs in coal conversion efforts. This technology promises to avoid the step of investing in coal facilities and handling equipment at each conversion site. Through the prior preparation of coal to give it liquid properties not unlike fuel oil, current oil fired boilers can readily retrofit. The mix of specially prepared coal and water should, therefore, greatly reduce the capital required by consumers intending to convert to coal. The first target for this technology will be in power generation and later targets will be more diverse.

The activity ultimately will move from feasibility to demonstration to application of both total and partial combustion of CWM. It consists of a number of steps to, first, prove the feasibility of using local coal to make coal water mix fuel; second, to test and demonstrate the fuel in a 30 MW boiler at the Marinduque Mining and Industrial Corporation, where the existence of a boiler, roaster, and a storage facility lowers costs of a test; and, third, to anticipate an application of a major conversion of the 800 MW power station run by the National Power Corporation at Sucat.

The implementation program for CWM consists of a series of phases to be carried out with the Economic Development Foundation in the Philippines. It is recommended that the EDF play a local coordinative role, assisted by technical assistance from a USAID contractor. While this activity is integrated into the coal development program discussed above, it is a separate activity from the point of view of implementation and EDF does not have responsibility outside of the CWM Activity. The timing, skills, and local knowledge required argue for a separate and early start with the local support of the EDF.

With activities designed to improve supply and demand as well as to prioritizing and balancing coal development and use, the substitution of coal for oil can proceed at an ambitious pace.

PREFACE

The Government of the Philippines hosted a conference on the utilization of coal in that country in February 1983. At that time, interest was expressed to continue relations between USAID and the GOP with reference to developing the local coal industry and introducing coal conversion technologies. With the objective of stimulating demand for coal and improving the capability for supplying coal from domestic sources, consideration was given to creating a technical assistance program.

In response to this interest, the Energy Office of USAID Washington sent a contractor, Development Sciences Inc., to the field to investigate an appropriate approach. An initial reconnaissance visit was undertaken from July 18 to August 5, 1983. The results of this visit were reported to groups in both Washington and Manila and revisions were suggested and incorporated in time for a full team visit from September 19 to October 15. The team members were Dr. Morton Gorden, Mr. Robert Rollins, Mr. William Watson, and Ms. Marsha Gorden, all senior members of DSI with years of experience in coal mining, combustion, marketing, and planning.

Coincident with the DSI visits, the U.S. Geological Survey also fielded teams to develop activities leading to knowledge of the coal resource. The USGS initial team visit from July 24 to August 5, 1983 included Mr. Edwin R. Lundis, Mr. Jack H. Medlin, Ms. A.L. Medlin, and Ms. M.D. Carter. Ms. Carter also visited in October.

During the second visit, a full proposal for a technical assistance project was jointly developed with Philippine counterparts. A list of participants appears in Appendix D. The body of this report provides a description

of the proposed activities recommended by the reconnaissance team based on their experiences from late September to mid-October in the field.

The team experienced extraordinary cooperation from their counterparts and from a decision process in the Philippines which thoroughly reviewed the proposed program of activities in detail. The team is thankful and grateful for the many hours of such priority attention.

ONE. AN INTRODUCTION TO THE PROBLEM

The Philippine economy has traditionally been based upon petroleum. Imported oil has served the nation's increasing power, agriculture and industrial needs. Recently, per capita energy consumption has increased from about one barrel of oil equivalent in the mid-sixties to one and three-fourths barrels in the early eighties. Similarly, the oil import bill has grown from less than a tenth of total export revenues in the early seventies to more than one-third of the 1981 export proceeds. The import/export imbalance is now worsening. This inbalance, much of which is due to the use of oil, has led to a series of key policy objectives as noted in the Philippine Energy Development Program of 1982-1987.

- SUPPLY OBJECTIVE. To provide timely, adequate, secure and affordable energy supplies to support the goals set out in the National Development Plan.
- EFFICIENCY OBJECTIVE. To promote the best use of energy fuels, within the context of given socio-cultural institutions and constraints.
- ENVIRONMENTAL OBJECTIVE. To insure that both objectives above are met in an environmentally acceptable fashion.

The continuation of the recent development of indigenous coal resources can be seen as one important factor consistent with these three objectives. Indeed, the significant reserves of coal, if developed in a timely and cost-effective manner, offer an excellent opportunity for fuel replacement in both the power and industrial sectors of this expanding economy.

The known coal deposits in the Philippines are found to be well distributed over the many islands of the archipelago. A good many are small and discontinuous while the great majority range in quality from sub-bituminous to lignite. Even though coal has been known and used in the islands for many

years, its locations and limited properties such as heat content have prevented extensive utilization. Power and industrial development have generally been based on imported oil, with support from hydroelectric and geothermal facilities. The increased importance of reducing oil imports along with the unreliability of hydro in drought years has led to interest in the expansion of the coal sector.

During 1982, additional drilling and exploration activities increased the total proven reserves to 263 million metric tons, of which 178 million are estimated to be mineable. This coal can be found in many locations, but approximately half of the reserves are identified on the island of Semirara. Other major deposits are found in the Cagayan Valley of Luzon and the Surigao and Zamboanga regions of Mindanao, as shown in Table 1, "Proven Coal Reserves."

Table 1
PROVEN COAL RESERVES*
(As of December 1982)

	Million Metric Tons	Percent of Total
Semirara	131.8	50.0
Cagayan Valley	64.2	24.4
Surigao	19.6	7.4
Samar-Leyte	5.2	2.0
Zamboanga	18.6	7.0
Southern Mindoro	4.0	1.5
Northern Cebu	1.8	0.7
Central Cebu	2.4	1.0
Southern Cebu	5.5	2.0
Batan Island	7.2	2.7
Quezon Province & Polillo Island	0.4	0.1
Catanduanes	0.6	0.2
Negros	1.7	1.0
Davao	0.2	--
Masbate	0	--
	263.2	100.0

* Based upon USGS Report, July 1983. For site locations, see map of Philippines at end of report.

These new exploration activities, especially in the Cagayan Valley, are leading to a replacement of Cebu coal as the major supplying island. In 1980, for example, over 80 percent of the coal production came from the island of Cebu with 2 percent from Semirara Island. By 1982, as shown in the following table, "Coal Production in 1982," Cebu production was down to less than half of the total mined in the country.

Table 2
COAL PRODUCTION 1982*

	Metric Tons	Percent
I. Semirara	90,808	16.3
II. PNOC Areas		
A. Malangas, Zamboanga del Sur	100,419	18.0
B. Bislig, Surigao del Sur	32,029	5.7
C. Uling, Cebu	12,068	2.2
Sub-Total (II)	144,516	25.9
III. Cebu (Private Sector)	248,557	44.5
IV. Outside Cebu (Private Sector)		
A. Batan Island, Albay	39,630	7.1
B. Polillo, Quezon	12,681	2.3
C. Malangas, Zamboanga del Sur	15,819	2.8
D. Others (Masbate, Davao Oriental)	5,972	1.1
Sub-Total (IV)	74,102	13.3
V. Total	557,983	100.0

* Based upon USGS Report, July 1983. For site locations, see map of Philippines at end of report.

Coal quality across the islands varies with the great majority classified as either sub-bituminous or lignite. In addition, there are small quantities of bituminous. Since there is variation within any of the deposits, it is appropriate to show coal quality parameters as a range.

Table 3
COAL QUALITY*

	Heating Value (10 Btu/lb.)	Volatile Combustible Matter (%)	Total Moisture (%)	Ash (%)
Cagayan Valley	7.0 - 8.0	28 - 34	11 - 16	29 - 32
Polillo-Batan-Catanduanes	8.6 - 13.4	22 - 52	10 - 30	3 - 30
Samar-Leyte	7.5 - 9.5	35 - 45	10 - 25	9 - 13
Northern Cebu	7.4 - 10.6	42 - 51	15 - 20	5 - 20
Central Cebu	7.4 - 10.6	42 - 51	15 - 20	5 - 20
Southern Cebu	10.9 - 11.8	44 - 48	4 - 10	5 - 10
Surigao	7.0 - 10.0	45 - 52	8 - 20	5 - 30
Davao	7.0 - 8.0	32 - 37	22 - 31	6 - 12
Zamboanga del Sur	10.5 - 12.9	20 - 51	2 - 10	3 - 10
Negros	8.1 - 9.5	42 - 51	12 - 25	10 - 30
Semirara	8.5 - 10.0	45 - 52	25 - 30	6 - 12
Southern Mindoro	9.4 - 11.0	50 - 55	27 - 30	5

* Based upon USGS Report, July 1983. For site locations, see map of Philippines at end of report.

Table 3, "Coal Quality" indicates relevant properties with their ranges for the major coal bearing areas. Limited sulfur data indicate generally low values. The determination of coal rank following the ASTM classification system is based primarily on the fixed carbon or volatile matter and the heating value (Btu/lb.). As can be seen from the table, there is variation from site to site as well as within a location, requiring specific analyses for specific coal uses.

Current National Goals

There is a six-year coal development program (1982 - 1987) actively encouraging the expansion of coal use. It is based upon additional electrical generation, cement plant conversions, and additional industrial use as appropriate, depending upon plant location and coal quality and quantity requirements. Table 4, "Projected Coal Demand," illustrates these major consumers for this time period.

Table 4
PROJECTED COAL DEMAND*
('000 MT at 10,000 BTU/lb.)

Major Coal Users	1982	1983	1984	1985	1986	1987
National Power Corporation	147	188	188	1,127	1,503	1,720
Atlas	330	480	531	531	531	531
MMIC	162	900	1,084	1,084	1,084	1,084
Cement	295	858	1,197	1,432	1,470	1,613
Philphos	--	--	50	50	50	50
National Steel Corporation	--	--	266	1,065	1,332	1,332
Others	113	113	313	313	349	349
Total	1,047	2,539	3,629	5,602	6,319	6,679

* The Philippine Energy Development Program 1982-1987, Ministry of Energy, Republic of the Philippines

Along with the expanding market, there are increased supply activities. It is anticipated that production will increase from 330,720 MT in 1981 to 4.3 million MT in 1987. Fifteen additional service contractors will be added

to the twenty-seven in operation at the end of 1981 for development and production. Similar contracts for exploration will also be added. The program anticipates that proven reserves will be documented at a level of 600 MT in 1987, up from 220 million MT in 1981.

An accompanying Coal Logistics Program over this same period will provide seven coal terminals, four coal outloading ports, and three relay stations. Additional coal carrying vessels will similarly be required. All of these activities will not be sufficient to provide the needed coal for the markets as shown in Table 5, "Projected Coal Supply and Demand." It is anticipated that the shortfalls will be met by imported coal as shown in Table 5.

Table 5
PROJECTED COAL SUPPLY AND DEMAND*
(In Thousand Metric Tons at 10,000 BTU/lb.)

	1982	1983	1984	1985	1986	1987
Coal Supply	834	1,773	3,235	3,838	4,273	4,273
Coal Demand	1,047	2,539	3,629	5,602	6,319	6,679
Coal Import Requirement	213	766	394	1,764	2,046	2,406

* Bureau of Energy Utilization, June 1983

Accomplishments to Date

Coal production has increased. Recently released figures for the first half of 1983 show a production of 594,000 MT as compared to 213,000 MT for the first half of 1982, an increase of 179 percent. Coal consumption for the same period in 1983 shows 351,000 MT as compared to 141,000 MT in 1982, an increase of 150 percent. Both of these figures, however, show that the projections of Table 5, "Projected Coal Supply and Demand," have not been met. It will take a concerted effort with specific actions on the part of both suppliers and users to meet this challenge.

TWO. THE CHALLENGE TO COAL PRODUCERS AND CONSUMERS: THE PROBLEMS TO BE ADDRESSED

As is indicated in the previous section, the coal producers of the country have never before accomplished goals of the magnitude currently set for them. Indeed, a key issue is whether or not significant amounts of coal will have to be imported to meet demand. The necessity to import coal for blending or simply for supplying adequate quantities is a major point of disagreement between producers and regulators of the coal industry. The consumers considering conversion to coal also show strong interest in the outcome. Whatever the prediction of the outcome, all parties are interested in increasing domestic production to minimize foreign exchange costs spent on oil or coal. For this to occur, a number of questions need to be answered, and uncertainties reduced regarding the supply and demand for domestic coal.

The producers have asked where the market will be if they expand production. The government has answered that it will be in power, cement, and other industries, stimulated by regulation or price incentives, or market research, or by assuring doubting consumers that there will be an adequate supply of coal for their timely use. With the mandating of conversion in the cement industry and with the planning for new pulverized coal combustion in the power industry, this question is of lessening concern to the producers. Even so, there remains enough uncertainty, especially as regards timing of demand, for the issue of markets to remain on the agenda of the industry and of government planners.

The rate of conversion is obviously linked to the cost associated with changing from oil to coal. Based on perceptions in the Philippines, and in most countries of the world, the conversion to coal is associated with substantial investment in coal handling facilities, boiler replacement, dedication of storage space, and other costly changes. Work done in the United

States and elsewhere now indicates the readiness of technologies which may mix coal with water and additives to create a combustible fluid with handling and operating characteristics much like oil. Knowledge of this technology as it applies to sub-bituminous coal of the type found in the Philippines is limited. The challenge to realize the promise of a new technology is not insurmountable, but special effort must be made to assure the application of this technique of preparing and using coal.

Still another concern which inhibits producers and raises doubts for consumers is the shortage of skills in the coal mining industry. While there is a long tradition of metal mining, the skills are not transferable to coal without some training demonstrating the differences between the two. One reason for planning to use imports is the doubt that skilled people can be recruited into the industry at the required rate. Indeed, one rather serious deficiency, from the point of view of financing, is the shortage of mining engineers with a credible record in coal feasibility studies. Banks are reputed to be reluctant to accept domestically produced studies as a basis for financing mine development. The challenge is to introduce about 3000 new skilled people into various aspects of coal production in the next ten years.

Assuming this increase in skills can be attained, there remains uncertainty about the coal resource itself. Knowledge of the resource is insufficient with reference to location and characteristics relevant to its commercial use. Coal is located in a number of different areas and it varies in quality. Furthermore, the records of its known attributes are in need of updating and improved accessibility. If investors are to be attracted to specific development opportunities and if planners are going to promise expanded levels of production, knowledge of the coal resource will have to be

expanded as well. The challenge is to do this in a timely fashion and build local capability for updating and maintaining an information system.

Still further along in the process of commercialization is the sale of coal to a consumer who also needs to know about the resource, but at the level of whether or not the coal meets contracted quality standards. Coal is a heterogenous substance and no two samples are exactly alike. Yet, differences of measurements are also induced by differences in man-made procedures such as preparation of samples, and a new coal industry needs to standardize performance. Moreover, certain critical coal properties may not even be recognized. The challenge is to create a national set of standards and assure their implementation among coal laboratories throughout the country.

Once the various challenges are met within the coal sector, local coal mines must then be developed according to a prioritization scheme that brings supply and demand into balance. While an exact balancing is probably not attainable, there is a need to minimize the breadth of the gap between the two. When production and consumption are out of phase, there are costs to be borne by all. One challenge is then to plan well for the scheduling of both markets and mines. Furthermore, the coal sector competes with other sources of energy, be it geothermal, oil and gas, or renewable energy. The prioritization of coal must, therefore, be related to the performance of other competing energy sources.

The prioritization effort raises the issue of criteria for selection of mine sites and the management of a coal distribution and marketing system. The use of the price mechanism in a free market for coal, thus, becomes a policy choice with important consequences for the success of conversion technologies. Coal pricing is a major concern for it affects producers' abilities to perform and has a major impact on the choice of fuel in the market-

place. Currently, coal is being offered at a price pegged to a fraction of fuel oil price. This is a consumer oriented incentive, but it may bear little relation to the producers' costs, which are often not well known by the price regulators. Indeed, the degree to which price is controlled or left to market behavior is itself open to question. At present, market behavior is closely monitored by the government and contracts between supplier and consumer require central approval. Even the details of contracting for coal are currently regulated matters of public policy.

Finally, based on numerous interviews with public and private sector participants in the coal sector, the very structure in which the resource will be managed is under discussion. There are various points of view on the role of the private sector and the public sector. The situation is, in fact, well modified and roles have been established, but the challenge will be to make them work as intended.

Thus, the development of coal in the Philippines must face challenges of technical, human, and institutional dimensions. An integrated technical assistance project of several component parts has been designed to meet the challenges which are appropriate to international cooperative efforts. That project and its various sub-projects are discussed in following sections.

THREE. THE DIRECTION FOR TECHNICAL ASSISTANCE: EMPHASIS ON THE TRANSFER OF SKILLS AND TECHNOLOGY

The challenges outlined in the previous section provide the backdrop for the directions to be taken by technical assistance. The desire to meet these substantive challenges should not overrule the need for a timely transfer of skills, and, where appropriate, technology to accelerate the production and consumption of domestic coal. Given enough time, the skills and technologies associated with the development of coal are likely to arise in response to demand in the Philippines. The severity of the foreign exchange problem does not, however, permit a slow response to the oil substitution process. Short time scales are more appropriate to the criticality of the current fiscal problems and to the fact that long term costly directions will be set by actions taken now. The job of technical assistance is to accelerate the response to the challenges outlined above. The formation of domestic capability to deal with the needs of developing coal with emphasis on transferring technology, not on simply installing it, provides criteria for the direction of the technical assistance. It should accelerate the development of coal production and use in the short term, but to assist in a manner that will leave long term capability in place.

The main value of bringing American experts to the Philippines is to share experiences. The reconnaissance team's impressions continually focussed on missed opportunities not seen by local coal producers and users, simply because the local personnel had not lived through the lengthy American experience with coal. Coal is a young industry in the Philippines, but it is being called on to grow rapidly to meet the national challenges. Technical assistance can accelerate performance when it is designed to transfer

experience to counterparts who will have the ultimate follow-up responsibility over the long term.

Whether the issue is as specific and narrow as the design of coal handling facilities or as general and broad as determining the technical specifications for setting coal prices to be paid to producers, the question is to share knowledge of impacts from experience rather than simply to provide answers. This must be done in a way that shows how to anticipate problems and accelerate solutions by avoiding the mistakes others have already made. For example, establishing incentive systems to encourage a quality coal product may add to the first cost of the producer, but experience shows it can reduce the overall cost to the consumer who will be willing to pay more for quality. Technical assistance can illustrate such basic principles of coal development for ready application during the high growth phase of the coal industry. Shared experiences can save time and money, as well as avoid unnecessary difficulties.

In addition to transferring experience in coal development, the technical assistance project will transfer technology. As will be discussed below, a substantial part of the overall program of activities includes the adaptation and transfer of Coal Water Mix technology. This is a technology now in an advanced stage of development. This technology has exceptional promise for application in the Philippines for it will assist with power plant conversion and industry conversion to coal without the usual heavy investment in infrastructure for coal handling and transport at the users' site. The technology transfer effort includes an early test of the suitability of local coal for CWM prior to more general application.

As is described in the next section, the technical assistance project has two substantive concerns. First, there is a series of coal development

activities associated with the transfer of technical experience and skills for the management of the coal resource. Second, there is a component of a particular technology transfer which is aimed at introducing CWM technology in such a way that it can have expanded applications based on local coals and personnel. In the overall design of the proposed project, these two areas are integrated and benefit from each other, even though they are administered and timed according to independent needs.

In implementing both areas of work, the direction that is taken focuses on the word "transfer". The approach is to transfer skills and technology, whether in coal development or CWM applications, so that counterparts will be able to accelerate the management of their own efforts toward their goals.

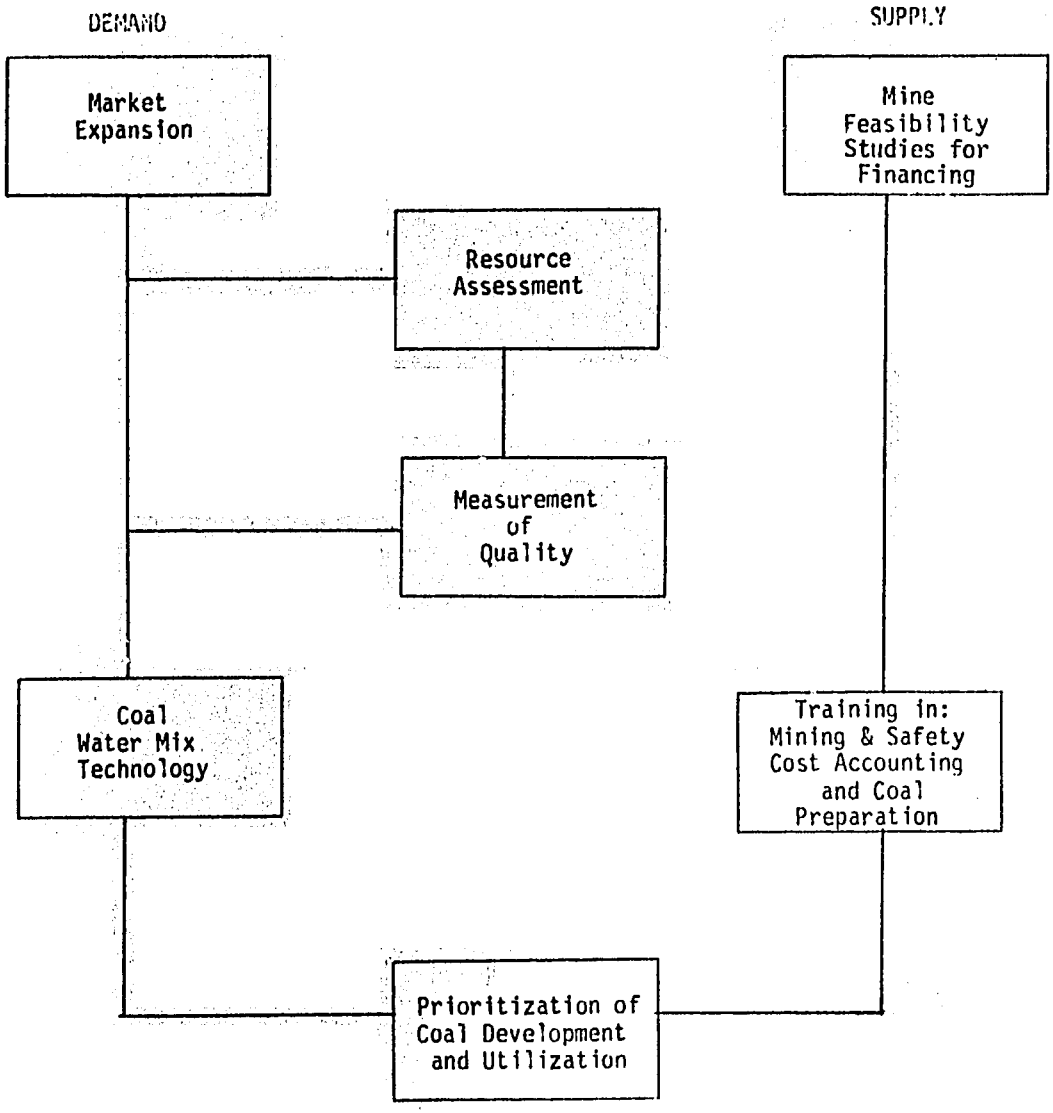
FOUR. PROPOSED PROJECT DESIGN FOR TECHNICAL ASSISTANCE

The activities described below are focussed and dedicated to the ultimate project objective of bringing the costs of energy down, especially the foreign exchange costs, by replacing imported oil with coal to the maximum extent technically and economically possible. Clearly, there are other measures employing other energy resources or conservation to accomplish this objective of reducing dependency on foreign exchange based fuels, and they are addressed in other domestic, USAID and donor programs. This project is dedicated to assisting the coal program in the public and private sectors to attain its goals of cost effective replacement of imported oil by coal, preferably from domestic resources.

There is a substantial institutional structure and program already in place to both stimulate supply and demand. An organization chart describing the government structure appears in a later section regarding institutional responsibilities. The projected USAID effort is integrated with the existing program, calling on public and private sector counterparts to work to accomplish mutually shared objectives.

The elements of that overall effort for which USAID should be best suited comprise the activities discussed below. The activities stand on their own merits and are discussed individually in Appendix B. In this section, they are briefly summarized and their position vis-a-vis the overall program for coal development is noted. Figure 1, "Project Activities," shows the different components of the technical assistance project. The demand group (left side) includes technical efforts to define expanded markets for coal, including those markets which can benefit from the use of coal water mix (CWM). The supply group (right side) includes mine feasibility studies for attracting financing for private sector mine development as well as substan-

Figure 1
PROJECT ACTIVITIES



tial training for increasing production safely, understanding costs, and in the preparation of coal for market. The information group of activities (center) facilitates communication between parties responsible for both the demand and supply sides. It brings information to bear on knowledge of the resource, the measurement of its quality for commercial purposes, and the scheduling of coal development. These activities can balance the timing of supply and demand through technical assistance which provides analytical capability for prioritizing and scheduling coal development in comparison with other alternatives. The parts of the project and the many interactions among them are discussed below.

The Demand Group

The first two activities are grouped under the broad heading of DEMAND because their primary focus is on dealing with the problem of insufficient and delayed demand. Since some of the coal to be produced in the Philippines will come from private sector investment, the existence of a market, or a potential market, must be well established prior to the attraction of capital and technical skills. The rationalization of production can be expected to follow the perception of a market for coal to replace oil, within limits to be discussed below. In the meantime, the government, through its regulatory powers held by the National Coal Authority (NCA) and its coal marketing and distribution system, held by the Philippine National Oil Company: Coal Corporation (PNOC: CC) and its equity interest in the Semirara Coal Company, has entered and dominated the coal development program.

The argument for this dominance is found in the fact that until now the primary effort at conversion was mandated by government in the power and cement industries. This occurred through price incentives, coal priced at 65%

of fuel oil as a ceiling; through bringing together small producers, with PNOC brokering coal to markets and assuring supply; and through a 15 year coal import program from Australia to avoid any shortfalls of supply or coal quality. To assure supply in the interim, a market has been stimulated in the power and cement industries. Among those people interviewed, it was agreed that initial government intervention was necessary and desirable to encourage domestic demand and supply. Today, however, the roles of government and of imports is more hotly debated by the private coal producers and within the government itself. The project, therefore, includes a great deal of private sector involvement along with Energy Ministry activity, reflecting the current status of the thinking in the country at this time.

The overall project reflects these concerns by focussing on certain problems with priority while excluding others. For example, there has been some lag time, perhaps some six to ten months, in accomplishing conversion of cement kilns, but the proposed project does not focus its resources on this mandated program for conversion. The progress in the area of cement conversion has satisfied the GOP, with more than half of the plants reported burning coal and the conversion of others is scheduled to be in place before the technical assistance effort can start. The power generation issues are different from those in cement, and they will be dealt with below through activities dedicated to making coal more acceptable.

Thus, the demand group of activities begins by extending beyond the current targets mandated in the cement industry. The need is to establish an understanding of additional potential markets including retrofit of power stations, thereby providing investors with better signals for investment both in conversion of facilities to coal and in coal production.

Activity 1: Expansion of the Industrial Market in Coal

This activity is designed to determine the markets (about 5) where the most important users of imported oil are candidates for fuel substitution by coal. These candidates include metal mining and processing, sugar, wood processing with pulp and paper production, coconut oil processing, and textiles. Using technical and economic criteria, a study will select those candidates who can lower the import bill most effectively. As in any study which must recognize the multiple objectives of a private sector firm, factors which influence the decision such as reliability of production, convenience of use, alternative uses of capital, etc., must all be taken into account.

The design of the study reflects the information needs of the decision makers in both the public and private sectors. To avoid diffusion of study resources, only the quantitatively most significant candidates will be examined. Power and cement, already under investigation with other studies and programs, will not be directly included in this particular activity.

Fortunately, energy consumption data are available on a national scale. Questionnaires regarding the energy consumption practices of over 100 firms have been completed by these firms. A substantial amount of market research has already been accomplished by PNOC:CC and the selection of candidates to limit the study focus can, thus, be done on a rational basis. Using definitions provided below, over 20% of the national petroleum consumption is in the economic sectors covered among the candidates listed above.

The theoretical potential for industrial fuel oil substitution will be enumerated, particularly for steam raising and, especially when the practical limits will be better understood, through an effort at on-site visits. Several such visits around Manila and environs were done during the team visit in October. Future visits can use supplementary audits oriented toward fuel

substitution. A diagnosis of barriers to implementation of fuel substitution in the industry chosen will also be necessary.

To allay some of the fears expressed by potential users that fuel substitution will later be followed by constraints of environmental regulation, or second thoughts on price concessions and fluctuations of real prices, a broad set of issues will be addressed at a series of seminars dealing with the potential user needs. Most attention will be paid to expanding the number of people whose level of technical competence satisfies the need for services to design coal conversion systems. The market assessment will focus on technical feasibility within environmental constraints. Information concerning how to use local low btu coal will be applied to selection of conversion technology. As will be indicated later, this area of investigation will span a broad range of opportunities. Once again, however, work will be done to identify mechanisms needed to encourage suppliers of the conversion technology and financers of the applications to ensure the most rapid possible technology transfer. Techniques for information dissemination to user and supplier will be part of the activity and its related activities. This is particularly important when trying to match the quality and quantity of coal supplied to the technical specifications of the user. Some users are specifying coal of such parameters that only imported coal can be used, when proper selection of boiler design details could encourage the use of domestic coal at a savings of foreign exchange.

In sum, the study to assess the quantitative potential for coal conversion will recognize the larger decision system in which the substitution will take place and it will therefore provide information to people in other parts of the program. Except for assistance in a demonstration, actual conversions will not be part of this technical assistance activity. Capital improvements might only be considered in a later phase.

Activity 2: Coal Water Mix (CWM)

The sequence of activities which focus on demand issues in the coal program includes a study which recognizes that the growth of the market for coal is constrained because burning a solid fuel will require a considerable investment in infrastructure and utilization equipment before operating cost savings can be achieved through coal substitution. Due to the development of a new technology that can prepare a coal water mixture for combustion under handling, transport and utilization conditions similar to oil, it may be possible to avoid much of the anticipated infrastructure and facility investment at the plant site and elsewhere in the system of logistics. With the coal water mix technology, some boilers may be retrofitted with a small capital investment compared to boiler replacement for direct coal conversion.

Coal Water Mixture (CWM), as the technology is called, was developed to facilitate the conversion to coal and it is now undergoing extensive testing and rapid improvement. Large scale introduction of this fuel is promising. CWM testing to this point, however, has not emphasized sub-bituminous coal of the quality found in the Philippines. Therefore, Activity 2 is designed to provide technical assistance which will permit the introduction of this new coal preparation and utilization technology to the Philippines and which reduces the risks usually associated with technology development and transfer. The support of feasibility and design studies in a highly structured set of steps outlined in Appendix B is the technique employed to reduce risk.

The activity foresees the ultimate commercialization of the coal water mix preparation and utilization technology in the Philippines through the conversing of the four units at the 800 MW Sucat electricity generation complex near Manila on Luzon Island. Its immediate objective is to achieve a successful demonstration of the use of CWM fuels in a 30 MW utility type steam

generator, which has been offered for this purpose by the Marinduque Mining and Industrial Corporation (MMIC). The activity accordingly supports a feasibility study and the design studies aimed at achieving this immediate objective. The objective of the feasibility study is to provide the support needed for obtaining from separate sources the funds needed to retrofit the steam generator and conduct the demonstration test. Accordingly, it will address and analyze, in the depth required, the individual steps that lead to the introduction of CWM technology at the Sucat station. It will also develop the detailed scope of work for the activities foreseen, to demonstrate and to introduce the technology. It will include the performance of laboratory tests to demonstrate that acceptable CWM fuels can in fact be produced from a variety of Philippine coals.

The activity also foresees the introduction of CWM fuels to substitute for fuel oil in the operation of a bank of ore roasters at the MMIC, in which it is necessary to maintain a reducing atmosphere. The problem to be addressed is the utilization of the first stage of two-stage coal burning equipment now in advanced testing stages which suppresses nitrogen oxide emissions. The first step is assessment of the readiness of the equipment, the adaptability, the inventives to convert, and the detailed program of activities leading to conversion. The equipment could utilize CWM fuels, and accordingly the scheduling of this effort is related to the steam-generator demonstration activity.

Given successful results from these studies, a major constraint on the use of coal, namely the cost of infrastructure and facility conversion, will be reduced. Activity 2 is among the more complex and expensive parts of the program with considerable foreign exchange and capital savings benefits expected in both transport and combustion applications. The transport of coal

by slurry techniques is not to be confused with combustion slurries. In the former, the greater water content is intended as a transport medium. In the latter, the smaller water content is intended as a combustion medium. The project tests are primarily dedicated to the combustion aspect, although transport considerations will be an important part of the Sucat design due to the availability of a pipeline which currently carries fuel to the power complex.

It should also be noted that there is a good potential to consider technologies other than CWM, especially fluidized bed combustion, for its ability to burn the low quality rejected fraction from CWM preparation or for its competitive position in mine mouth power generation applications. Initial priority, however, will be applied to CWM due to its advantage in adapting to existing utilization equipment.

The two activities and their various component parts described in detailed designs in Appendix B, comprise the Demand group. As Figure 1, "Project Activities," indicates, the Demand group both receives and creates information from other efforts. The knowledge of potential markets gained in Activity 1 will aid in finding applications of the CWM technology. The existence of a tested technology from work in Activity 2 will enhance the credibility of the market for suppliers with appropriate coal and create an option for users who could not consider coal under ordinary circumstances of space and capital limitations. The information activities will bring the supplier and user together. As the institutional discussion in a later section will address, it is essential that users and suppliers know about each others' potential in the young coal industry. Thus, the overall project must relate the activities into an integrated framework that brings supply and demand decisions into contact with each other.

The Supply Group

There are two primary activities of use to the GOP in the supply group of activities. As Figure 1, "Project Activities," indicates, they include an effort to improve mine feasibility analysis and a training program with three different elements. Both sets of activities include the training of trainers who will multiply their efforts over the years to create skilled people capable of evaluating the financial feasibility of mining and of enhancing the safety and productivity of coal mining operations. The details of these activities are provided in Appendix B, the emphasis on transfer of skills is particularly evident here.

For purposes of this overview, however, it should be noted that the mine feasibility effort, Activity 3, has a number of important features. A major barrier to the development of mines, as indicated by interviews in both the public and private sectors, is the availability of local and credible skills to assess the feasibility of coal mining. In part, this is due to the fact that mining engineering in the Philippines has previously focussed on metal, not coal, mines. Furthermore, there is a lack of experience within the financial community itself when called on to assess feasibility reports. Activity 3 addresses these concerns by transferring skills in the technical assistance mode directed toward local capability.

Activity 3: Mine Feasibility Studies for Financing Mine Investment

The design of this program is oriented towards assisting several different participants in coal development to make a critical step toward increased coal production. For mine owners, developers, engineers, financial community analysts, and others for whom knowledge in mine feasibility analysis is essential, a curriculum will be provided to assure local private sector capability

to take this fundamental step. The private sector participants in the activity, who are willing to spend the risk capital necessary to provide geological information, will be eligible for nomination for case studies to determine the feasibility of further development at their mines. This activity, therefore, will have immediate impact in terms of coal production at a few sites. It will also have a long term impact on the financibility of opening new mines through the training of individuals and companies to follow a development process through to completion.

Activity 4: Specific Training Activities in Coal Mining

A set of three sub-activities, important to increasing production safely, has been identified as early candidates for technical assistance.

For administrative convenience, the three part training activity in Figure 1 can be treated as one Activity. The training in mining and safety, cost accounting, and coal preparation can be implemented as Activity 4 by one responsible training unit. These areas have been chosen because they are responsible for considerable impediments to rapid and substantial growth of coal production. It is estimated that approximately 3000 miners and supervisors and other producers will be needed in the years ahead if the domestic coal industry is to meet its desired production targets. This will require an approximate doubling of skilled people over currently available personnel. In addition to the efforts designed to enhance long term productivity, there is training in coal preparation and coal handling designed to overcome coal quality problems borne of using as-mined coal. The current incentive system is not perceived to significantly reward coal quality beyond btu's/ton.

Activity 4a: Underground Coal Mining: Training Program on Mine Operation, Safety and Health

Based on discussion with representatives of the private and public sectors, the most important need in the area of underground mining is in-field training for people operating in the mines. This includes miners, supervisors, safety inspectors, safety engineers, and mine managers. A curriculum designed to train trainers in the areas of responsibility of these types of jobs would make a major contribution to enhancing production in underground mines. There is a need to create a capacity for self-sustaining training activities in underground mining where local employment is a key feature and where technological transfer is otherwise least likely to take place from international mining companies.

Activity 4b: Training for Cost Accounting in the Coal Industry

There is a diversity of cost accounting systems in the coal industry. Furthermore, the implementability of those systems varies widely due to the variety of the scale and sophistication of the industry. This diversity of approach and follow-through has made it difficult to have a uniform reporting system needed by both the industry and those who plan for it.

Even PNOC, whose previous experience in the oil industry cannot be readily transposed, requires training to develop and use a new system suitable to its needs. As discussed in Appendix B, a training program oriented to an implementable approach for a variety of mining situations will be designed. Additionally, a group of accountants who can pass on the information to others will address the needs for the future.

Activity 4c: Training in Coal Preparation and Handling

At virtually every site visited, the team noticed that as-mined coal and coal handling techniques were creating operational problems that were unnecessary. Neither the technical knowledge nor appropriate incentives were in place to avoid the difficulties being experienced. This sub-project is designed to inform relevant parties of the methods and arrangements necessary to upgrade the quality of coal provided to the user. This will be done in a symposium covering different aspects of coal characteristics and suitability for washing or other means of preparation. Coal handling techniques will be thoroughly covered as they apply to local circumstances.

Activity 5: Resource Assessment

A report done in 1978, commonly known as the Robertson Research Report, needs to be augmented and updated. One deterrent to investment is the poor knowledge and access to basic resource data. An activity both to assemble information and facilitate its access has been designed. The program includes EDP techniques as well as a substantial effort to impart skills to staff, and to maintain the resulting information system. There is a substantial training program included so that the continued updating of the information can be done entirely by Philippine personnel. The Ministry of Energy will be responsible for exploratory drilling to add to the existing data base.

Activity 6: Measurement of Quality

As in many other countries, disputes between producers and users of coal regarding the quality of the coal are severe. The economic consequences of these disputes are often significant. An investigation of the causes of differences has determined that coal sampling and quality measurement tech-

niques need to be standardized and improved. The issue is not simply the acceptance of international standards such as those of the ASTM, but the implementation procedures as well. The activity employs numerous techniques to overcome the problem of unreliable coal quality measurement.

Activity 7: Prioritization of Coal Development

The ability to balance supply and demand requires analytical capabilities and computer software to synthesize findings in a timely and economic fashion. This activity, using the specific problem of energy needs for Luzon, exercises the data bases developed in the other activities and provides the methods and ability to support decisions regarding the priority areas for coal development and encouragement of utilization. In the case of this activity as well as the others discussed above, full details of how the problems stated will be addressed are found in Appendix B of this report.

This activity provides the methods by which coal will be compared with other energy sources; geographic areas will be scheduled for mining; and consumers encouraged to use coal. All of the activities come together at this point and this Activity 7 provides the management objectives, the rules for compatibility of data bases, and the bridges for cross communication among activities. It is the "user" against which competing objectives can be measured to establish priorities.

Integration and Interaction Among Sub-Projects

While the activities stand on their own merit, each in fact fits into the larger design of the overall project. Figure 2, "Relations Among Activities," below lists the main points of interaction among activities and the ensuing discussion points out the manner in which each part of the effort builds

Figure 2
RELATIONS AMONG ACTIVITIES

INPUTS From Activity Functions	ACTIVITY	OUTPUTS To Activity Functions
	(1) MARKET EXPANSION	
CWM Characteristics (2) Mine Location (3) Costs and Prep (4b,c) Resource Character (5) Quality Assurance (6) Prioritization (7)		Sizing CWM Facility (2) Market Feasibility (3) Preparation Need (4c) Prioritization (7)
	(2) CWM	
Demand Quality (1) Mine Location (3) Potential Sources (5) Quality Assurance (6) Prioritization (7)		Conversion (1) Feasibility (3) Suitability (6) Prioritization (7)
	(3) MINE FEASIBILITY STUDIES FOR FINANCING	
Market Location (1) CWM Users (2) Trained Personnel (4a,b,c) Identification of Sites (5) Prioritization Schemes (7)		Costs at Market (1) Facility Siting (2) Case Studies (4a,b,c) Cost Data (5) Supply Sequence (7)
	(4) SUPPLY TRAINING	
Assures Supply (1) Assures Personnel (3) Role of Underground Mines (7)		Supply to CWM (2) Prioritization (7)
	(5) RESOURCE ASSESSMENT	
Demand Quality (1) Potential Demand Source (2) Identification of Sites (3)		Proximity to Market (1) Supply Source (2) Geologic Data (3) Prioritization (7)
	(6) MEASUREMENT OF QUALITY	
Assures Quality (1) Encourages Preparation (4c)		Eases Conflicts (1) Sets Specs (4c)
	(7) PRIORITIZATION	

This activity is the synthesizing and managerial project for assuring the data needs and format for the entire project. It sets the performance level for project data to bear on decisions at a common level of reliability and relevance. Thus it defines the ultimate set of interactions among activities, and needs to be designed at the outset.

toward the ability to make informed technical and planning decisions regarding the balancing of coal production and consumption in the Philippines. Such an ability is a necessary precondition to replacing imported oil with coal and much of the interaction will be anticipated in the needs for information established in Activity 7.

As Figure 2 indicates, each activity is provided inputs from others and in turn provides outputs to others. Thus, the Market Expansion Activity 1 will receive information from the CWM Activity 2 to indicate the range of applicability of the technology and at the same time provide information to the CWM Activity 2 to indicate the sizing of conversion markets. Scanning Figure 2, from the inputs on the left going to one of the seven Activities in the center and outputs from the center going to other activities on the right, it can be seen that the functions of one activity are useful for others. The coordination among efforts is essential to avoid duplication and data management problems as well as to capitalize on opportunity. Removal or alteration of one activity should only be done in the context of its impact on another. The effort is highly integrated and each activity is a beneficiary and also benefits the others.

This level of integration of design places a burden of management on the project which will be worth the effort. The management consists of different obligations, the first of which is to develop scheduling over time to assure a smooth and cost effective sequence of activities. Second, data formats and other mechanical and substantive considerations need to be harmonized to assure communications among parts of the project. Third, counterpart relations need to be coordinated in order to benefit from each party's' expertise. The accomplishment of these objectives focusses attention on project management and scheduling. Appendix B deals with the details of activities, but this section concludes by setting those efforts in the context of time and management control.

Project Management and Scheduling

It is clear that the project will require a broad array of skills to accomplish its objective. It is also true that there is a great deal of coordination required to achieve the most within the diversity of necessary skills. There is a tradeoff to be expected. Some organizations will have the specialized skills necessary, but it is unlikely that any single contractor will be able to carry the breadth which must include market analysis, CWM expertise, resource assessment, training in coal production, and synthetic planning. At the same time, the coordination among activities calls for unitary management.

The strategy of organization will respond to this situation by minimizing the number of organizations both within the U.S. contractor group and among the counterparts. At a minimum, it is likely that two groups can handle the project on behalf of the Philippine counterparts and two on behalf of USAID. In the Philippines, the Planning Service of the Ministry of Energy can coordinate among the various counterpart groups listed above, except for the CWM Activity 2 which can be managed by the Economic Development Foundation. The roles of these two counterpart institutions will be clearly marked in Project Agreements so that cooperation levels and coordinative mechanisms can be established early in the project, while still benefitting from the independence that the nature of the different efforts requires.

On the side of the U.S., there are several functions to be performed and the challenge is to select organizations which balance special skills with general management ability to incorporate diversity. One option would be for USAID to manage the overall project itself, calling on different firms, most likely in the CWM Technology, Training, Resource Assessment, and Planning fields, to accomplish sets of tasks. Thus, there would be four contracts all

reporting to one project officer in Washington or in the field. This option is, frankly, quite attractive because it maximizes the chances of getting the best skills for each job. On the other hand, USAID staff positions are limited and it is unlikely that qualified personnel can be made available to accomplish this effort. Under those circumstances, a tradeoff can be made which will use management techniques and skills to assure quality of the parts and integration of the whole.

CWM technology skills are sufficiently limited and Activity 2 is sufficiently well defined so that one contractor can handle the tasks outlined in Appendix B. As is discussed below, an early and preliminary phase is called for to do feasibility studies of CWM for the MMIC boiler and roaster. After feasibility is proven, the substantial portion of the work can follow within the purview of a single CWM contractor.

The remainder of the project should be under the general supervision of one contractor. Whether or not each of the participating organizations would then be subcontractors is a matter for bidders to determine. Whether or not USAID would like to reserve a portion of the activities for USGS participation is a matter of USAID providing integrative management. USGS has the skills to accomplish Activities 5 and 6. If negotiations between the two government organizations can satisfy time and budget constraints voiced during the project design phase in October, then it would be wise to include USGS skills. There would have to be some arrangement to assure that USGS would be responsive to the supervisory contractor's scheduling and priorities for finishing certain sets of work in the framework of the overall project.

This accomplished, then the team to execute the project would include (1) a CWM contractor for Activity 2, assuming a positive feasibility study; (2) a general contractor with supervisory responsibility for the timing of the over-

all project as well as the full range of skills under its command; and (3) the USGS operating within agreed upon constraints. Hopefully, a USAID project officer with appropriate skills or a USAID group will be given time to monitor the project to assure its integration by the supervisory contractor. This does not mean second guessing th contractor, but it means holding the contractor accountable for benefiting from the interactions built into the design of the project.

This management strategy balances the multiple objectives in the activities needed to replace imported fuels with domestic coal. The project is workable as long as the objectives are clear and the supervision takes place in a unitary framework with clear accountability. One of the objectives to which management must respond is that of efficient timing and sequencing of actions. An early effort at formal scheduling should be called for within the first quarter of project life and a preliminary schedule should accompany proposals.

Institutional Responsibilities

It is recognized that the institutional aspects of the development of coal in the Philippines are among the more difficult subjects to treat. Policy and opinion are difficult to distinguish from each other in the best of circumstances. A stay of less than one month, especially one which coincides with the most troublesome time in Philippine politics in many years, makes it difficult to understand institutional behavior. Nonetheless, the subject must be treated, for no project can succeed without being established on a firm institutional base. Furthermore, given the dynamic environment in which the project will take place, adjustments may be needed during the implementation period to deal with the assumptions that are made at the outset.

Among the first impressions is that there are a great number of explanations of the same event and no two people characterize the institutional environment for the development of coal in the same way. The policy position of the government is "noisy," that is, different officials describe past events and future policy with sufficient variation of rationale to create unclear signals for the private investment community. On the other hand, the private sector statements to government are also often misleading so that a basis for policy may be incorrectly drawn. The dominant theme is mistrust and miscommunication. During the course of numerous interviews, the same material was discussed, but from very different points of view. The government insists it is preparing the way for private institutions to develop coal. The private institutions insist that the regulatory practices of the government can only end in government domination of the industry.

This report has neither the purpose nor the place to determine who is correct or whose characterization of policy is the most accurate. It is the purpose of this discussion to clarify the roles expected from each institutional actor and provide the rationale for the design and selection of institutions in the project. Thus, it is assumed that the private sector will be the main producer of coal. It is further assumed that the PNOC Coal Company, a government body, will only play the role of catalyst in the marketplace and will not be allowed to become a dominant force in the industry. Furthermore, it is assumed that neither the National Coal Authority nor the various government banks or development corporations will conduct themselves to suppress private sector activity.

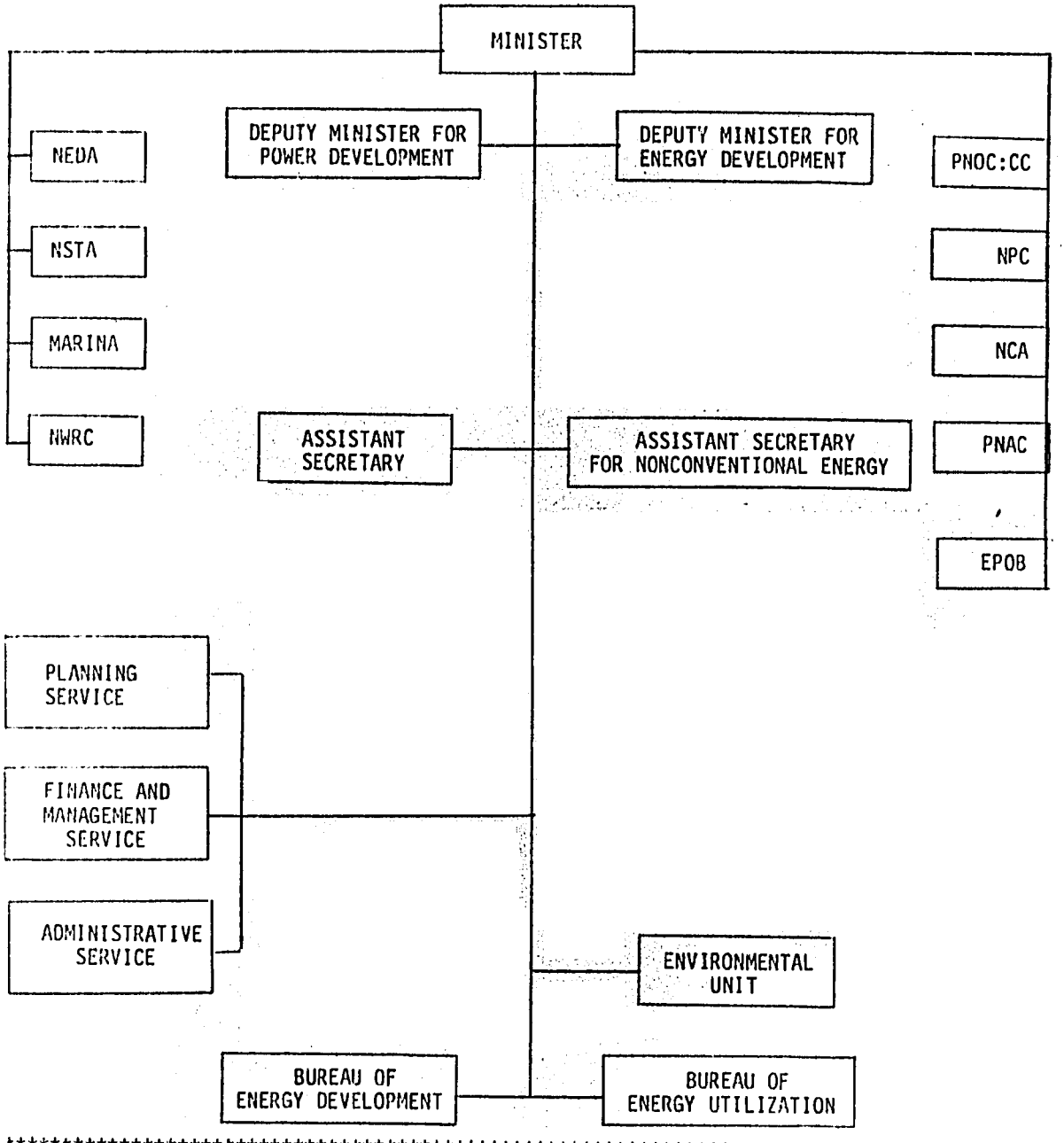
For one group of people, these assumptions are considered naive and false. For another group, they are considered accurate representations of government policy and reflect the need to protect the private sector, its

capital, skills and resources. There is evidence provided by different parties in support of the different points of view to render suspect these or any other set of specific assumptions. The simplest explanation of uncertainties surrounding assumptions is that the coal industry is young, and the specifics of what will work are still undergoing experimentation. Much institutional behavior is, therefore, currently based on uncertain premises and private and public roles are yet to be sorted out. Flexibility, within the organizational structure, is the guide in such circumstances.

The organizational chart of the M.O.E. in Figure 3 indicates that some structure is already in place. A full ministry with a defined division of labor is operating. While the institution is still evolving, there are policies that assign roles for agencies. The project and its activities are, therefore, set in the context of taking government policy at face value, of encouraging the private sector to play the major role in production, and of using the existing government structure to organize the markets for coal and conversion of facilities. The government is represented to play an informational role about markets and resources while the private sector is expected to extract coal under a set of incentive contracts with the government or through direct sales.

In each of the activities, this division of labor is evident. The first Activity, which deals with marketing, is done under the auspices of the PNOC Coal Company, which has already done much in this area. The private sector producer has shown little interest in vertical integration of the industry, and has been content to let PNOC:CC take the lead in marketing. PNOC:CC will be the counterpart group for this activity and will assure that information from the marketing effort will be available to the public.

Figure 3
ORGANIZATIONAL CHART OF THE MINISTRY OF ENERGY



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NEDA - NATIONAL ECONOMIC AND DEVELOPMENT AUTHORITY
NPC - NATIONAL POWER CORPORATION
NSTA - NATIONAL SCIENCE & TECHNOLOGY AUTHORITY
NCA - NATIONAL COAL AUTHORITY
NWRC - NATIONAL WATER RESOURCE COUNCIL
MARINA - MARITIME INDUSTRY AUTHORITY
PNAC - PHILIPPINE NATIONAL ALCOHOL COMMISSION
PNOC:CC - PHILIPPINE NATIONAL OIL CO.: COAL CORPORATION
EPOB - EMERGENCY PETROLEUM OPERATIONS BOARD

The second Activity, on the other hand, is of great interest to the private sector because the Coal Water Mix technology offers an enormous step forward in opening coal markets. Due to the need for funds to establish a fuel supply plant, this activity will be managed to attract those funds. The Economic Development Foundation will take the lead in providing counterpart skills to attract local and international funds.

The entire supply set of activities from mine feasibility to training will be based on close coordination between the government institutions and the Philippine Chamber of Coal Mines, Inc., a private association of approximately fifty coal producers. Responsibilities for money, time, and facilities will be shared by both private and public institutions. Both are expected to send and pay for trainees as well as carry on the effort started in the first year of the activities. The assumption that production is basically a private sector responsibility is particularly in evidence in this part of the project.

With reference to the informational activities which are designed to characterize the resource and measure its quality, the Bureau of Energy Development of the Ministry of Energy is the counterpart organization. They will keep the records of coal field potential, while making the information accessible to private investors. They will also assure that national standards will be met in measuring the quality of coal.

In the seventh Activity, which deals with prioritizing the sequence of production and consumption of coal, the MOE Planning Service will be the counterpart organization. It is at this level that policy discussions will be prepared. It is here that the opportunity to centralize in government hands, indeed to over-centralize, will be most tempting. An information system can be built to give confidence, perhaps false confidence, that coal policy can be

made to cover all aspects of supply/demand balancing. This activity provides the most opportunity for learning the practical limits of government involvement or for running the risks of an excessive potential for centralized planning. Activity 7 can reveal useful answers as an experimental process for defining government/private sector relations. It provides an excellent forum for resolving the key institutional issues in coal development in the Philippines. It synthesizes information from many sources, focusses it on critical decisions which compare coal with other alternative fuels, and creates incentives for production and consumption in which the private sector must live. No more important opportunity exists to sort out the institutional issues and the public decision process which allocates resources for coal development. Also, pending the success of this activity, there should be a series of follow-on activities identified with appropriate institutional and capital needs.

Thus, the seven activities provide opportunity for both public and private sectors to play important roles, and this follows publicly announced policy. At the same time, information sharing and conscious decision processes provide a forum for testing alternatives and sorting out the options of a young industry and regulatory body. The country is today going through the difficulties of thrashing out these issues on a national forum in a national debate. The general answers as to the public roles in business and vice versa are being dealt with even as the project is being designed. The most appropriate posture under these circumstances is to involve all of the essential actors in the decision process who find it important enough to participate, and assign them the roles of their choosing and abilities. In this sense, the project becomes the forum for the generation and determination of the institutional aspects of coal development. The private sector has risen to the challenge of producing more coal than ever thought possible. The public sector has risen to the role

of finding and developing markets while aggregating producers and sources of coal to assure that demand can be met. The project sets the further challenge of institutionalizing the process to accomplish the ends by the most efficient and acceptable means possible.

FIVE. RECOMMENDATIONS AND IMMEDIATE ACTIONS

As described in the previous section, there are seven major distinct activities in the technical assistance project. Yet, each is related to each in such a fashion as to require very close coordination. The recommendation is that funding be set at a level to accomplish all seven components. Any lesser amount will require project revision, for the coherency of the design through an integration of its components is one of the criteria for a successful project.

While funding is recommended for all seven activities, the technical assistance in CWM technology transfer requires a separate set of skills and time schedule. This means that it should be funded and administered as a unit of activity. It is labeled as Activity 2 in order to assure communications of findings among the activities. However, it is to be implemented by a technical contractor with CWM skills and by a local contractor with responsibility for integrating Philippine institutions participating in the test as well as providing the follow through of transferring the technology to local users. Thus, the recommendation is to procure the services of two CWM contractors, one for technical services from the US and one for providing local services of technology transfer, the EDF.

The particular services required are identified in Appendix B in some detail, while the summary of those services is described in Appendix A.

The transfer of technology can have a substantial impact on replacing imported fuels. The development of coal in the Philippines is, however, a much broader challenge than technology transfer. The six other activities deal with this broader challenge and are also essential. Due to the substantial integration among component parts of the project, it is recommended that the services of one contractor be procured to manage and integrate the ser-

vices of the variety of skills needed. Whether or not those skills require more than one contractor, only one should be made responsible for the performance of sub-contractors or participating agencies.

Once again, the Appendices provide the details and summary of services required to accomplish the coal development components of the project.

The next set of recommendations deals with the roles for each of the participating institutions.

It is recommended that the Ministry of Energy, through its planning service, be responsible for the coal development activities (Numbers 1-7 with the exception of Number 2). It can coordinate the services of the several agencies in the Philippines who will provide counterpart personnel and who will be the recipients of services.

It is further recommended that the Economic Development Foundation provide a parallel role in the coordination of the CWM technology transfer effort (Activity 2). Their responsibilities should include organizing information for potential users, investors and trainees to facilitate the transfer of the technology. The EDF also should be of assistance to the technical contractor for the CWM sub-project. Whether or not bidders wish to provide a full-time resident to manage their operations in the Philippines, local contact and establishing local arrangements to ensure technology transfer of CWM remain the responsibility of the EDF.

Private sector involvement is essential to the long term success of the project, and the Philippine Chamber of Coal Mines, Inc., has shown a willingness to participate in several of the coal development activities, especially in providing the risk capital for obtaining new or providing previously acquired geological information for mine feasibility studies and for providing trainees and a site for training participants in Activities 4a, b, and c.

The National Power Corporation should be one of the major users of coal in the future and they are recommended to be participants in the CWM technology transfer of Activity 2. It is expected that they will send observers and participate in the design of the testing to assure the credibility of the results as they apply to NPC future use of the CWM technology.

It is also recommended that the First Philippine Industrial Corporation be invited to participate in the study of the feasibility of using their pipeline to transport coal water mix slurry to the Sucat plant.

The next set of recommendations deals with the timing and scheduling of activities.

It is expected that the review process of these recommendations can be completed by January, 1984, and agreements signed with Philippine institutions shortly thereafter. The coal development contractor should be able to be secured and in the field by mid-1984. The duration of each activity and its time of completion will vary, but it is recommended that the start-up schedule be adhered to with seriousness. Events are occuring at a rapid rate and options for the future are being closed.

Indeed, one activity, the CWM technology transfer effort for boilers and roasters, cannot be delayed. Momentum has been building for the CWM test since February, 1983, and the interest in establishing the technology in the Philippines has been high. Interest in financing this technology transfer by different means and sources has been raised, and a precise set of costs, as well as feasibility studies, needs to be developed immediately to take advantage of the interest. This report has outlined the milestones of the activity, but it has not delineated the costs of establishing a CWM facility, converting the MMIC boiler, and conducting and interpreting the test burn for application to the Sucat power plant. It is recommended that the Phase I

portion of Activity 2, the feasibility studies, benefit from immediate implementation so as to take advantage of the opportunity for technology transfer, both at the MMIC 30 MW boiler and at the ore roasters. Since these studies are needed to reduce the risk of taking the next major steps, they should be initiated before much time passes and momentum is lost.

The final recommendation is that the coal sector in the Philippines provides a major opportunity for foreign exchange savings through oil substitution with local coal. The project has been designed to provide technical assistance for the development of coal for an initial period. It should be recognized that the value of and opportunity for technical assistance will probably extend beyond that period. The last and synthetic Activity 7 can be used to identify valuable long term cooperation and this project should, therefore, be conceived as a first step in the long term cooperative effort in the development of coal in the Philippines.

Immediate Actions

Some of the recommendations require immediate action to maintain interest and levels of cooperation that greatly facilitate the start-up of the project. The first such requirement is to begin the feasibility phase for the conversion of the Marinduque Mining Company 30 MW boiler. The Company has offered its facilities and services on site to make the test. This represents a substantial contribution to Activity 2 and a timely start of that task is essential before competing plans for the boiler are implemented. The test MMIC site also includes a 250 K barrel storage tank. It would allow for a smaller capital investment in a fuel mix plant which could store a lower output instead of producing on high demand schedules. The boiler, an ore roaster, and

the offer of a storage facility are subject to change borne of commercial alternatives under discussion.

The ore roaster offer is also especially interesting because the use of a new design for a slagging burner may make the use of CWM to create a reducing environment for ore roasting technically feasible. From a foreign exchange point of view, it is surely desirable.

MMIC is also offering drafting facilities and personnel of highly skilled labor. The retrofit costs of the boiler will be much less at MMIC than elsewhere. The opportunity should not be missed and an immediate start to the project for this limited feasibility phase would ensure the cooperation extended.

Another immediate action needed is confirmation that Philippine coal will make a suitable CWM fuel. This must be done before any major contracts are executed. Since it will take several months to conduct tests, the process must begin as soon as possible.

In addition, planning for the future of the Sucat power station is now ongoing. Studies for coal conversion have been recently completed. It is essential that at least some prefeasibility work begin to indicate the potential for a major CWM application and to show NPC engineers how the MMIC test will be conducted.

All of these reasons for taking immediate action are reinforced by the urgency with which the foreign exchange and employment benefits are perceived. The country is taking its own action now to forestall a more grave situation in the future. These actions, under current consideration, should include CWM use as a serious candidate for scarce resources.

APPENDIX A

DRAFT PROJECT DESCRIPTIONS TO SUPPORT PROJECT AGREEMENTS

Contents

1. Technical Assistance Project in Coal Development (Ministry of Energy)

2. Introduction of Coal Water Mix (CWM) Fuels in the Philippines (Economic Development Foundation)

3. Participation of the Economic Development Foundation in the Implementation of Projects

TECHNICAL ASSISTANCE PROJECT IN COAL DEVELOPMENT

Over the past ten years, the Government of the Philippines has begun efforts to diversify the nation's energy supply through the development of its indigenous coal resources. Coal production in the Philippines dates back to 1941. By 1981, 233 million metric tons had been identified presumably as proven reserves. These reserves are widely distributed throughout the nation. In 1980, the annual capacity to produce coal was about 790,000 metric tons, but actual production was only about 359,000 metric tons. The coal production forecast for 1982 was given as over 1 million metric tons based on the projected completion of oil/coal conversion projects in the consuming sector. Actually, 1982 coal production was 558,100 metric tons.

At the same time, the most recent statistics on primary energy consumption in the Philippine Islands show that 70 percent is attributable to oil and 2.4 percent to coal. Local expansion of domestic coal use offers the opportunity of replacing imported oil. The Philippine government 10-year coal development program foresees a coal industry by 1992 at a level of 8.6 million tons/year production. This expansion is foreseen also as a major employment generator. At the same time, the nation recognizes the need for environmental protection as coal production and utilization increases. During the ten-year period, considerable opportunity can exist to accelerate progress through effective technology transfer and enhancement of personnel capabilities and institutional functions.

Accordingly, the longer term goal of this project is to help reduce foreign oil imports with their correspondingly high foreign exchange needs through the use of coal as a substitute fuel. The objective of this coal project is thus to help expand the coal production and consumption capacity of the Philippines and to also provide technical assistance as the method of accomplishing this objective. Coal utilization has been growing at a steady rate over the past few years, but in order to meet the more than ten-fold increase envisioned by the Philippine Energy Development Program of 1982-1987. This growth rate needs to be stimulated.

This project includes a set of seven distinct activities. These activities can be considered as either demand-oriented or supply-oriented and are directed by a strong planning requirement. These activities are also interrelated, and require careful management in order to make effective use of the input/output flows of the intermediate results from one activity to another.

The first activity, "Expansion of the Industrial Market in Coal," reflects the strong need for a marketing effort which both identifies the primary targets for coal conversion and then provides the necessary information on the most appropriate technology for their use. Such an effort requires familiarity with coal and its alternative combustion technologies. At this time, it is anticipated that the major targets for conversion will be those industries in need of steam raising, with the exclusion of steam raising for central station power generation.

The adaptation of a new technology which may prove appropriate in expanding the use of coal, particularly for the power sector, is a separate activity. "Introduction of Coal Water Mix (CWM) into the Philippines", is the second activity in the total program, but will be treated separately under a

special relationship with the Economic Development Foundation, as it contains activities which can be started earlier under separate auspices. There is, however, a need for coordination between this activity and the others which can interact. The adaptation of a coal water mix thus made from Philippine coal will involve the performance of a demonstration employing a steam generator to be made available and then the extension of the experience gained from the conversion of a major Philippine central electricity generation station.

Activity 3, "Mine Feasibility," has a twofold aim. Not only will the activity actually produce mine feasibility studies, it will also train local engineers in the procedures of completing them. In this way, the Philippines will have the opportunity of producing studies for specific mines which show that they have appropriate economic conditions to pursue funding. Local engineers will be ready to continue these activities through the associated training program.

The next activity, Number 4, consists of a series of three specialized training programs for those who work in coal mining activities. The major constraint in the expansion of the coal mining industry is the lack of trained operators. The first activity is the development of a training program in underground mining which includes mining operations and specific health and safety actions. The focus is on training trainers in order to ensure a continuing focus on these important aspects. The second training program in this group is design to establish a cost-accounting system for the industry and train accountants to utilize it. In this way, there will be both a new appropriate program designed specifically for coal mining, but one which coordinates with other resource accounting programs, as well as trained accountants for the program. The last program in this group is the development of a coal preparation and handling course. There is a lack of understanding of the relationship between coal properties and coal uses. Traditional beneficiation steps offer the opportunity to provide coal for more markets. This program will train coal mine operators in these techniques. This combination of three training programs in this fourth activity can provide the needed skills for increasing the use of coal in the Philippines while providing for the health and safety of the miners.

Activity 5, "Resource Assessment," provides an opportunity to update the Robertson Report, a geologic study completed in 1978. There is a great need for accurate data to characterize the Philippine coal fields and attract interest, and an appropriate data handling system to provide access to these data. This activity includes the development of a computer-based system for collection, storage, and retrieval of both existing and new-found data.

The next activity, Number 6, "Measurement of Quality," will establish internationally known quality standards and procedures for the coal industry. This activity is designed not only to establish standards, but also to train relevant coal personnel in their implementation. Such a program will facilitate the buying and selling of coal in more easily defined parameters.

The final activity in this project is Number 7, "Prioritization of Coal Development." As the last activity it serves as the main coordinating activity among the group. In addition, it has a series of functions itself which must be met over the life of the project. These functions include the development of a methodology for prioritizing coal areas for attention depend-

ing upon independent data produced under this subject as well as from Activity 5, and the development of coal service contract systems which will expedite coal use again based upon data from this task as well as from Activity 5. Accomplishment of these functions along with the coordinative role will ensure the timely development of Philippine coal. This activity will produce the basic outputs/results of the project, and can identify the needs for further activity toward the projects longer-term goal.

The basic approach in the performance of all activities is their performance as a joint effort if designated personnel from Philippine organizations and personnel of requisite qualifications and experience provided by a contractor organization.

INTRODUCTION OF COAL-WATER MIX (CWM) FUELS IN THE PHILIPPINES

Coal-water mixtures (CWM) fuels have been evaluated as a potential substitute for fuel oil in power generation for several years. The utilization of a slurry-like mixture of coal, water and specific additives offers the opportunity of replacing oil-fired combustion units with coal. A project to determine the applicability of CWM made from Philippine coal would permit the substitutability of domestic coal for imported oil at a substantial cost savings while retaining the convenience of a liquid fuel. Such a project is proposed as a part of a larger technical assistance program to the Government of the Philippines.

The Economic Development Foundation has been extremely interested in the opportunity of demonstrating this technology on Philippine coal. Originally, this project developed because of the willingness of the Marinduque Mining and Industrial Corporation (MMIC) to utilize a 30MW steam generator at Nonoc Island to provide a large-scale demonstration of the performance of CWM fuels, and also because of MMIC's interest to convert a bank of oil-fired nickel ore roasters to use coal.

The tasks involved in the project are to be accomplished in three phases, each phase having a specific objective which may comprise accomplishing several consecutive or parallel steps. The objective in Phase I is to demonstrate the technical, economic and financial feasibility of the concept in thes Philippine and will comprise two parallel activities. The first is to prepare small samples of CWM fuels from Philippine coals, estimates of costs to retrofit and perform demonstration runs, options for the supply of coal and CWM fuels, and analysis of the benefits from the conversion of a major (Sucat) station of the National Power Corporation. The second activity is an investigation of the feasibility of employing the first stage of a two-stage slagging coal burner, now under development for low-nitrogen-oxide combustion of coal to fire the MMIC roasters, and the identification of the needed test program. For both activities, the downstream activities and schedules will be developed and described.

The objective in Phase II is to achieve a successful demonstration of the performance of Philippine-based CWM fuels in the MMIC steam generator, and, if warranted, concomitantly in the MMIC nickel ore roasters. The activities will be undertaken essentially stepwise through achieving limited objectives. First, the basis of fuel supply will be established; second, the retrofit will be designed and installed; third, the operating program will be specified; fourth, the performance runs will be conducted; and, finally, the results will be evaluated and conclusions drawn.

The objective in Phase III is to achieve the conversion of the Sucat station of the National Power Corporation to CWM fuels on a permanent basis. The nature of the activities will depend on the experiences in Phase II and these could involve a second demonstration at NPC's Naga station on Cebu. An additional objective in Phase III is to achieve the conversion of the MMIC ore roasters to coal firing.

The basic approach in the performance of all activities is the performance as a joint effort of designated personnel from the Economic Development Foundation, the Marinduque Mining and Industrial Corporation, and personnel of requisite qualifications and experience provided by a contractor organization.

The expectations are that Phases II and III in the roaster conversion activity will be subjects that can involve conventional commercial transactions among the parties requiring little, if any, technical assistance.

PARTICIPATION OF THE ECONOMIC DEVELOPMENT FOUNDATION IN THE IMPLEMENTATION OF PROJECTS

Services from the Economic Development Foundation (EDF) are required in connection with the implementation of the Project to introduce Coal-Water Mix Fuels in the Philippines. Services are required in both Phases I and II.

EDF and the USAID Contractor designated for each phase are to work in a joint and integrated fashion with duties allocated as to whether they are technology transfer and cost oriented (USAID Contractor) or economic and Philippine adaptation oriented (EDF).

It is anticipated that EDF will undertake to coordinate the following types of activities, as examples:

1. Collection and transfer of coal samples to U.S. labs for testing.

2. Organization of sampling and analytical program in Manila.

3. Organization of meetings relevant to the activities involved in the implementation.

4. Evaluation of technical and institutional issues from Philippine perspective.

5. Dissemination of information as required in each phase.

6. Expediting the participation of the National Power Corporation in the activities, as appropriate.

One criterion for success of the Phase II activities will be the willingness of the National Power Corporation to undertake the lead roles on the Philippine side for Phase III conversion of a major power station and that of the MMIC to undertake the lead role for the Phase III conversion of the nickel ore roasters.

APPENDIX B. MATERIALS TO SUPPORT PROCUREMENT OF CONTRACTOR SERVICES

The following materials are designed to supply information on the seven specific activities identified in this report.

Activity 1. Expansion of the Industrial Market in Coal

Activity 2. Introduction of Coal Water Mix (CWM) into the Philippines

Activity 3. Mine Feasibility

Activity 4. Specific Training Activities in Coal Mining

a. Underground Coal Mining: Training Program on Mine Operation, Safety, and Health

b. Training for Cost Accounting in the Coal Industry

c. Training for Coal Preparation and Handling

Activity 5. Resource Assessment

Activity 6. Measurement of Quality

Activity 7. Prioritization of Coal Development

Activity 1

EXPANSION OF THE INDUSTRIAL MARKET IN COAL

The use of coal by industry offers an opportunity for the Philippines to reduce their consumption of imported oil. Recent statistics in the Bureau of Energy Utilization's "Quarterly Review" indicate that mining, manufacturing industry, transport, power and others consumed 4,306 megaliters oil equivalent during the first half of 1983. Total use of imported oil over this same period was 5,190 megaliters. A traditional industrial sector can be defined as a combination of mining and manufacturing and this sector consumes 21 percent of the total compared to 36 percent for power. Certainly the industrial sector is an excellent candidate to consider, after power, for potential conversion to coal.

Objective

This activity is proposed to both determine and encourage opportunities for coal conversion within the industrial sector of manufacturing and mining. It is designed to provide technical assistance services which will further identify industrial targets for coal conversion and assist in their actual conversions through seminars, a training program including marketing and engineering, and an industrial demonstration. Capital needs for the industrial demonstration are not anticipated in the activity.

Scope of Work

A brief review of candidate industries for conversion which have been identified by the Ministry of Energy Planning Service, the Economic Development Foundation, PNOC Coal Corporation Marketing Services, coal suppliers, and others suggest that there are good opportunities for conversion, yet their rate of conversion has been slower than anticipated. A series of interviews with personnel of the above organizations and others along with eight industrial plant visits indicates that there are four major reasons for this lack of conversion.

One - the economic climate precludes available investment capital;

Two - there is a lack of accurate information on industrial coal requirements including size, moisture, ash, heat content; on appropriate industrial technologies for combustion including conversion; and on related costs;

Three - 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.; and

Four - poor logistics prevent the right coal (appropriately beneficiated) from being at the right place, (industrial plant site) at the right time (to meet the plant schedule) for the right price (competitively established) with the right environmental considerations (appropriate emissions and disposal sites).

Several prospective solutions to these marketing problems have been identified and further developed into an integrated program of specific activities. At this time, it is assumed that no direct investments will be considered. Future activities, if appropriate, could include a mechanism such as a revolving bank fund for industrial use in coal conversion.

The first task includes technical assistance in further defining the market. It is assumed that work efforts will be directed towards the Marketing Services section of the PNOC Coal Corporation, but available to all. Further marketing will be designed to build upon their present work in the use of coal for steam raising which meets process heat requirements. This expansion can lead to steam use for direct electrical generation as well as cogeneration. Industrial use in mining and manufacturing will be stressed, but a survey of all related steam uses including marine boilers will be made at the start.

A brief review of the major industries suggests that metal mining and processing, sugar, wood processing with pulp and paper production, coconut oil mills, and textiles are the five leading candidates for coal conversion. These five industries utilize 68 percent of the industrial sector's consumption of petroleum products or 14 percent of the nation's total use. Barriers to their conversion, including appropriate technologies, will be identified. It should be recognized that these industrial totals include the partial conversion of the cement industry as indicated by its petroleum products' use for the first half of 1983. Additionally, it is assumed that the cement conversions will continue with no further marketing efforts required.

The second task builds upon the analysis of coal marketing produced in the first activity and develops a series of seminars. They are designed to educate Philippine industrialists and their related engineering consultants in the use of coal. Three meetings are envisioned which will cover the three major regions and be responsive to the types of industries, processes, and conversion opportunities appropriate to the region. At this time, if appropriate, attention should be paid to the use of CWM.

Following the series of seminars, task three, a major training program covering approximately two months of time at a twice-a-week rate, will be developed for a specific set of engineering consultants and industrialists. Working in combination with two local counterparts, the program will be designed for mechanical engineers with industrial and power experience who wish to participate in the industrial coal conversions identified by the market study. Major subjects will include the nature of coal in the Philippines, stressing qualitative and quantitative aspects, opportunities for both new and retrofit markets, technologies including CWM appropriate for markets with design characteristics, specific applications for electricity and cogeneration, environmental aspects of coal use stressing air particulates and ash disposal, and specific opportunities to use coal conversion as part of an overall industrial plant optimization program for energy utilization.

Next, following the training program, a specific industrial demonstration, task four, will be planned. This is envisioned as a cooperative effort stressing the inclusion of items deemed important by the participants of the training program. At this time, it is anticipated that the possibility of a design for a mixed fuel will be considered. Several industries have or are evaluating the conversion to other solid fuels such as fuelwood, coconut

shells, agricultural residues, etc. and have expressed concern about their long term availability. It should be noted that industrial use of agricultural residues, not including bagasse, has increased at a rate of 9.4 percent from the first quarter of 1982 to the first quarter of 1983. The use of coal as a baseline fuel at, perhaps a 50 percent level with the other nonconventional fuels as available for the other 50 percent, appears extremely interesting. There is a lack of available trained personnel who can provide services on such a design, and the training program should encourage both the personnel and their interest in coal conversions with or without supplementary nonconventional fuels.

The final activity, task five, includes a study on the basic pollution parameters to be considered as a result of increasing markets for coal conversion. It is suggested that several case studies be evaluated using a systems approach and showing the environmental issues associated with all of the stages of coal from mining through benefication, transport, and final use. Such a report shall be designed to establish the parameters of a major effort at a later time.

Outputs

Two trained counterparts in industrial coal conversion market analysis and technologies, a group of engineering consultants trained in conversion installations, and a replicable demonstration of an industrial installation designed to show the application of appropriate technologies and fuel mix as well as further designation of industrial targets for coal conversion. In addition, opportunities for the use of CWM in industrial settings would be identified, thus encouraging coordination with Activity 2, "Introduction of Coal-Water Mix (CWM) into the Philippines."

Activity 2

INTRODUCTION OF COAL WATER MIX INTO THE PHILIPPINES

Objective

Implementation of the activity is expected to help to reduce the importation of petroleum by accelerating the use of an alternate fuel, CWM, produced from indigenous materials. A successful implementation of the activity should also significantly advance the state of the art of CWM technologies for worldwide recognition.

Strategy

The activity begins at the mine, sampling a number of coal sources and testing them for their ability to be converted into CWM, continues through the verification of the eventual conversion site, transport systems, and finally conducts an actual burn test in a steam generating unit. Experimental work toward developing a substoichiometric CWM burner is also included.

Scope of Work

Phase I

The objective of Phase I is to investigate in an exploratory fashion, the technical factors, the market potential, and the demonstration requirements such that the incentives are identified for public and/or private sector initiative to provide the necessary fuel supplies to support the overall project of introducing CWM to the Philippines. The following topics will be addressed in this phase only to the extent and depth needed for this purpose.

A. Determine feasibility of making CWM from Philippine coals.

- Select Philippine coals. Candidates are representative coal samples from Semirara, Cebu, Bislig, and Samar. (See map)
- Collect samples. Samples shall be collected by EDF and transmitted by EDF to selected CWM manufacturers and testing facilities. Instructions on sample collection can be found in Appendix C, "Proposed Sampling Program for Small CWM Test Samples."
- Accomplish tests and evaluate results including costs of CWM process for Philippine coals. Samples of CWM fuel produced should be returned to EDF for inspection and laboratory work.
- Select candidate and backup coals for further CWM consideration.

B. Review concept of feasibility of Sucat conversion.

- Working at the "drawing" level, select one unit for evaluation.

- Consider feasibility of conversion using one boiler design.
- Consider use of present oil pipeline from Batangas.
- Decide upon acceptability of possible derating.
- Develop preliminary cost estimate for conversion.

C. Perform prefeasibility study on conversion of one of three 30 MW surplus steam generators in the MMIC nickel plant on Nonoc Island.

- Select generator and confirm availability, suitability, and determine retrofit required to handle CWM at the existing fuel oil storage tank at port facility.
- Identify new equipment items, changes and other needs for conversion.
- Estimate capital cost of retrofit.

D. Perform analysis of CWM production plant costs and develop perspective fuel supply sources.

- Determine specifications for CWM plant required for Nonoc test.
- Design appropriately sized plant to provide sufficient CWM fuel for test.
- Develop cost analysis of CWM production plant for Nonoc test.

E. Investigate feasibility of CWM as fuel for nickel ore reduction roasters at MMIC.

- Evaluate available alternative burner units
- Design preliminary test program.

Phase II

Given positive results from Phase I, and reasonable expectation that a fuel supply will be available when needed:

A. Evaluate opportunity for steam generator test burn at Nonoc.

- Perform detailed combustion test on selected CWM produced with Philippine coal at US laboratory site with research capability to ensure use in an oil fired unit. Include burner and boiler performance, slagging and fouling problems, pollutant emissions, and handling characteristics.
- Perform detailed design for a demonstration program to test CWM on one (1) of the 30 MW steam generating units at Nonoc.

- Design test program. The objective of the design would be the assurance that all needed data can be measured and recorded.

- Design retrofit needs. The objective would be to specify and detail new equipment items, changes to existing installations, new instrumentation and control needs, to enable the conversion. In this respect, it may be necessary to add cyclonic dust separation equipment to accommodate the possible higher ash content of CWM.

- Perform a definitive cost estimate for the retrofit for, and operation of, the Nonoc test program.

B. Evaluate opportunity for use of CWM in nickel ore reducing roasters at MMIC.

- Identify equipment needs and changes.

- Develop cost estimates for retrofit and operation.

- If appropriate, demonstrate use of CWM

C. Prepare Nonoc site for demonstration.

- Perform the retrofit work, charge the fuel tank with CWM, and prepare for the carrying out of the Nonoc test program.

D. Demonstrate use of CWM at Nonoc.

- Perform the Nonoc test programs and collect operating data.

- Evaluate use of CWM in test(s).

Phase III

Given appropriate results from CWM test(s) in Phase II, continue evaluation of CWM as replacement for oil-fired steam generation units. The objective of the evaluation would be to enable a conclusion regarding the transferability of results to Sucat and other applications.

A. Develop full scale evaluation of three basic designs at Sucat. Consider use of black products pipeline system from Batangas and/or other transport method.

B. At this point in the program, it may be convenient to address the possibility of a second demonstration test at the Naga, Cebu, NPC presently coal fired 50 MW steam electric power generating plant. The benefits of a demonstration test at Naga could be:

Demonstration of CWM on a conventional electric power grid unit.

Comparisons between CWM characteristics and pulverized coal characteristics when burned in the same furnace.

An opportunity to train NPC plant operators for eventual Sucat staffing.

C. Design, planning and carrying out of the conversion of four (4) Sucat oil fired steam generators to CWM firing.

Activity 3

MINE FEASIBILITY

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 by doing field work and probably a few drill holes.
- These data often reveal that the discovery does indeed look promising and that further and additional work to develop the project is justified.
- Such work is done which 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 is analyzed and if it appears that there are many millions of tons of a potentially mineable and valuable resource, then a feasibility study should be carried out.
- 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 say the project should go ahead and the report would be used to convince bankers and others to provide funding.
- Also, the project may be decided to be marginal and additional drilling may be done to locate additional reserves, or other important assignments. Also, it could be shown to be negative and it would be put on hold until some important factor changes.

To be meaningful and acceptable to funding institutions, a feasibility study must be thoroughly done and by impartial and qualified people. It is believed that it would be beneficial if the P.I. developed a capability to perform these feasibility studies. Certainly all the basic talents to do such studies are available in the Philippines, but they need to be trained in the details of making such studies.

Coal Mine Feasibility Studies

After basic exploration work (geology, drilling, testwork, etc.) has established the existence of a potentially large mineable coal resource, it is necessary to make a study of the potential profitability and feasibility of developing the deposit further. This is necessary to present to financing authorities to acquire funding for further development if the project is favorable. The study could give marginal or poor results which would stop its development for the time being. 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.

Training Program

This program includes a coal mining engineer with experience in carrying out feasibility studies and a financial analyst with computer experience coming to the P.I. and working with 10 - 12 selected Philippine candidates to train them in feasibility study preparation.

The Philippine candidates would be from mining consulting companies with mining engineering and financial analysis capabilities. There would be a mining engineer and financial/computer person from each of 5 or 6 companies. The other specialist required for feasibility studies is a market specialist, but in this case coal marketing studies done by PNOC:CC would be used in the analyses. Additional marketing data will be available from Activities 1 and 2.

The program would consist of carrying out actual feasibility studies on three different coal deposits now in the pre-development stage. That is those where exploration, drilling, geology, testing, and analyses have been completed. The properties to be assessed would be selected from the Philippine Coal Producers Association (PHILCO), and should include both surface and underground mines.

Each property would be considered a separate case study and would require three months elapsed time. Each would cover the following:

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

- 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.

- While the above is being done by the mining people, the financial/computer expert will be working with his 5-6 Philippine 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.

- 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.

After the first study, the procedure is repeated with other potential mines to show the variety of possible situations. Each progressive study should proceed better and be accomplished easier as the participants become familiar with the procedure.

It is assumed that the government would provide facilities for the working groups and that the expenses for Philippine participants would be borne by their companies.

Activity 4

SPECIFIC TRAINING ACTIVITIES IN COAL MINING

a. Underground Coal Mining: Training Program in Mine Operation, Safety and Health

Background

Information available shows that at the end of 1982, the total Philippine coal potential was estimated as 1.7 billion metric tons. Of this amount, 263 million metric tons was proven reserves and of this amount 178 million tons is estimated as being mineable. 50 percent of the current proven reserves are on Semirara Island, 25 percent are in the Cagayan Valley of Luzon, 15 percent are on Mindanao and 10 percent are scattered on Cebu, Samar, Mindoro, negros, Polillo, Bataan and Catanduanes. It is estimated that of the proven reserves 82 percent are mineable by open-pit methods.

Coal production has increased over the years 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. However, production from underground mines will expand and the number of underground mines and miners employed will increase. Hence, these 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 a low ebb and not likely to improve substantially. These miners would require only a brief orientation and training to be taught the nuances 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 P.I. underground coal mines. The methods can consist of room and pillar and longwall systems on seams that do not dip severely (0-20^{0}) 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.

Scope

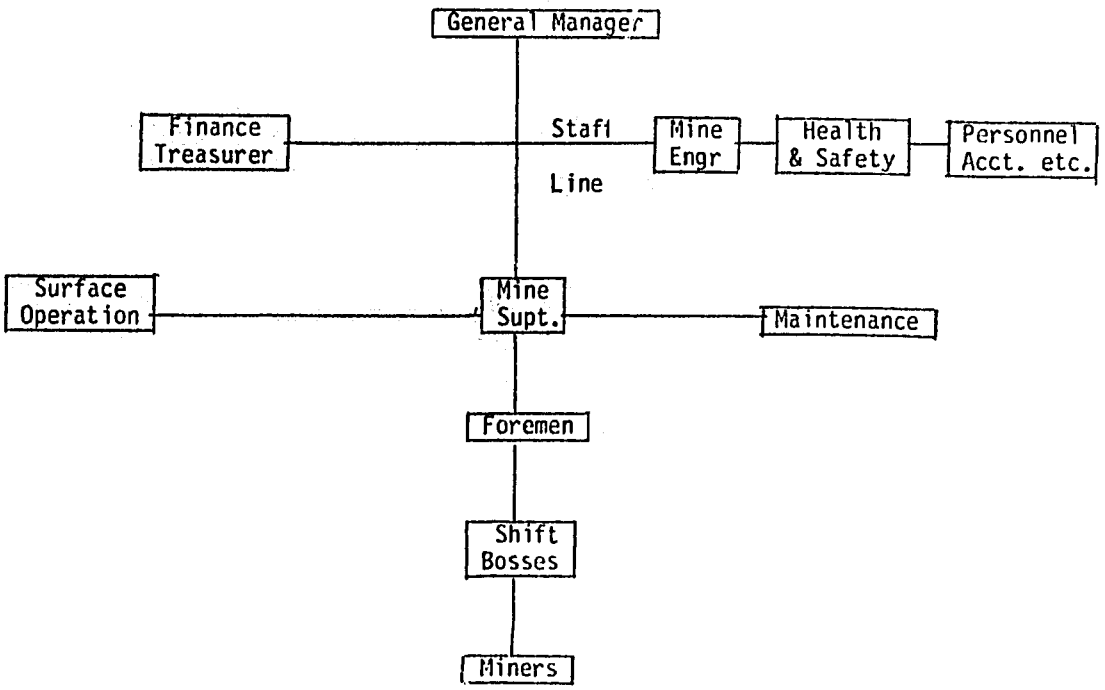
The program envisaged for this activity would consist of three major parts.

- Training of people for the operation of underground coal mines. Foremen, shift bosses, engineers, miners, health and safety men.
- Training of management people in coal mine cost accounting.
- Training of engineers to make pre-operation feasibility studies.

These training programs require different approaches and methods of accomplishing the objectives, hence they are discussed separately. The scope of each proposal is to include work that will result in trained people to assist in the improvement of the coal industry.

Programs

The training of people for the operation of underground coal mines comes first. 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:



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 the people. These would be as follows:

1. Orientation/Introductory Course: To be taken by all candidates and the only course for miners. (To last perhaps 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.

2. Advanced Course: For candidates to become mine engineers, foremen, shift bosses, and health and safety men. To last perhaps 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.

3. 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.

Program for establishing courses:

There should be a joint Philippine-USAID effort in establishing these courses. It could employ two U.S. experts (one experienced under ground coal mining engineer and one coal mine health and safety expert) working with the Philippine counterparts with the same type of general experience. It may not be possible to find a Philippine coal mine safety authority, but a person with experience in metal mine safety would be a candidate. It is envisioned that these Philippine counterparts would be trained by going through the courses, then remain to run the school after the U.S. counterparts had left. They, in turn, would train additional instructors.

The program would include three phases:

- An initial assessment to last about two months to do the following:

  Visit all U.G. coal mines and determine from the visits and discussions - details of the training needed to fit in the suggested courses, numbers of various types to train, location for training center, proper details of curriculum, course timing, etc.

- An assessment of the data obtained and design of the courses, acquisition of training materials needed, selection of the first candidates, plan for inauguration of the school, etc. Timing about four months.

- Inaugurate and run the first series of courses.

Indoctrination Course	1 Month
Advanced Course	3 Months
Health and Safety Course	2 Months

Total Time: 1 year

Selection of candidates should probably be made by having them fill out an application giving their education and experience and other data. From that, the course faculty (4 people) would select candidates who would take only the miners course or two courses or all three. It would be appropriate to accept at least 25 percent of the candidates from existing private and government coal mining companies staffs and miners to give such people a chance to learn something and advance to better positions. The exact nature of the selection is to be determined by the contractor in Phase 1 of this program. There is evidently a need for about 250 newly trained miners per year, perhaps 100 foreman and shift bosses, and 10 health and safety people. Again, such estimates are to be refined and determined in the first stage.

It is assumed that the Philippine Government would provide physical facilities for the course and would take care of the wages and expenses of the Philippine counterparts.

b. Training for Cost Accounting in the Coal Industry

Background

Cost accounting for an underground coal mine is no different from 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 this is handled is necessary. This can be best accomplished by having a U.S. authority and specialists in coal mine cost accounting come to Manila and present a series of two two-week seminars to candidates who already have accounting degrees on accounting backgrounds and who wish to specialize in coal mine accounting.

Coal production has increased over the years to 557, 983 MT in 1982. It appears that 10-15 students per session could be accommodated. Hence, 20-30 candidates could be trained in the total program. This should be adequate to initiate a coal cost accounting capability in the Philippine coal industry. Candidates would come from government agencies, mining industry consulting companies, and private coal mining companies. Selection of candidates would be jointly done by a committee formed by the Ministry of Energy and the Philippine Chamber of Coal Mines.

It is assumed that the trained accountants would return to their respective companies and establish coal mine cost accounting systems and start and train others in the use of the systems.

Scope

The course shall consist of the following:

- One week of lectures, discussions, and explanations of coal mine cost accounting systems.
- A second week of carrying through a case study of an actual coal mine cost accounting practice.

Program

The following program can accomplish the above. The contractor is to provide a coal mine cost accounting specialist to come to Manila for six weeks (2 weeks to inaugurate the course, 4 weeks to complete two 2-week programs). It is assumed that the government would provide physical facilities for carrying out the program as well as organize the selection committee.

c. Training in Coal Preparation and Handling

Background

The purpose of coal preparation is to improve the quality of coal, making it suitable for a specific purpose by, (1) cleaning it to remove inorganic impurities, (2) sizing -- crushing or screening or both, or (3) by special treatments such as dedusting. All coals have certain properties that place limitations on their most advantageous use. Because of a general lowering of quality of raw coal in recent years, the need for coal cleaning has significantly increased. Some of the factors contributing to the need for increased coal preparation are, (1) increased demand brought on by market and environmental requirement, (2) increased dilution with extraneous material, and (3) depletion of high quality coals.

Preparation can be very simple (crushing and sizing only) to complex where all size fractions are processed by gravity separation processes and flotation (deep cleaning). The concept of improving quality general includes removing the ash constituents and sulfur bearing minerals. Lowering ash and sulfur content improves the quality (higher BTU value, lower ash and sulfur).

The incentive for having miners clean their coal is, of course, a higher price because the improved coal lowers the cost of the consumer's operations. Hence, an understanding between coal consumer and coal producer is required and the consumer must know the quality of coal he needs and the benefits to his process of higher quality coal. The coal producer, on the other hand, must understand his coal and know what can be done with various washing processes to improve the quality of his coal as well as the economics associated with each potential washing process.

The potential for particular washing plant flowsheets 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 get improved quality products and good coal recoveries.

Scope

This program can be accomplished by having an authority on coal preparation and handling come to Manila and put on a two-week symposium for public and private sector coal mine engineers, plant managers, and management people in the coal industry.

Some 20-30 people could be trained in such a seminar (more, if physical space were available). It is assumed that the government would provide the facilities and that a joint Government-Philippine Chamber of Coal Mines Committee would select the candidates.

Program

The program would consist of lectures, discussions, films, examples, etc. presented by he expert in two one-week sessions as follows:

First Week: General discussions of coal preparation.

- Reasons for preparation
- Examples of flowsheets 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 intepretation
- Design of plants from washability data
- Selection of equipment and discussion of individual parts of flowsheets
- Discuss and show different flowsheets 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

It is expected that the first weeks course would give a general view of coal preparation and handling, why it is done, and what it will accomplish. Presumably, some candidates would then drop out and those with a more technical engineering interest would continue the second week of a more detailed and technical discussion.

It is suggested that the U.S. expert spend one week in Manila preparing for the course and then two weeks giving the course. The expert must be a

recognized authority in these subjects and come prepared with all materials (reports, handouts, films, slides, charts, texts, etc.) for presenting the course.

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Activity 5

RESOURCE ASSESSMENT

Objective

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 with an appropriate coal data management system, and

2. National standards for coal sample collection, handling, preparation and analysis.

Scope

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

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

- Evaluate and integrate all parts of the final report on coal resources.

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

- Gather, organize and integrate the known data on quality of Philippine coals.

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

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

- 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.

- Develop coal resource classification scheme with Philippine government (GOP) requirements.

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

- Define data sources and responsibilities within GOP and develop system flowchart.

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

- 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.

- Train general users in operation of data base system (in Philippines)

Outputs

All materials prepared will be documented and made available to all potential users.

Activity 6

MEASUREMENT OF QUALITY

The issue of standardized values for coal properties is important to buyer and seller alike. Procedures are required for sample handling and shipping, physical operations, and chemical analyses. The objective of this activity is the definition of these standards and procedures along with the required training of key personnel to ensure their utility to the Philippine coal sector.

- Establish and implement procedures for identifying, organizing, documenting, verifying and computerizing existing coal quality data.
- Establish and publish written standards for the collection and geologic documentation of all exploration and production coal samples.
- Establish and publish written standards and procedures for packaging, handling and shipping of coal samples derived from exploration and production activities.
- Establish and publish written standards for grinding, crushing, pulverizing, sizing and splitting of exploration and production coal samples submitted for chemical analyses.
- Establish and publish written standards for analyzing exploration and production coal samples including ulitmate and proximate analyses, Btu and ash fusion determinations, coking properties, forms-of-sulfur, and major, minor and trace element concentrations.
- Establish inter- and intra-laboratory quality control procedures for all analytical laboratories.
- Establish standard reporting scheme which states the confidence limits for analytical determinations and provides the reporting format for all chemical determinations.
- Establish procedures for computerizing all new chemical and physical data on Philippine coal and for making these data available to all users.
- Establish training program for chemists and geoscientists to become familiar with all written standards, analytical laboratory methods, and sample collection and preparation procedures. Train four to six geologist/chemists and chemists for several months in U.S.
- Establish procedures for exchange, collection, and analysis of 20 to 30 Philippine exploration coal samples per year with USGS.

Outputs

All procedures and standards will be documented and made available to all potential users.

Activity 7

PRIORITIZATION OF COAL DEVELOPMENT

This final activity develops the synthesis of the materials prepared previously and interprets them for prioritizing the development of specific coal fields. It contains three major parts. The first is methodological in the sense that it develops an analytical structure whereby coal use can be compared with other fuels and with alternative conversion technologies. The relevant parameters for decision making will be determined. An accounting scheme for comparing alternatives will make analysis responsive to these decision making needs.

The results of the second part will be a set of computer programs which will develop alternative strategies for the sequence and timing of the development of coal fields. The programs will include inputs which relate specific mines with their locations and characteristics, alternative logistical systems, and the markets.

The methodology of the first part is directly linked to the second aspect of the activity. The method requires data to evaluate timing and sequencing decisions. The market for coal in power, cement, and from those industries examined in Activity 1 will be analyzed to provide an idea of how much coal demand will be likely to occur within selected time intervals. This second part of the final activity, thus consists of market projections taken from previous analysis.

The third part of the effort relates to the institutional aspects of service contract conditions. To encourage private sector financing of coal development within the criteria of national policy, alternative schemes that are proposed to develop coal fields in a timely fashion will be examined. The institutional evaluation will be related to the prioritization effort in that the timing and financial constraints will play a role in the degree to which encouragement of the industry is necessary. Thus, the market, the resource, and the incentives will all be related and tested through analyzing alternative approaches.

Initially, the three part system will be tested on the Luzon region to determine the plausibility of the results of the methodology. After this test, consideration will be given to expanding the analysis to other regions. It should be noted that the accounting system of analysis is only designed to facilitate decisions, not make decisions. The software is an aid to understanding, and does not itself provide sufficient understanding to select the final strategy. That still requires a decision process with legitimacy and credibility.

This activity synthesizes much of the previous data and work as it applies to fundamental coal development. It, therefore, will also result in outputs of value to determining the next phases, if any, of technical assistance. Using the Luzon prototype, it will test the overall project for utility and its ability to be responsive to the needs of the Philippine public and private coal sectors.

Furthermore, it will result in an estimation of capital needs to develop the coal sector. Many technological and energy resource alternatives will be compared on their capital requirements, thereby determining the financing program to be needed in the energy sector.

As further by-products, coal mining projects will be identified for further consideration and the need for adaptation of coal production and utilization technologies will be quantified to a degree of use to planners in both the public and private sectors.

In sum, this synthetic activity integrates the overall project and provides the means to evaluate the utility and effectiveness of the performance of the design and execution of the technical assistance effort.

APPENDIX C

PROPOSED SAMPLING PROGRAM FOR SMALL CWM TEST SAMPLES

I. Basis:

It has been determined that approximately 150 lb samples from four mines will be sent by air freight to four test laboratories in the United States. Should the requirements for sampling need to be changed, additional instructions will be developed.

II. Locations:

To cover the range of coals likely to be considered for CWM use, it is suggested that samples from four active mining areas be taken as follows:

1. Semirara - Sample from active mine at Unong. Open-pit mine ± 12 meter seam.

2. Southern Cebu - Select Luvimin Mining Company mine. Underground mine ± 3.0 meter seam.

3. Samar - MMIC coal mine area near Bagagday - Developed coal seam - 2.5 meters thick. Open-pit mine.

4. Surigao - Bislig Area - PNOC mine, underground ± 2.0 meter seam.

III. Sampling Procedure:

The idea is to sample a fresh coal face at each mine, prepare that sample and split out portions to end up with equal samples.

Take a sample of the entire coal seam from an active mining face or fresh new coal face at a location the mine manager or engineer believes would be representative of the present mining area. (No samples are to be taken from stockpiles, bins, or conveyor belts.)

Take a channel cut of the entire seam from top to bottom as follows:

1. Clean up around the coal face and floor and lay down a collecting canvas or cloth (piece of canvas or material about 6' square).

2. Mark the channel to be cut from top to bottom with chalk or other marker. Then cut out this channel for the full height of the seam. For the Semirara sample, the channel cut will be 13 cm wide and 13 cm deep. For the other sample, the channel cut will be 30 cm wide and 30 cm deep.

   With different seam heights, different widths of channel cut are taken to get approximately the same amount of sample as follows:

Semirara	- 670 lbs.
Cebu-Luvimin	- 840 lbs.
Samar-MMIC	- 743 lbs.
Surigao (Bislig)	- 620 lbs.

3. Chip out the sample by hand with hammer and chisel or pneumatic hammer, if available.

4. The sample will fall on the collecting cloth. From that, it should be put in a clean container or containers (barrel, box, etc.) and taken to an area where there is a flat, clean, concrete slab or other smooth, clean, uncontaminated surface. (Sweep surface absolutely clean with a broom.)

5. At this location, the sample should be crushed so that every particle passes ± 1/2". With these relatively small samples and coal, this can be done by hand on the flat surface by breaking up the lumps with a hammer. If there is a 1/2" screen available, the sample can be screened to be sure everything is 1/2". If not, the engineers judgment that everything is 1/2" is alright.

6. The sample is now mixed, coned and quartered, and split as follows:

   a. Pile up the sample in the shape of a cone (with square point shovels).

   b. Flatten out the pile with a shovel and mark into quarters.

   c. Form a new coned pile to one side by taking one quarter and placing it, then the opposite quarter, then the third quarter and then the fourth. Always place material on the top to form another coned pile. Be sure to take all the fine materials.

   d Repeat the above procedure (b and c) four times and end up with a coned pile.

   e. Flatten the cone and mark into quarters.

   f. With a small scoop or shovel, take a grab sample of about three pounds from the center of each quarter. Place those all together in a double plastic bag and seal.

      This provides the ± 10 lb. sample to remain in the Philippines for analysis.

   g. Form a new coned pile (as in "c") with the remaining sample. Flatten it out and mark into quarters.

h. Place each quarter (with shovels) into double plastic bags in a steel drum. Be sure all fines from each quarter go into the sample. Use a broom to sweep fines into the shovel and into the sample.

This will prepare four samples, each of about 150 lbs.

i. Seal each plastic bag carefully (the inner one first, then the outer one). Close the drums and seal. Send one sample by air freight to each of the identified U.S. laboratories.

NOTE: All steps, 1-6 should be completed as rapidly as possible. All in one day or less. Be sure all samples are properly marked.

MATERIALS NEEDED:

- Mixing and collecting cloth - 6' x 6' canvas
- Shovels, hammers, picks, broom
- Plastic bags - large, heavy duty, ± 100
- 1/4" screen
- Drums for sample shipping (16 - 20 gallon drums)

APPENDIX D

MEETINGS

Between September 19 and October 15, 1983

Agency for International Development	Mr. Lawrence Ervin Ms. Baby Silva
CALTEX, Inc.	Mr. Cosme de Leon
PNOC Coal Corporation	Mr. Marcelino Soriano Mr. Willie S. Mediavillo
Bureau of Energy Development	Mr. Rufino B. Boomasang Mr. Wenceslad Dela Paz Mr. Art Mori
Bureau of Energy Utilization	Mr. O. Galang Mr. Benjamin Lim
Ministry of Energy	Mr. Gary Makasiar
National Power Corporatior	Dr. Jose U. Jovellanos Mr. Avelino T. Galvez Mr. Villanueva Mr. Jess Gatmaitan Mr. Vic Luzon Mr. Ben Babilonia Mr. Hispanto Mr. Mendoza Mr. Nestor M. Pedron Mr. Alfredo Bora
Philippine Petroleum Corporation	Mr. Santa Ana Mr. Pat Lopez
Economic Development Foundation	Mr. Cesar N. Sarino Ms. Purita Festin Dr. Alexandro Melcior Mr. Melito Ricafrente Mr. Gil C. Guevara
Asian Development Bank	Mr. Alan Roy Mr. Harold F. Haiek Mr. Peter Brinkmann Mr. Robert Montgomery Mr. Eda Hadding Mr. Jung Won Kim Mr. Seung Y. Rhee
Chamber of Coal Mines	Mr. Pio Caccam

MEETINGS
(Continued)

Marinduque Mining and Industrial Corporation	Mr. Jones Castro Mr. Cassal Mr. Hassain Mr. Mel Bilkey Mr. Jesus Cabarrus Mr. Alfredo Velayo
Philippines Coal Producers Association	Mr. Jose M. Delgado (Montenegrin Mining Corp.)
National Coal Authority	Mr. Mario Tiaoqui
University of the Philippines	Dr. Perfecto Guerrero
Fortune Equipment Company	Mr. Ramon M. Hachero
SGS Far East Limited	Ms. Yolanda J. Verzosa
First Philippine Industrial Corporation	Mr. Edilberto C. Gamboa Mr. Agripino S. Cabanas Mr. Eustaquio E. Generoso
Embassy of the United States	Mr. Richard M. Smylie (Assistant Commercial Attache)
Shell Distribution Company, Inc	Mr. C. P. Mata
Manila Bay Hosiery Mills	Mr. Ting Pai Tan
Island Cement	Mr. E. Serra
Rizal Cement	Mr. de la Fuente
Insular Sugar Refining Corporation	Mr. R. Jocson
UNICOM	Mr. P. Ortaliza (Legaspi Oil Mill)
Metroplex Coconut Oil Mill	Mr. Marasigan
San Pablo Coconut Oil Refinery	Mr. Rebueno
Fil Syn Fiber Corporation	Mr. Avila
Semirara Coal Corporation	Mr. Domingo Mr. Tomaneng

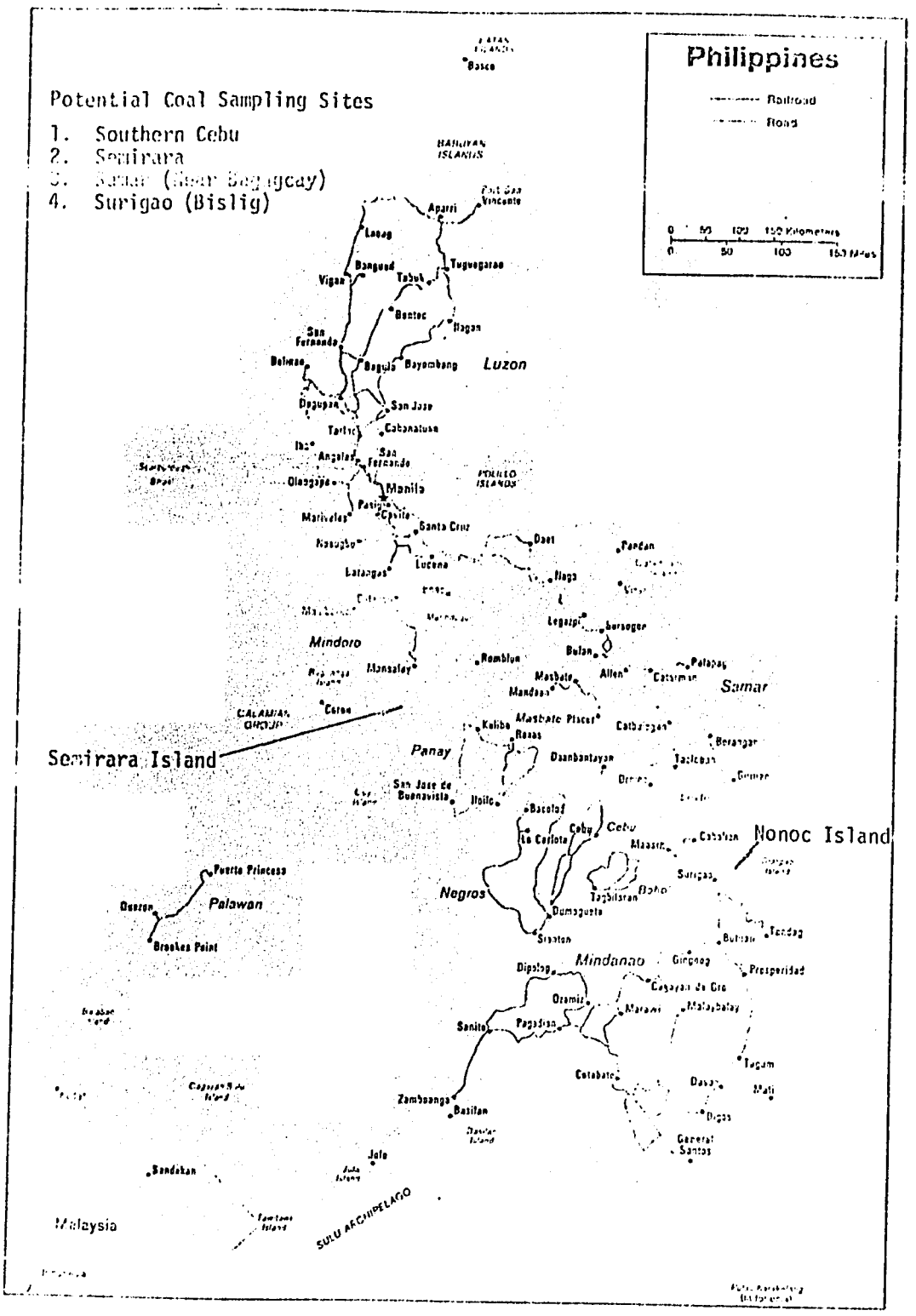
INTERVIEWS

Between July 18 and August 5, 1983

Semirara Coal Corporation	Mr. Pablo P. Gallego, Jr.
Ministry of Energy	Mr. Mario C. Berbano
Bureau of Energy Development	Mr. Rufino B. Boomasang Mr. Wenceslad Dela Paz
Bureau of Energy Utilization	Mr. Orlando Galong
Philippine National Oil Corporation	Mr. Gary Makasiar Mr. Willie S. Mediavillo
National Power Corporation	Mr. Jose U. Jovellanos
Bureau of Industrial Development	Mr. Wilhelm G. Ortalix
Philippine National Oil Company	Mr. Francisco M. Roa
Asian Development Bank	Mr. Alan Roy
PNOC Coal Corporation	Mr. P. S. Santos Mr. Marcelino Soriano
National Coal Authority	Mr. Mario Tiaoqui

The United States Geological Service visited a number of additional persons during their trip. The attendees of these sessions can be found in the USGS report on their visit.

APPENDIX E


Potential Coal Sampling Sites
1. Southern Cebu
2. Semirara
3. Samar (Near Bagangay)
4. Surigao (Bislig)
Philippines
Railroad
Road
Luzon
Mindoro
Samar
Panay
Cebu
Negros
Mindanao
Palawan
Semirara Island
Nonoc Island
Manila
Malaysia
SULU ARCHIPELAGO

SUMMARY OF THE CASE FOR A COAL PROGRAM IN THE PHILIPPINES

In the last quarter of 1983, a program of technical assistance to improve production, consumption, and the expenditure of capital in the coal sector was designed. The design, accomplished by a team of USAID, DSI consultants, the USGS; and in the Philippines, various agencies of the Ministry of Energy, and the Economic Development Foundation, represents a consensus forged by virtue of numerous meetings, review processes, and technical analysis. The design for a coal program is discussed in full in a report by DSI, "Identification and Description of a Technical Assistance Program in Coal Development for the Government of the Philippines".

This program was designed at the request of the GOP. The initial request was for assistance in introducing a new technology, Coal Water Mix (CWM), that would make coal handling and, therefore, coal conversion from oil cheaper and easier. This request was broadened to include a program to improve the performance of the coal sector in certain critical areas of need.

The GOP has already mounted a serious effort to develop indigenous coal, production having almost tripled from the first half of 1982 to the first half of 1983, when 594,000 metric tons were mined. Yet the goal for 1987 is to meet a target of almost 7 million metric tons. If the local coal producers cannot meet this ambitious goal, then Australian coal imports will be required. The local producers are trying to meet targets, but can use assistance. Furthermore, demand for coal is not growing as rapidly as anticipated, once again, an area where international cooperation can be helpful. Whatever the problems, the private and public sectors have mobilized their resources because the stakes are high.

The balance of payments problem in the Philippines continues to become more grave. The government has singled out the energy sector as one place where foreign exchange can be saved by fuel substitution. The oil import bill in the early 1970's was only one-tenth of offsetting exports. One decade later, the fraction changed to one-third of the export income. Today, the situation has reached critical proportions. Yet, the Philippines has a major part of the solution available at its disposal, locally mined coal to replace imported oil.

Proven coal reserves were 263.2 million metric tons at the end of 1982. The quality of the coal varies considerably, but the applications in power and industry are substantial. The problems of moving from mine to market are, however, enormously challenging. Progress is being made along with the mistakes of inexperience. The opportunities to benefit from US technical cooperation are great. In the series of paragraphs below, there is a challenge/response structure which indicates the nature of the problem posed by the GOP and the private sector and the response designed to overcome the problems of an accelerated coal program.

CHALLENGE: The Marketing of Coal

To stimulate demand, and hence supply, the government mandated the use of coal in power and cement production. While this program has begun to have an affect, any further expansion will more closely resemble free market decision processes where the consumer chooses. Experience to date has shown a gap between coal quality and handling practices, and the satisfaction of consumer need.

RESPONSE: Establishing the Market for Coal

A market study and some demonstration work have been proposed to develop

more understanding of consumer needs outside of the mandated user community. The size of the market needs to be better understood and the characteristics of the coal that are important to specific users need to be documented.

CHALLENGE: Conversion of Oil-Fired Facilities

There are important constraints on the ability of consumers to convert to coal because an infrastructure has to be built to handle coal. Boilers designed for oil will frequently have to be scrapped rather than converted. The capital cost of such an operation is often prohibitive.

RESPONSE: Coal Water Mix (CWM)

A new technology for the handling and combustion of coal, greatly reduces the capital cost of conversion, in one case to one-fifth of the ordinary approach. By mixing very fine coal with water in a suspension, coal can be made to handle very much like oil, and burn like pulverized coal. Usually, this can be done with a relatively small derating of boiler capacity. This technology has grown dramatically in the last year and excitement for its introduction to the Philippines is high.

A test program to verify the use of Philippine coal with this technology and to demonstrate its feasibility, is a most tangible and impactful part of the overall program. Pending a successful outcome of the demonstration phase, the National Power Company is prepared to develop a program of conversion of an 800 MW power facility.

CHALLENGE: Mine Enough Coal to Meet Projected Demand

There are considerable barriers, both capital and human, to meeting projected demand. The first is the limited experience of the financial

community with local studies of mine feasibility. It is very difficult to get financing for mine production with local banks and local consultants.

The second barrier is the limited experience of the underground mining community with operations at a scale and level of safety that are required for current needs. While open pit mining will be responsible for the major portion of new expansion, the underground mining capacity is of good quality. These traditional sources cannot readily meet the non-traditional expansion of the industry without improving performance.

Not only is there a need to modernize the process of getting coal out of the ground, but also to prepare and handle that coal such that problems experienced by users will not inhibit the willingness of the marketplace to convert to coal.

Coupled with this problem of coal quality, is the question of coal cost analysis. The reward structure for producing good usable coal is not well understood. Cost accounting methods for extraction and preparation do not reflect later user costs so that pricing is not reflective of the total system costs.

RESPONSE: Training to Sensitize Financiers and Producers

Overcoming these barriers is a matter of training people to accelerate performance which otherwise will result in lost time and mistakes. The private sector is most involved in this part of the program. Representatives of the coal producers association have offered risk capital and expect to continue the effort after one year of the training of future trainers. A series of courses and cases has been designed to help the Philippines more rapidly respond to the growing demand for coal.

CHALLENGE: Define the Coal Resource

Knowledge of the resource to date is spotty, and information is difficult to access. The USGS has defined a long term program for both assessing the resource and accessing the information. In so doing, they have identified the challenge in its full particulars. Especially needed is a cadre with local talent. They can continually update information and provide useful knowledge to the developers of the resource, especially to capital sources willing to make development possible. If CWM were to succeed, that technology alone would lead to consumption levels that would require a better understanding of the resource.

RESPONSE: An Assessment and Training Program

A major long term effort on building counterpart skills to update knowledge of the coal resource has been designed. The need for such information and for storing it in a convenient form, will meet criteria proposed by all parties involved. A program to deal with the potential waste from not knowing the best opportunities and the delays in attracting capital to develop the resource, will provide critical support to meet the ambitious goals of the overall program. Planning for drilling to be done by the Ministry of Energy, recording the data in computer retrievable form, and interpreting the results are all part of the design to eliminate limits imposed by lack of information.

CHALLENGE: The Measurement of Coal Quality

As is any coal industry in the world, the question of measuring an heterogenous and traded substance results in conflicts between buyer and seller. Based on an investigation, it appears that the uncertainty in

measuring coal quality is induced less by the resource and more by the lack of uniform conventions of its sampling and testing procedures. There is also a problem due to the lack of specification of critical parameters to measure, such as sodium.

RESPONSE: A Quality Measuring Activity

This problem can be overcome by introducing uniform procedures for the standard international codes. The problem of execution and a system for overcoming differences in technique can be dealt with by training and verification among local and American laboratories.

THE FINAL AND MAJOR CHALLENGE TO BE ADDRESSED: Prioritization

When all of the information from the varied activities is brought together, it provides the missing ingredients for a system of incentives and efforts to prioritize the development of coal extraction and market penetration. Currently, the letting of service contracts, coal logistics investments, and comparisons among competing technological and resource bases are done with insufficient information by either government or private sector investors. The challenge is to put together the information from the overall program about the resource, its market, the use of coal water mix, and the incentives needed to meet industry costs and consumer preferences. It is especially important to provide the synthesis of this information in a manner that overcomes excessive centralization of decision making. Finally, there is a substantial need for capital in the sector, and prioritizing its use will be facilitated by the identification of capital projects throughout the coal development process.

RESPONSE: An Example of How to Prioritize

A major study will be undertaken which makes the methods and the tools of decision making visible to the potential users in the public and private sectors. Comparisons of technological and resource alternatives will be examined as well as incentive systems. Information from the previous activities will be synthesized in this activity. Coal Water Mix will be compared to competing technologies such as geothermal, renewable, oil, pulverized coal, and fluidized bed combustion alternatives for electricity generation and other uses.

The response to what will be known after the full program of technical assistance will result in capital expenditures. More informed decisions about the placement of effort over time will be available. Prioritization for coal development will be suggested, and alternatives will be examined such that the process of future decision making will be able to rise to the challenge of developing the coal production and technology conversion systems in the context of the most rapid and efficient means available to replace oil imports in the Philippines.