

February 13, 1986

MEMORANDUM

TO: ANE/TR/ENR, Robert Ichord, Jr.
FROM: ANE/TR/ENR, Robert Archer *RA*
SUBJECT: Burma Trip Report

Attached is my trip report on my meeting with the Minister of Energy U Sein Tun and discussions with Charles Ward, USAID Representative, and Terry Barker, Program Officer.

Based on my discussions, analysis of the World Bank Burma Energy Assessment and meetings with the Minister of Energy and the World Bank Project Identification Team in Burma, I proposed a set of assistance options focusing on energy analysis, planning and training that can be undertaken sequentially or simultaneously. This allows Mission flexibility and opportunity to proceed to greater involvement based on the degree of success and impact of the initial efforts.

Ward and Barker thought the proposed approach was sound, were very supportive and concurred with the recommended course of action which is:

ANE/TR/ENR will discuss with ST/EY their interest and budgetary capability to support some level of assistance as described above and communicate the results, including a proposed scope of work, if appropriate, to USAID/Burma;

USAID/Burma will discuss the nature, timing and level of assistance with the Minister and determine his interest; and

If merited based on the discussions, an ST/EY representative would visit for detailed discussions and write up a program of assistance. If possible this visit would occur in early April when an ST/EY representative is scheduled to be in the region.

Consequently, we should discuss this with ST/EY in the near future.

Attachment

cc: ANE/TR, Ken Sherper
ANE/EA, David Merrill
ANE/EA, Tom Kellerman
ST/EN, Jack Vanderryn
ST/EY, Alan Jacobs
ST/EY, Jim Sullivan
ST/EY, David Jhirad

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Archer Burma Trip Report
February 3-7, 1986

PURPOSE OF TRIP: To examine Burmese energy needs, meet with the Minister of Energy to hear his thoughts on Burma's energy sector and provide the Minister with information on A.I.D./Washington initiatives in this area.

BACKGROUND

Burma may possess the most significant oil and gas resources relative to its needs of any Asian country. Yet it is experiencing declining oil production with negative implications for foreign exchange, public debt and agricultural development.

Burma possesses substantial forest cover, yet there is an alarming rate of depletion of:

forest cover around the central Dry Zone due to fuelwood and charcoal demands and agricultural land clearing, and

mangroves in the delta to provide charcoal for the Rangoon market.

Burma faces major energy development and utilization decisions now and in the coming years that will have far reaching impact on national development including agriculture, balance of payments and State Economic Enterprises (SEE's) debt situation. Decisions are required on policies, plans and investments for:

Further development of proven on-shore oil fields,

Utilization of oil for multiple domestic needs versus exportation for foreign exchange earnings,

Development and utilization of on-shore natural gas,

Provision of energy for continued growth of agriculture,

Amelioration of the pressure on forests and mangroves through efficiency improvements and substitution for charcoal/fuelwood,

power generation choices between natural gas and hydropower and restoration/expansion of the distributions system including remote rural electrification, and

Off-shore oil and gas development utilization options that approach \$1 billion in investment needs.

AID/Burma Strategy and Energy Institutional Relationships

The AID/Burma strategy focuses on agriculture and health. The Strategy and staff discussions indicate that energy is a high priority problem--if not the highest priority--impeding agricultural development. The following is from the Interagency Review (draft) for the Burma Consultative Group Report:

"Notwithstanding (agriculture's) success, the shortage of energy has been particularly harmful in agriculture because of the difficulties in meeting production targets and/or of getting farm production to available markets. The success of Burma's efforts in agricultural diversification will require the availability of a number of inputs (the most important of which are fertilizer and improved seeds) as well as such supportive infrastructure and services as irrigation..."

It should be noted that fertilizer is essentially transformed natural gas and that AID/Burma efforts to establish seed plantations have been seriously hampered by the unavailability of power.

AID/Burma has included participant training in the energy sector as part of its strategy. Approximately 40 Burmese have received extended training in the United States primarily through the Conventional Energy Training Program (managed by ST/EY) in such areas as oil, gas and power systems. The training has been well received and the trainees have resumed positions in the key energy corporations.

On April 12, 1985, a Ministry of Energy was established by combining four SEE's previously under the Ministry of Industry No. 2: Myanma Oil Corporation (MOC), Petrochemical Industries Corporation (PIC), Petroleum Product Supply Corporation (PPSC) and the Electric Power Corporation.

Also, an Energy Planning Department has been created in the Ministry. It will be responsible for preparation of energy demand forecasts and planning, carry out energy research and analysis and provide training.

The new Minister of Energy U Sein Tun established his reputation as Minister of Cooperatives through his involvement with the AID Oilseed Project which includes assistance to private oilseed processors. The new Head of Office (third highest position) U Tin Tun also came from the Ministry of Cooperatives with U Sein Tun.

The record of successful AID-supported training in the component organizations of the new Ministry combined with the new Minister provides a receptive institutional relationship for AID/Burma. Because of the rather unique process in place for access to Burmese government officials, the successful training and experienced leadership (in the SRUB and with AID) are significant factors in the consideration of further energy-related activity.

World Bank Burma Energy Sector Assessment

The assessment was completed and published in June, 1985 and provides substantial information on the energy institutions, policies and issues facing Burma (and the donor community).

While I was in Burma a World Bank project identification team was there assessing the potential for an on-shore gas sector loan. I met before and during my TDY with team members.

Burmese Position on Energy Development

The Burmese position on their energy resources and development are contained in two documents:

Burma Energy Development Conceptual Programme, Ministry of Energy, January 28, 1986 (Attachment A)

Statement of the Burmese Participants to the Consultative Meeting of the UNDP/World Bank Energy Sector Assessment Programme and Energy Sector Management Assistance Programme, Paris, January 15-17, 1986. (Attachment B)

The documents describe the rationale for the cautious development of Burma's energy resources and put forward the elements of the "concept" some of which are:

Expanded on-shore oil and gas development,

Balancing expansion for domestic and export purposes,

strengthening technical and managerial skills.

The concept is to develop the country's energy resources by accepting outside assistance where mobilization of Burmese capabilities are limited. The debt service ratio is to be maintained at an acceptable level. Burmese material inputs and human resources are to be maximized so that development is balanced and politico-economic sovereignty is maintained.

The Burmese "recognize the need for assessment and planning steps between concept and realization."

Meeting with the Minister of Energy

Date: February 2, 1986

Attending: U Sein Tun, Minister of Energy, U Than Nyunt, Deputy Minister, U Tin Tun, Head of Office, Charles Ward, USAID Representative to Burma, Terry Barker, Program Officer.

The meeting was the result of a previous discussion initiated by the Minister of Energy. Routinely, USG contacts are at the Head of Office level (third in line under the Minister and Deputy Minister) for the conduct of foreign assistance activities. Consequently it was exceptional to meet with the three top people in a Ministry. Under the previous Minister of Industry No. 2 there were virtually no meetings at the Ministerial level with any USG official.

At the meeting I described the S&T Office of Energy project support including the following:

- Energy Planning and Analysis
- Conventional Energy Assistance
- Biomass Energy Utilization
- Renewable Energy Development (& Energy for Agriculture)

I described several project activities that were relatively germane to the Burmese situation including energy analysis assistance, bagasse and rice husk utilization, coal briquetting, conventional energy utilization pre-feasibility studies, Thailand small hydropower development and analysis of remote power options.

The Minister discussed at some length his perception of Burma's energy problems, opportunities and experiences. His account was extensive and included a wide range of experiences and proposed activities--some significant and some less so. With his background as former Minister of Cooperatives he was interested in rural energy issues but also recognized the need for major natural gas and oil development.

Near the end of the meeting we focused on the new Energy Planning Department that is now part of the Ministry. In response to a question about his interest in technical assistance for the Planning Department, he mentioned that the Asian Development Bank had offered assistance for energy planning, training and institutional development but that he did not want to accept it. He said this was an area where the U.S. had experience and expertise and assistance could be provided. He specified that assistance is needed to analyze and project energy demand to carry out their responsibility for development of energy plans.

The meeting was very cordial. We exchanged documents at the end of the meeting and the Minister hoped I would visit some energy facilities and requested the Head of Office to work to arrange a trip--an unexpected gesture. The Minister also mentioned that he hoped to visit the U.S. in March or April and was waiting to hear from the UNDP. (See Attachment C for memorandum of meeting.)

Meeting with World Bank Team

I met with the World Bank Project Identification Team in Rangoon. They were scoping out a natural gas development project focused in the delta which will include development drilling and a pipeline to Rangoon and beyond designed to displace oil use in the power and industrial sectors.

We discussed the issue of assistance for the Energy Planning Department. They said the Department will have two functions: management oversight of the four corporations and energy planning, analysis and research. They felt the Minister was receptive to new ideas and told of his desires to accomplish greater efficiency in the operations. When I suggested some modest organizational development and technical assistance for energy demand analysis they urged boldness over modesty. In sum, they felt this was a welcome area for assistance that could be valuable in promoting rationalization of policy and pricing objectives.

Technical Assistance Options

There are several activities that can be undertaken. These can be staged depending upon the level of funding and degree of success achieved.

Training--The Participant Training effort still has approximately \$200,000 (out of \$500,000) available for

continued training. It could focus on (a) energy analysis and planning and/or (b) technical medium-term "hands-on" training in natural gas (e.g., pipeline operation) to support the expected development in this sector.

Energy Analysis and Planning--The most immediate stated need is assistance in the establishment of energy demand analysis capability. Related to this are data collection and development, computer model installation, other analytical tasks and the establishment of priorities and methodologies.

Special Studies--This is a subcomponent of the energy analysis effort and is a critical one that would provide the reasoned and substantiated analyses that address policy and pricing issues. In addition the studies can raise the profile of areas of need and lead to action in issues such as household fuel substitution and remote power generation. The special studies could focus on either or both of two areas depending upon several factors: (a) analysis of macro-level oil and gas policies, prices and related issues, or (b) energy and agriculture-related analyses.

Technology Transfer--Once priorities are established, it might be appropriate to support development and adaptation of technologies critical to, for example, the rural sector. This could include small hydropower systems, rice husk or coal briquetting, water pumping technologies for small private farmers, and efficient rice mill use of rice husks. All these efforts could potentially be carried out entirely with private sector entities.

Organizational Development--The infant Energy Planning Department needs to be established properly if it is to be effective and credible. Assistance could be provided to develop the planning and analysis component or the management and monitoring component.

Funding alternatives are ST/EY Energy Policy Planning under Oak Ridge National Laboratory, USAID/Burma Participant Training project through the ST/EY Conventional Energy Training Project, other Mission funds that potentially come available, and utilization of other mission project funds. For example, if analysis indicates there is high priority interest in analyzing small scale water pumping or agricultural waste utilization for energy, conceivably this work could be undertaken in the Burma Agriculture Research and Development Project.

Conclusions

The Energy sector offers major potential for improving balance of payments, debt servicing ratio and agricultural development, all key concerns of the donor community and the government.

The assistance has been requested from a Minister and Ministry with which USAID/Burma has had positive working relationships.

The Energy Planning Department is at a formative stage and will be the key entity in the new Ministry on policy and planning issues.

The assistance is recommended in the World Bank Energy Sector Assessment and would complement the proposed Bank loan activity.

The development of sound analysis might influence policy debate positively while the lack of such analysis dooms the debate. There are indications that such analysis is desired in the arena.

Provision of assistance in the immediate future fills a void that will only be partially addressed by the World Bank gas loan program. It will also provide a basis for Mission decisions on bi-lateral funding in the future and for other donors as well.

Recommendations

1. Archer will discuss with ST/EY their interest and budgetary capability to support some level of assistance as described above and communicate the results to USAID/Burma.
2. USAID/Burma will discuss in general terms the nature, timing and level of assistance with the Minister and determine his interest.
3. If merited based on the discussions, an ST/EY representative can visit for detailed discussions and write up a program of assistance. If possible this visit would occur in early April when an ST/EY representative is scheduled to be in the region.

Attachments: A--Burma Energy Development Conceptual Programme
B--Statement of the Burmese Participants to the Consultative Meeting of UNDP/World Bank Energy Sector Programme
C--Memorandum of Meeting with Minister
D--Burma: Issues and Options in the Energy Sector Summary and Conclusions (UNDP/World Bank)

SOCIALIST REPUBLIC OF THE UNION OF BURMA
MINISTRY OF ENERGY

BURMA ENERGY DEVELOPMENT CONCEPTUAL PROGRAMME

DATED 28th JANUARY 1986.

BURMA ENERGY DEVELOPMENT CONCEPTUAL PROGRAMME

1. Burma was to have held discussions with the World Bank, Norway, Japan, Germany and Austria regarding financing and assistance to the Martaban Offshore Gas Utilization Project in November 1985. The down turn in the oil market and the slowing down of the World general economy causes us to reconsider the endeavour we are about to undertake. Three following conditions were taken into account in these reconsiderations:-

- (a) What will be the country's debt serving burden if an investment of such magnitude is undertaken with borrowed capital.
- (b) What will be political implications in the decision making sovereignty.
- (c) What effect will it have on the country's economic manoeuvrability.

2. Although we do have exploration and development experience in offshore work, Martaban Offshore Gas Utilization Project regarding production & undersea transportation is an entirely new technology. On the other hand Burma has an extensive experience in the entire range of onshore hydrocarbon industry. There exist onshore extensive facilities, when rationalized, could earn foreign exchange in a short time. The amount of capital investment would be less. Therefore, Burma have decided to give implementing priority in onshore hydrocarbon resources.

3. Although the preceding paragraph laid heavy emphasis on the petroleum industry, this paper is to present Burma's energy development programme. Emphasis was shown in the opening paragraphs were due to the change in discussion timing about offshore gas development.

Objective:

4. The objective of this paper is to present to the World Bank team, and any other interested parties, Burma's Energy Development Conceptual Programme.

Strategic Concept:

5. The strategic concept is to develop the country's energy resources by accepting outside assistance, where mobilization of own capabilities are limited. In doing so to maximise export potentials so that the debt servicing ratio is maintained at an acceptable level and to maximise in country context, not only the material inputs but the human resources as well so that the development is balanced and politico-economic sovereignty is maintained.

Onshore Petroleum Industry Development

6. Kyontani Oil Field Development A thick deposit of limestone with hydrocarbon presence have been discovered at Kyontani. Myanna Oil Corporation possess necessary deep drilling rig. To procure expensive consumables of tubulars and chemicals with international or bilateral assistance.

7. Tuyintaung Oil Field Enhanced Oil Recovery Crude deposit at Tuyintaung near Pagan have been proved. Extraction is difficult due to the crudes thickness. Procure equipment and /or technology to extract the thick crude with foreign assistance.

8. Rationalize Refineries. There are three refineries at Syriam of various age and capabilities, one at Chauk and one at Thanbayakan. Due to declining crude availability, refinery 'B' at Syriam and Chauk refineries are working intermittently. It is uneconomical and is not conducive to the well being of the refinery. It is intended that refining work would be concentrated at Thanbayakan (25000 bpd) and to use the vacuum still 'A' at Syriam to obtain lubricating stock. Others would be turned off and maintained in mothball condition. Labour would be retrained and relocated to other up-coming petro-chemical works. Assistance required.

9. Establish a Lubrication Production and Re-refining of Spent Lubrication Facility. Burma imports over 110 million kyats worth of lubrication base oils and additives a year. Most of Burma's crude are too light to be suitable for lubrication processing but crude from a selected field shows possibilities. Should test shows positive results, crude from

these selected fields would be brought to Syriam Refinery 'A' for vacuum distillation for lubrication base. Blending of local and yet unavoidable imported lubrication base and additives would be done at a suitable place. Since some of the processes would be similar, a spent lube re-refining facility would be annexed to the lubricating oil plant, Assistance required.

10. Conversion of Mann-Syriam Crude Oil Pipeline to a Gas Pipeline. Concentration of crude refining at Thanbarykhan would idle the Mann-Syriam 10" crude oil pipeline. On the other hand there is a surplus of gas at Mann whereas the major users are concentrated in southern Burma. Conversion of the pipeline to convey gas by changing only the crude oil pumps with gas compressors would be an economical solution. Injection of gas from way side fields such as Prone, Pyalo would turn this pipeline into a national gas artery. Wayside users like Lyawzwa Fertilizer Plant; Shwedaung Gas Turbine Generators would benefit. Other industries that uses gas either as fuel or raw material could be established. Assistance required.

11. Sittaung -Thaton-Myaingale Branch Line. A branch line from the above converted line would convey gas for fuel to Sittaung Paper Mill, Thaton Tyre Factory and Myaingale Cement Plant which are now being supplied with furnace oil after two to three rehandlings, would be supplied with good fuel. Assistance required.

12. Strengthening of the River Oil Barge Fleet. Deterioration due to age is rapidly depleting the river barge fleet. Growing petro-chemical industries along the Irrawaddy river needs transport, including oil barges and tugs. Myanma Oil Corporation (MOC) operates a dockyard, and the Petro-Chemical Industry Corporation (PIC) operates three slipways at Syriam. Both are capable of building oil barges and has a certain capability of building powered tugs. It is intended to purchase steel sheets, sections, propulsion machinery and to locally construct barges and tugs. Assistance required.

13. Conversion of Motor Vehicles to Compressed Natural Gas (CNG) Fuels. There is 0.63 trillion cubic feet of natural gas, 0.19 trillion cubic feet of associated gas, onshore.

Offshore proven deposits are 5.3 trillion cubic feet of natural gas and 1.7 trillion cubic feet of associated gas .Since it is difficult and expensive to export gas, it is intended that local vehicles to be converted to gas fuel and the resulting surplus of liquid fuel such as gasoline, diesel and furnace oil to be exported.Small compressors located where the present gasoline stations are situated near gas pipeline could refill gas bottles fitted to the vehicles. Gas bottles, pipings and conversion kits will have to be imported with assistance foreign exchange.

14. Erection of Manufactories for Exportable Production.

Hydrocarbon processing plants that produces exportable products like ammonia,urea,methanol, , LPG are to be erected where gas crude stock could be obtained from both onshore and offshore gas lines and situated near export facilities.They could be in line with the suggestions made by Petro-Canada, but location of the factory at Purian Point will have to be carefully reconsidered.Assistance required.

Offshore Gas Development

15. Drilling. To drill four to eight gas wells at 3DA-XA field, by using Myanma Oil Corporation's Jack-up rig" Nayminyaung Consumables to be purchased with loan assistance.

16. Pipe Laying. Laying 59 miles of undersea pipeline from 3DA-XA field to Amar.From Amar to Payagon pipeline of 53 miles and from Payagon to Rangoon 64 miles.The intention is to lay 18 inch gas pipeline,Assistance required.

17. Production Platform. Petro-Canada's original study recommends a production platform costing US\$ 60.3 million and local cost of US\$ 13 million.The intention now is to convert the jack-up rig "Nayminayung" to a production platform. Myanma Oil Corporation had practical experience in docking the rig locally.It had on hand gas turbine generator etc. ,which would be needed for conversion.Some items will have to be imported with loan assistance.Certification and insurance will also need assistance.

18. Petro-Chemical Complex. Petro-chemical processing facilities that will produce exportable products will be integrated with onshore manufactories vide para 14.

19. World Class Port Facility. Petro-Canada's report suggests a 3000 meter long trestle to a shipping wharf carrying pipelines and conveyor belt. It is felt that this solution is too restrictive. This method would no doubt serve the purpose of exporting liquid ammonia and methanol, MTG as well as urea, but would not serve any other purpose despite the high expense. Since a LPG terminal is already working at Syriam as well as a coke loading wharf and taking into consideration that a road and railway bridge connecting Syriam with Rangoon is already under construction with Chinese aid, it would be more economical both in terms of money and time to upgrade the present facilities. Upgrading of wharf facilities would range from renovation of storage; installation of suitable pumps to purchase of harbour tugs to help manoeuvre bulk petroleum carriers. Assistance required.

Electric Power

20. Burma prefer to develop hydro-power despite longer gestation period, heavier expenses and difficulty of installation because it would like to maximize the use of renewable energy sources. In doing so it would be developing major as well as mini and micro hydro electricity generation. Development of major hydro-electric power will be multipurpose i.e.; irrigation and power generation will be given priority over pure power generation. Yenwe hydro electric and Htondawgyi are two major potentials. Emphasis would be given to mini and micro electric power development. They would be usually out of the natural electric grid but would be oriented for rural development. Preference will be given to low head hydro power and when conditions permits to be operated by the local co-operative society. For mini and micro hydro electric generation major expenses will be for transmission and distribution. Foreign assistance will be sought for these schemes.

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21. Electrification of Rangoon - Prome Railway. The Rangoon - Prome Railway line is only 161 miles between cities. As the Mann - Rangoon gas pipeline parallels the railways gas turbine generators could be built at interval to minimize voltage drop. Concrete overhead power poles system will minimize import of steel and lessen danger of electrocution of man and beast. It would require infusion of concrete pole making technology. Assistance required.

22. Electrification of Rangoon Circular Railway. A heavy passenger carrying commuter trains electrification will contribute towards easing inner urban travel. Electrified railway with smaller individual train load with frequent interval will be more suitable for urban mass transit. Assistance required.

23. Electric Trolley Buses for Rangoon and Mandalay. Electric trams and trolley buses used before the war in Rangoon and Mandalay are non-polluting mass transits. It would be unfeasible to lay tram tracks but rubber tyred trolley buses are entirely feasible. Since electric power supply to Mandalay have increased due to Kinda hydropower came on stream, and Sedawgyi hydro electric power generation scheme nearing completion electric powered mass transit system would alleviate the congestion of present system. Assistance required.

24. Renovation of Ahlone Electric Power Plant. Ahlone steam turbine generator was once the premier electric generating station of Burma. They were originally fired with coal, later converted furnace oil. Since cheaper hydro electric power came on stream, Ahlone power station was given the benign neglect treatment. The power station has five boilers connected to three 10 megawatt and two 2.5 megawatt generators. The availability of gas have revived the interest in the power station. Examination by the Boiler Inspectorate have pronounced the shell to be sound, but the tube need replacing. The turbines parts also need replacements. Burmese technicians have carried out this task before. Availability of these parts and some other spares would bring back to life an important and major electric power source.

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25. Renovation of Rangoon and Mandalay Power Distribution System. Antiquated electric power systems of the two major cities of Burma are overloaded. Loss due to both technical and managerial shortcomings are endemic. Both cities electric power distribution system need to be overhauled and updated. Financing is needed.

Other Energy Developments.

26. Paddy Husk Charblocks. Cooking in the built up urban areas are meeting difficulty in the availability of fuel. Cooking kerosene availability has declined due to adjustment of refinery cut to increase gasoline and diesel fuel out puts. This puts the demands on charcoal which is made from mangrove tree. Destruction of these shore protecting and valuable shrimp spawning grounds do not augers well for the long run. On the other hand paddy husk has become a nuisance, since burning of it to raise steam have declined with the easier availability of electricity. Pilot scale production of paddy husk char blocks by the Cottage Industries Department of the Ministry of Co-operatives have succeeded. Spread of manufacturing and hence supply has not grown due to lack of financing for small manual presses needed to make char blocks. Financing of this industry would not only increase household cooking fuel availability but would create employment and earning in the rural area, based on now a nuisance by product. Financing is needed.

27. Homehold Cooking Gas. A number of steel bottles with required ancillaries have been bought. Use of LPG for domestic purposes will be introduced after careful education of the public.

28. Recovery of Chemical Fractions from Charcoal Mulip.

Charcoal making in Burma is almost on an industrial scale. A number of valuable products like creosote could be recovered, should proper design of kiln be introduced. The Ministry of Energy intends to introduce recovery techniques of destructive wood distillation products. Technology is needed.

Research

29. Kalewa Coal. Soft coal mined at Kalewa is used for firing a steam turbine. Present transportation method is wasteful and uneconomical. The Ministry of Energy intends to find out the feasibility of transporting coal slurry from the mine to the power station and firing of coal slurry or powder at the steam turbine plant. Technical and financial assistance is required.

30. Geothermal. A number of hot springs exists near heavy power use industries. The Ministry of Energy has formed a small group of engineers to survey and collect data on geothermal resources. Assistance is required in this new field of work.

31. Energy Conservation. It must be admitted that Burma as a whole is not energy conservation conscious. The Ministry of Energy intends to carry out better energy use and conservation, education and training.

32. Renewable Energy. The energy sector had treated biomass, solar and wind energy as an exotic plaything. The ministry of Energy intends to bring biomass energy conversion, solar power generation and use, wind power generation and use under its purview.

Business Management

33. State Economic Enterprises. The four state economic enterprises under the Ministry of Energy viz. , Myanma Oil Corporation (MOC), Petro-Chemical Industries Corporation (PIC), Petroleum Products Supply Corporation (PPSC) and Electric Power Corporation (EPC) were weak in business management. These corporations have given themselves priority on public utility services with heavy emphasis on the technical aspect of the work. The Ministry is asking the corporations to conduct themselves more as business enterprises. It is introducing financial analysis methods, more managerial accounting rather historical accounting is to be practised. Inventory control, productivity and integration of work are being urged.

34. Energy Department. The Ministry is drawing up organizational set up for an Energy Department. This is to be a government directorate to allow the four economic enterprises to conduct their work in a more business like manner. The department will be making such things as energy demand forecast and planning. It will have training institutes and research facilities so as not to burden the economic enterprises with their expenses.

35. Business Management of the State Economic Enterprises (SEE). The SEE will in the future be responsible for market research, product development and marketing with a view to making a profit, by efficiency and not by raising prices. They will have to use business management technique including such things as Operation Research and Productivity Analysis.

The Department of Energy.

36. The Function of the Department. The department will be responsible primarily for national planning concerning energy. It will also be a regulatory agency. It will run energy research and training facilities. The department will project and forecast national energy demands, it will carry out research into energy availability, use and conservation. The SEE will plan by themselves to meet this energy demand without losing sight of overall profitability.

37. Training Institutions. It had been observed that energy enterprises are weak in both managerial and technical training. There is a large gap between officers and ordinary workers. There is very little deliberate job oriented training once a person had joined the enterprise. For established older enterprises new recruits had time for on the job training. Younger enterprises do not have the span of organization nor the time to carry along new recruits for on the job training. The Ministry plan to set up a training institute that will cover both management and technical aspect of energy enterprise. Assistance is required.

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38. Research Organizations. Here also the requirement is for twin research of management and technical. The Ministry do not plan to carry out fundamental research or even applied research, which is now being carried out by the Central Research Organization (CRO) but would conduct research for its direct application. In the managerial field such research as movement of gasoline tankers to optimize their turn in round time to the shop opening and closing time of the gasoline stations. In doing so such things as computer modelling will be carried out. Technical research will be carried out in such work as utilization of dewaxed vacuum tower distillates, now being dumped into ground reservoirs to enhancement of petroleum coke into more valuable graphite products. The most urgently felt need is a good reference library. World Bank Publications such as World Bank Staff Working Papers, UNIDO technical papers and ILO publications are invaluable. For technical subjects general reference like Encyclopedia of Chemical Technology (Kirk - Offmen) to specific subjects on reservoir engineering, enhance oil recovery etc. Since petro-chemical industrial research and discoveries are moving at a fast pace, trade journals such as Hydro-Carbon Processing, becomes invaluable source of development information.

39. Data Management. Myanna Oil Corporation already own two mini computers. One is used in geophysical work and the other for general management work. Both are very much under utilized. It is due to both the senior management's lack of comprehension to the machines capability and the computer staff educative effort to the management. It is felt that both computers are adequate even to be used indistributed network for PIC, PPSC, and EPC by use of dedicated Lines. Assistance in soft wares and work station expansion is required.

Conclusion

40. The requirement of the Ministry of Energy are presented conceptually with very little quantification. It is deliberately presented in such a manner so that there is more room to examine managerial, financial, technical and planning aspects more thoroughly, to enable us to come to conclusions wide in scope than if presentation are channelled by figures. We hope, in this way, our co-operation will result in an energy plan for Burma worth the amount of money intended for it.

STATEMENT OF THE BURMESE PARTICIPANTS TO THE CONSULTATIVE MEETING
OF UNDP/WORLD BANK ENERGY SECTOR ASSESSMENT PROGRAMME AND ENERGY
SECTOR MANAGEMENT ASSISTANCE PROGRAMME HELD IN PARIS FROM 15TH TO
17TH JANUARY, 1986.

Burma finds the UNDP/World Bank Energy Sector Assessment Programme useful and valuable. It's report, Burma: Issues and Options in the Energy Sector is informative and some of the recommendations are acceptable for implementation.

The chapter on petroleum is of particular interest to Burma. Petroleum is a very important source of energy to the country's industry. Crude oil and gas are also feedstock to the country's developing petro-chemical industry. Petroleum products are exportable and they have potential for earning large amount of foreign exchange. Burma also has a large potential hydropower resource, only a fraction of it is now being utilized. Deposit of coal need better development than it is being done at present. There are many hot springs in the country which are potential geothermal sources. Utilization of geothermal resources could make available a cheap, non-exhausting power source for the country.

Burma's petroleum history is a long one. Earth oil was obtained and used in the country's historical times. Refining of Burma's oil was carried out earlier than some of the now well known countries. But we have husbanded this resource carefully. Burma is a country that has a surplus of food, it has plentiful supply of construction material and could clothe the population adequately. In short, the quality of life of the country, although not flashy is one of a high order. Careful exploitation of the non-renewable petroleum resource is one of the contributing factor. We have avoided the pitfall of rapid exploitation accompanied by meteoric rise, followed by subsequent depletion and let down. Due to our controlled use of this resource the country did not have to bear the consequences of international oil's gyrations. Our emphasis on exploration, noted in the report, attests our concern for long term situation about petroleum resources.

Discovery of a substantial deposit of gas in the Martaban Offshore area have considerably enhanced the country's energy situation. Exploration for this deposit, as well as all onshore ones are made our own resources, accepting loan and grant

only when they would not impinge on our sovereignty or economic freedom. After the discovery of Martaban Offshore deposits, we requested Canada and was granted a pre-investment study. Petro-Canada International Assistance Corporation found in its Burma Gas Utilization Pre-Investment Study, the project to be economically feasible and have presented two options. The knowledge that we have substantial amount of exploitable resources near at hand have strengthened our flexibility regarding total petroleum utilization planning.

The reassessment of the country's total petroleum resource exploitation, taking into consideration that very large economic potential and the accompanying large investment need in money, material, management and technology indicate to us that we could use the onshore resources as a stepping stone towards the larger offshore exploitation. The present instability of the world economic situation and the instability of the petroleum market in particular, strengthened the view that we should proceed from a more firm situation and plan a course which would lessen the investment amount by optimizing facilities already on hand.

Based on the above considerations, the concept that we intended to follow are enumerated ; -

- (A) Obtain more drilling rigs and consumables like tubulars and chemicals to develop more wells from the proven explorations, both onshore and offshore.
- (B) Improved development of proven onshore fields like extraction of Kyontani where deposits lies around 13000 feet depth and enhanced recovery from Tuyintaung field where difficulty is being experienced due to the thickness of crude.
- (C) Build transportation and processing facilities initially based on onshore oil and gas extraction but with a strong emphasis on the ability to hook up with the offshore reservoir.
- (D) Develop the industry with a view to export at the same time to meet the country's industrial and household demands. This could be done by building ammonia, urea, methanol,

MTG etc., plants sited near good export harbour. At the same time draw gas supply line to captive industrial users and procure equipments to convert vehicles to use both gasoline and CNG or LPG.

- (E) Utilize the jack-up rig "Nayminyaung" firstly as a drilling rig and later as a production platform until such time a proper production platform could be procured. Lay undersea pipeline to the shore.
- (F) Set up production facilities to produce other necessities for energy utilization that are petroleum products i.e., lubricants.
- (G) Strengthen technical and managerial skills.

The concepts enumerated take into consideration the present facilities. As an illustration the following could be visualized. Natural gas from Payagon field (102 km South-West of Rangoon) is now piped to Ywama, with more pipes the way to supply Syriam refinery. The original idea was to use this gas as process fuel. But study have indicated that this gas could be used as feed stock to produce either ammonia or methanol, if the Syriam refinery is converted. A LPG export wharf is situated less than 2 miles away from the refinery. Additional pipes and pumping equipments could enable loading of ammonia, methanol or MTG, from this wharf. Most of the gasoline consuming vehicles are concentrated around Rangoon. Should they be converted to run on either LPG or CNG, a considerable amount of liquid fuel, which is easy for export handling would be freed. Supply of domestic fuel in gas containers, some of which are already on hand, would ease the pressure on the mangrove forests that protect our shore line and are the spawning grounds of valuable shrimps.

Hydro-electric power is generated from large stations and distributed through a national grid. Gas turbine generated electric power is also fed into the grid. Although a mini hydroelectric power station was set up before World War II, it is only now that more mini and micro hydro-electric power stations are being installed. They are most useful in supplying electricity in the isolated area; with the expansion of small scale and cottage

industries, the demand for electric power has spiralled upward. Generation of power can keep pace with the demand, but distribution has come up against bottlenecks, especially in older built up areas. Assessment and management, including studies for transportation would be most useful.

Burma's coal deposits are located in remote areas. It is now utilized to generate electricity in a limited way. Different aspects of transporting coal e.g. pulverized slurry conveyance and firing need to be made or coal could be studied as a feedstock for chemical industry.

Some hot springsexist near energy use locations. They have not been studied. Systematic studies could reveal or otherwise indicate the availability of this non-exhausting energy source.

Cooking fuel is near critical level in large urban centers like Rangoon and Mandalay. Technical studies to make rice hull char briquettes have been successful. Should financing be available to purchase necessary machinery, the presently waste rice hull would become a useful energy source. Wood charcoal making also need to be studied and rationalized. Burma's charcoal industry is situated in the delta area and are made in fixed location at almost industry scale. At present the side product i.e., smoke is wasted. Should destructive distillation method with, proper equipments be carried out valuable products such as ethanol and creosote could be recovered. These need study from technical, economic and managerial aspects.

It is realized that between concept and its realization lies many steps of assessments and planning. Operation Research encompassing market survey, demand projections, critical path method, linear programming etc., would have to come into play. Since almost all the data are on hand, only development of the correct methodology would need infusion. Mobilization of domestic and foreign financial resources would, of course, be required. These are the field the UNDP/World Bank Energy Sector Assessment Programme is of most use and value. We hope that the programme would be forthcoming as it has in the past.

As we have not participated in the management assistance programme, we could not comment on the subject.

v3

UNITED STATES GOVERNMENT

memorandum

DATE: February 4, 1986

REPLY TO
ATTN OF: Terry Barker/Bob Archer

SUBJECT: Meeting with U Sein Tun, Minister of Energy, February 3, 1986

TO: The Files

The meeting, which was requested by A.I.D./Burma and held in the office of the Minister of Energy at 2:00 p.m. on February 3. The meeting was arranged so that Bob Archer, Deputy Chief of the ANE/TR Energy and Natural Resources Division, might meet the Minister, hear his thoughts on Burma's energy sector, and provide the Minister with information on A.I.D.'s initiatives in this area. Those present were: Archer, Charles Ward, Terry Barker, U Tin Tun, Head of Office, U Than Nyunt, Deputy Minister, and the Minister.

At the end of the meeting, The Minister provided copies of the Burma Energy Development Conceptual Programme, January 28, 1986 (Attachment A), and the Statement of the Burmese Participants to the Consultative Meeting of UNDP/World Bank Energy Sector Assessment Programme and Energy Sector Management Assistance Programme (Paris, January 15-17, 1986) (Attachment B). Mr. Archer gave the Minister a copy of the Report on Renewable Energy Systems Installed In Asia: Results From Current AID-Sponsored Projects.

The hour long discussion began with Mr. Archer describing AID/W energy assistance as global in nature and designed to disseminate successful activities and undertake initiatives in promising areas. He then discussed four major areas in which A.I.D./Washington can provide assistance in the energy field.

--Renewable Energy Development (Including Energy for Agriculture)

--Biomass for Energy Production

--Conventional Energy

--Energy Planning and Analysis

To illustrate the type of assistance available, activities that were germane to Burma's energy situation were described. Some of these are mentioned below.



Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

OPTIONAL FORM NO. 10
(REV. 7-76)
GSA FPMR (41 CFR) 101-11.6
5010-112

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Energy analysis assistance including supply and demand analysis and computer planning models, special analyses such as pre-feasibility studies, remote power supply options, charcoal market analysis, etc. (assistance provided through Oak Ridge National Laboratory).

A.I.D. success with small hydro systems in Thailand and our interest in and experience with analyzing appropriate remote power generation options such as hydro, diesel or grid extension.

Analysis of energy needs for agricultural production with particular emphasis on irrigation and water pumping. (Tubewells are being developed in the central Dry Zone with Australian assistance.)

Technical assistance for the utilization of sugar mill bagasse for energy (power or ethanol) or other viable products.

Analysis of the efficient utilization of rice husks for power generation.

oil, gas, coal and power sector analytical and technical assistance including oil and coal power pre-feasibility studies. (The Minister recognized the contractors Bechtel Corporation and A.D. Little recalling that some Burmese had been trained at ADL.)

Technical, economic and institutional analysis of the feasibility of introducing smokeless coal briquettes to replace charcoal.

Lastly, the Conventional Energy Training Program utilized by many Burmese was mentioned.

Following are summaries of the extended discussion of energy issues and opportunities put forward by the Minister. He mentioned several of the issues/projects described in Attachment A. The comments are provided in three categories: energy analysis and planning, non-conventional energy, and conventional energy.

Energy Analysis and Planning

The Minister indicated that the new Ministry of Energy included the Myanma Oil Corporation, the Petrochemical Industries

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Corporation, the Petroleum Product Supply Corporation and the Electric Power Corporation. Coal remained with the Ministry of Mines. There were indications that the Ministry would be active in non-traditional energy activities as well such as the problems of charcoal demand on mangroves, rice briquettes, etc.

In response to a question about his interest in technical assistance for the new Energy Planning Department within the new Ministry of Energy, he mentioned that the Asian Development Bank had offered assistance for energy planning, training and institutional development but that he did not want to accept it. He said this was an area where the U.S. had experience and expertise and assistance could be provided. He specified that assistance is needed to analyze and project energy demand to carry out the Ministry of Energy responsibility for development of energy plans.

The Minister mentioned the need to:

- Analyze energy demand within the country
- Determine how much energy might be available for export
- Establish appropriate allocations of crude by product
- Establish the most efficient uses of gasoline tankers for distribution.

(In connection with the latter item, the Minister said that there has been no increase in production of fuel since the recent fuel crisis. The reason we no longer see gas lines is that the tank trucks are being used more efficiently now. They are now working at night and filling the stations when there are no customers. He noted with amusement that fastest news in town was that which would indicate that a gas barge might be stuck on a sand bar and that fuel would be in short supply. He said that such news would inevitably send the price of gasoline up. He said that there is now a small surplus of fuel available so that shortages would not result from short delays in deliveries.)

In response to Archer's question on the policies governing private sector power generation he said the Private Enterprise Law states that only the State and Cooperatives can generate electricity. The State controls all generating capacity in excess of 100 megawatts. The cooperatives can control generation which is less than 100 megawatts, but most are working now with plants which produce only 3-4 megawatts. (Note: Previous discussion indicated that the cutoff was 10 MW and that private entities could generate their own power; this requires clarification.)

Non-Conventional Energy

Demand for charcoal had placed pressure on Burma's coastal mangrove swamps and the spawning ground for shrimp.

Small hydropower systems in the villages is a priority. There is a need for lighting from 6-12 p.m. and some daytime power for milling, etc. He spoke of trying other than Pelton turbines because of the low-head (7-10 feet) intermittent flow of the water. (Note: Archer mentioned the successful A.I.D./Thailand experience in small hydro development.) FAO offered to assist with a micro-hydro program using Chinese technology, but by the time the Chinese arrived, the Burmese had already copied the technology. The problem encountered is the lack of the appropriate "black box" for regulating power fluctuations. He said that this is a problem area where the U.S. has technical capabilities.

In response to Archer's inquiry about the private rice mills need for assistance for more efficient rice husk utilization (which Charles Ward indicated was similar in concept to the oil seeds project), the Minister indicated that the World Bank/Japanese were funding large 100 plus tons/day mills to be run by the government. Smiling, he said the Americans should be very pleased, however, because these State-run mills will prove very inefficient. The government imported 300 new boilers for sale to private millers which were not purchased because the milling fee paid by the government to the private millers was inadequate to justify modernization. There is a world class rice mill still packed and stored in Burma. The owner would not accept it. He said (speaking as a miller) that the government bureaucrat who wouldn't approve the higher price for milling gets paid if he does right and paid if he does wrong.

Millers are converting to electricity where it is available because of its convenience. This leaves a substantial disposal problem and the need to try and convert rice hulls to briquettes. Briquettes have been "successfully" made but did not do well in market tests because of smokiness in the households.

Burma's testing of rice husk briquettes has encountered smoking problems and cost more energy in manufacture than they generated in burning. Several binders have been used for the brickettes, but an appropriate one has not been found.

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Burma had also experimented with biogas, using manure. Combined with kerosene, the biogas produces a nice blue flame, but rats bite into the digester bag to get undigested rice seeds resulting in gas loss.

Dissemination of wind energy systems in the delta for water pumping is desired using locally manufactured windmills devised from bamboo and sacking (canvas) and in which the steel shaft would be the most expensive part. He said that local blacksmiths could make the materials for these windmills. (The Minister mentioned VITA (Volunteers in Technical Assistance) and the ITDG (Intermediate Technology Development Group) as groups that do this kind of work.)

Engine tests utilizing peanut oil encountered trouble after 5-6 hours of operation. The concept is for village-produced power using its own vegetable oil, filtering and treating it with a solvent to run engines.

During one of the discussions he mentioned that there is the right way, the wrong way and the Burma way.

Conventional Energy

Production of natural gas is increasing and Burma could use assistance in determining the appropriate uses of the gas. The focus was to use natural gas to displace oil use which could then be freed up for export. Use of natural gas for transport was mentioned (including trains and cars) among other options.

With respect to the Martaban off-shore natural gas find, the Minister gave special credit to Ne Win, saying that he was "wise" in making the decision not to pursue the Martaban off-shore natural gas project further. He said that three months ago, even before petroleum prices had begun to drop, Ne Win had pointed out that the small dollars they would have to borrow now for this project would have to be paid back in big dollars later. The implication is that priority is given to on-shore exploration and development (this is confirmed by Attachment A).

During a discussion of substitution for imported lubricating oils, the Minister got up and retrieved a set of paper-bound worn books published by Socony (Standard Oil Company of New York) about 30-40 years ago on lubricating oils and other oil subjects.

Assistance is needed in in energy conservation and in the use of geothermal energy, a technology in which the United States is strong.

Conclusion of Meeting

The Minister mentioned that he planned to travel to the United States in March or April pending hearing from the UNDP. Charles Ward offered assistance if necessary.

The Minister hoped that Archer would visit some energy facilities and requested Head of Office U Tin Tun to discuss arrangements that could be made.

Summary Observations

The meeting indicated that there was an awareness of the need to address a multitude of energy-related problems but inadequate understanding of the relative priority, cost and feasibility of many of the options. It was a receptive meeting that indicated further consideration of assistance and discussions are merited.

Attachments

FOR OFFICIAL USE ONLY

Report No. 5416-BA

BURMA

ISSUES AND OPTIONS IN THE ENERGY SECTOR

JUNE 1985

This is one of a series of reports of the Joint UNDP/World Bank Energy Sector Assessment Program. Finance for this work has been provided, in part, by the UNDP Energy Account, and the work has been carried out by the World Bank. This report has a restricted distribution. Its contents may not be disclosed without the authorization from the Government, the UNDP or the World Bank.

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ABSTRACT

Burma's energy resources are large and varied, including hydropower, oil, natural gas (onshore and offshore), coal, forest resources, and biomass residues. While the Government has done a commendable job of developing these resources largely on its own, their development has nevertheless been comparatively slow. While this may have constrained economic growth to date, it also provides a ready basis for an acceleration in future economic growth and increased exports. This report analyzes the technical, financial and institutional requirements for realizing that potential through the turn of the century in the context of two scenarios -- a Planned Growth scenario which reflects the official growth targets, and an Economic Growth scenario under which public finance and balance of payments constraints result in somewhat slower economic growth.

Under either scenario a major investment program and infusion of current technology will be needed. The report recommends considerable technical assistance and studies to help effect this transfer of technology. Average annual investment requirements in energy development are estimated at up to \$330 million annually over the next decade. To help finance these requirements, it will be necessary to improve the financial footing of the public corporations in the sector; this would entail price increases for many energy products. There is also a need to strengthen energy planning and inter-ministerial coordination on energy matters. Although the requirements of this energy development program are large, in few countries would meeting them pay off as richly as in Burma.

SUMMARY AND CONCLUSIONS

Background

1. This report, prepared under the World Bank/UNDP Energy Assessment Program with Asian Development Bank assistance, is the first attempt by these organizations to develop and present an overview of the energy sector in Burma. Both the World Bank and the ADB have had involvement in the power and forestry sectors, but neither was in a position until recently to carry out in-depth analysis. The energy assessment mission overlapped in the field with a World Bank power subsector mission, and the main findings of that mission are included in this report. The relatively short durations of these missions and limited amount of information available beforehand is reflected in the broad and strategic, rather than specific, nature of the main recommendations, and the call for a considerable number of studies. However, the need for these studies, most of which are of a highly technical nature, also reflects the relatively sophisticated state of the energy sector in Burma, and the consequent need for detailed technical support which was beyond the scope of the missions.

2. Compared to most developing countries, Burma is fortunate to be endowed with abundant and varied indigenous sources of energy, including hydropower, natural gas, crude oil, forest resources, and coal. Burma thus has greater energy security and more options for meeting its needs than most countries. Projections by the mission indicate that commercial energy needs will, at an absolute minimum, double, and possibly increase as much as sixfold, by the year 2000, while non-commercial energy needs will grow by about 40%. Not only does Burma have the capacity to easily meet those needs at relatively low cost, but at the same time it can transform the role of the sector into an important source of economic growth and foreign exchange earnings. The mission estimates that by 1989/90 petroleum exports based on the development of onshore reserves could increase more than tenfold over the level achieved in 1983/84. The purpose of this report therefore is to focus on the major issues and options facing Burma as it seeks to realize the potential provided by its abundant energy resources through the end of the century.

3. Despite Burma's energy wealth, petroleum production has at best grown only slowly in recent years, while there have been distribution difficulties for electric power. Any program aimed at transforming the role of energy in Burma will have to address these constraints. Three principal constraints can be identified -- technical, financial, and institutional. Since nationalization of the energy industries in the early 1960s, Burma has done a remarkable job of exploiting its energy resources on its own. That process, however, is becoming increasingly complex as the easiest energy sources are exhausted. Meanwhile, industrial technology abroad has continued to improve rapidly, with the result that there are now significant gaps between current world and

Burmese technologies in certain sectors. An infusion of modern technology, especially in the petroleum sector, would have a significant beneficial impact on production. The financial constraints stem from the low profitability of the energy corporations, which has forced them to finance most of their considerable investment through borrowings. These borrowings have contributed substantially to the growth of the overall public sector budget deficit, and pressure to contain the deficit has inevitably constrained some much-needed energy sector investment. At the same time, foreign exchange shortages have restricted the importation of critical goods and services from abroad. While Burma must continue to take steps to contain the public sector deficit, it must also increase investment in energy if this sector is not to constrain overall development. This can only be done if the corporations can increase their own contributions to investment; this would entail price increases for most energy products. Finally, there is a need to strengthen inter-ministerial planning and coordination concerning energy supply and demand, to reorient some aspects of energy planning to recognize the cost implications of alternative development strategies, and to begin relying less on administrative mechanisms and more on pricing policies to allocate energy resources and ensure their efficient use.

4. The mission's recommendations regarding future energy development are also heavily influenced by two important qualifications to the comfortable overall energy picture. First, given the large amount of presently undeveloped and underdeveloped known reserves of oil, and especially gas, there is no reason existing reserves cannot be developed more aggressively. While the Government recognizes that the natural gas potential can easily sustain exports, the mission also considers Burma's oil reserves more than sufficient to justify their development for export as well as domestic purposes. In the mission's view, a plan to effect significant increases in production levels would not entail rapid depletion or undue exploitation of the resources. Such an effort would, among other benefits, also serve to generate the financial resources needed for further investment in the sector, given the attractive exploratory potential existing in the country. Second, while Burma is still fortunate to be covered with around 70% forests, recent surveys indicate that this coverage is declining at an accelerating rate. Extraction of fuelwood, the main source of energy in rural areas, has been the primary cause. It will not be easy to reduce dependence on fuelwood in the short term, but if early efforts are made to address the problem it should be possible to stabilize the situation so most of the forest cover remains intact.

Energy Development Strategy and Programs

5. Considering the high level of proven but undeveloped crude oil reserves, current petroleum product shortages, as well as the export potential, it is recommended that early steps be taken to increase production. At the policy level, this would entail shifting away from the current emphasis on exploration towards developing known fields. In

operational terms, the balance between the number of heavy rigs used mostly for deep exploratory drilling and the number of light rigs and surface facilities for use in developing production from known fields would need to be adjusted accordingly. To implement this development strategy in the most efficient way, a study is recommended which would examine the potential and characteristics of each known oil and gas field. This would permit field-by-field development plans to be developed which would be consistent with the overall production targets and ensure efficient use of resources and facilities. It would also result in a framework which would permit a clear policy on future exploration to be developed. In addition to developing proven but currently unexploited reserves, the mission believes it should also be possible to increase production from existing fields by applying modern extraction techniques. In the process of developing a field-by-field development program, the above study would also serve to identify those changes in technology abroad which would be best suited to Burma. The results of this study would, in turn, also lead to the need to optimize gathering and storage facilities, and develop vapor recovery and, where necessary, multi-gas separation systems. In the mission's view, a concerted effort to increase crude oil production could result in production growing at a sustained 5-10% per annum, depending upon the amount of resources invested in the sector (para 16).

6. Although the rapid development of onshore petroleum reserves could result in an increase in the overall economic growth rate of about one half of one percentage point, the principal benefits would come in the form of increased foreign exchange earnings. The mission estimates that domestic consumption is most likely to increase at about 5% per annum; if overall petroleum production also grows at 5% annually, it is estimated that petroleum exports (excluding Martaban but including onshore LPG and methanol exports) could rise from \$11 million in 1983/84 to \$100 million by 1990, and according to World Bank staff estimates, account for almost 10% of total exports. If, however, the Government implemented a program which resulted in production growing at an average of 10% per year, exports by 1990 could amount to around \$190 million and account for 15% of total exports. By the year 2000, oil exports alone could amount to over 18 million barrels equivalent.

7. With the completion of the Mann refinery, the refinery sector as a whole is operating at only about 40% capacity. Although Burma has three main refineries the two largest are being operated for logistical reasons and to meet product mix requirements. This has led to high refinery fuel losses and consumption; however, these should decline once crude oil supplies and refinery throughput increase. At that time, the Government would also have increased options of redistributing production between refineries, or even closing down certain units in order to optimize current refinery operations to meet domestic needs, maximize export earnings, and minimize fuel consumption and losses. This very comfortable capacity utilization position will also give the Government great flexibility in choosing between crude oil and product exports once crude oil production has increased sufficiently to permit crude oil

exports in addition to surplus products. To address these complex optimization issues, a study with technical assistance input is recommended.

8. Burma's enormous natural gas wealth and its role in developing the economy have become perhaps the central energy policy issue. Already the Government has begun exploiting onshore reserves through a series of natural gas-based industries -- including fertilizer, methanol, and LPG extraction -- and through the conversion to gas, wherever feasible, of industries currently using oil (e.g., ceramics, tires, cement). In addition, most recent additions to power generation capacity have been gas-based. By the year 2000, it is estimated that natural gas could rise from its present 7% of final commercial energy consumption to as much as 60%. The recent discovery of the huge offshore Martaban reserves provides even greater opportunities to engage in energy based industry; already, major export-oriented industries are under consideration. (para 13).

9. While Government policy regarding the use of natural gas in industries is quite clear, in practice its use is confined to a relatively small number of public sector industries. This is because while natural gas is abundant and cheap to produce, it is relatively capital-intensive to distribute and exploit. This tends to confine initial use to large industrial and commercial users. Over time, it is desirable to broaden the distribution and use of natural gas; however, there are a number of important policy issues which should be addressed beforehand, including gas pricing, extent of flaring, and policy regarding LPG extraction. The pricing issue is particularly important. Historically, Burma has been able to meet most, if not all, of its gas needs from associated gas (i.e., gas produced in conjunction with crude oil). As crude oil was the more critical product, and governed petroleum exploration and development activities, it naturally bore the bulk of the costs. Moreover, the price of gas was kept low to encourage its use. However, projections show that by the year 2000, non-associated (free) gas could account for over 80% of production. Under these circumstances, more realistic gas pricing is required which better reflects the actual costs of drilling wells for free gas (para 21). The recent doubling of natural gas prices is an important step in that direction.

10. Secondly, the Government will need to address the issue of gas flaring. Although it has a commendable policy of conserving energy by not permitting flaring, this policy is constraining crude oil production in certain fields where the associated gas cannot be consumed. Given the wealth of natural gas, the economics of selective flaring for purposes of increasing crude oil production in the short term should be carefully examined. As production technology improves, it would be possible to reinject this gas in the wells for purposes of maintaining well pressure and conserving energy supplies. Another important policy area involves LPG extraction, since the LPG and condensate fractions of certain fields can exceed more than 10% of the gas produced. This is important because LPG is not only a high value fuel with good export potential, but it is

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also a suitable fuel for household and light industrial use. As part of the recommended field-by-field analysis (para 5), a systematic evaluation of condensate and LPG potential should be conducted.

11. Although natural gas is abundant and relatively cheap to produce, the need for a pipeline network makes it capital intensive to exploit on a broad basis. While most new industries are being situated with natural gas supplies in mind, the rate at which existing industries and commercial establishments can be converted depends upon the rate at which the gas pipeline network can expand. Given Burma's assured long-term supplies of gas, such a network is likely to be justified; however, there is a need to develop it in a manner which will meet the most needs at the least cost. Accordingly, the report recommends the preparation of a gas transport master plan to develop an optimal network.

12. The natural gas wealth also has important implications for power generation. Although Burma has abundant hydro, natural gas, oil and coal resources and hence several options for meeting its power needs, the Government places top priority on hydropower development because it is a renewable resource whereas the primary alternatives are not. Moreover, products based on natural gas -- the main alternative -- are considered to have good export potential. However, due to the continued rapid growth in demand, the high cost of hydropower development and the abundance of natural gas, gas-based power generation will continue to play an important role in meeting power demand, at least until the major hydro projects come on stream. This is confirmed by the mission's analysis which suggests that the most economic means of meeting additional power needs, at least through the next decade, would be through gas turbines and that hydropower projects cannot be justified on the basis of power benefits alone. Studies indicate that the cost of hydropower averages around 3.9 cents per kWh, as compared to about 2.5 cents per kWh by gas turbine generation, even assuming a substantial increase in the price of natural gas (para 21). Coal generation, the analysis indicates, would be even less economic, given the remoteness of the coal reserves and the relatively small size of the plant being considered.

13. The recent discovery of natural gas in the Gulf of Martaban has more than doubled Burma's known reserves. The Government intends to develop these resources for petrochemical exports. The technical, financial, and economic viability of alternative options has been investigated by PetroCanada. Two options are under final consideration - one which would produce ammonia and urea, and a second, towards which the Government is leaning, which would produce ammonia, urea, and methanol to be converted into gasoline. Either option would be implemented in two phases, under which Phase II would replicate the processing facilities of Phase I. Either option is estimated to cost about \$880 million. Although the straight ammonia/urea option has a higher economic rate of return, the Government views favorably the greater product diversification of the scheme which involves gasoline production via the methanol-to-gasoline (MTG) plant. The Government's preferred

configuration contains both positive and negative economic and risk elements which must be carefully balanced. Product diversification to include gasoline in the export mix does reduce dependence on any one export commodity and avoids the need to export methanol which, though based on cheap gas feedstock, is unlikely to be economic on its own in the face of oversupply in the world and the depressed price situation foreseen in the long term. However, the marketability of gasoline in a region which generally has a deficit in middle distillates must be carefully evaluated. Irrespective of the process configuration chosen, the project carries with it a considerable element of risk due to fluctuating and erratic international prices, and difficulties in handling, storing, and trading the products. It would thus be important to enter into firm marketing arrangements with prospective buyers before embarking on this project. In addition to market risk, there are a series of macro-economic risks which are posed by the project by virtue of its enormous size. The project would place great strain on the economy which already has an excessive public sector budget deficit financed by expansionary borrowings from the banking system. The domestic financing requirements of this project would therefore necessarily come at the expense of investment in other sectors if the deficit is not to grow further. On the positive side though, the foreign exchange earnings from the project would be a great asset once a positive cash flow situation has been established. By the early 1990s it is estimated Phase I of the project could add about US\$140 million, or about 10% of total projected exports. Given appropriate loan terms, including a high degree of concessional financing, it is likely that these increased export earnings would cover debt service even in the early high debt service years. But if there were significant volume or price shortfalls, these could depress earnings below the level of debt service payments with important overall balance of payments implications, because of the large size of the project. However, given the low natural gas cost the project has the potential to contribute very significantly to the economic development of the country. In this context, no other single project now being planned would be comparable.

14. Apart from carefully reviewing the gas/hydro composition of new investment in power generation in the context of a least cost expansion study, there are two further technical issues in the power sector which need reviewing -- system losses and the distribution system. System losses have increased steadily in recent years and now amount to 32% of total generation, which is excessive by any standard. Reducing these losses represents a cheap and desirable means of effectively increasing generation. EPC estimates that about two-thirds of these losses are due to the antiquated distribution system and metering losses. Compared to generation and transmission, there has been little investment in the distribution system over the past 15 years. Not only is the system therefore very old and inefficient, but with the steady growth in demand, it has become overloaded and unreliable. EPC therefore needs to place major emphasis on upgrading and expanding the distribution system. This will reduce system losses and ensure that consumers can fully benefit from increased generation.

15. Although fuelwood consumption has probably not grown as rapidly as that of commercial energy, it nevertheless accounts for over 80% of final energy consumption and is the predominant fuel in the household sector. Pressure on fuelwood has increased in recent years as a result of the decision to restrict kerosene production, and forest cover is declining at an accelerating rate, now estimated at a significant 2% a year. Although the heaviest consumption occurs in populous central Burma, recent surveys show that forest resources are now declining rapidly in some of those areas once considered remote, such as Shan state and Sagaing division. While there is little that can be done to alleviate this trend in the short term due to the long lead time required for efforts to show effect in this area, it is important that efforts to slow deforestation begin now. The Department of Forests intends to more than double annual fuelwood replanting during the next five years to about 12,000 ha a year, but due to the relatively long cycle for fuelwood production this is estimated to be only a small fraction of what is required. Forest Department plantation efforts can, however, be supplemented by social (cooperative) forestry programs to establish village woodlots, by programs designed to make better use of logging wastes, and programs aimed at making use of agricultural residues, especially paddy husks. Other important ways to effectively increase fuelwood supplies include programs to promote use of more efficient wood stoves and charcoal kilns, and greater use of alternative fuels such as LPG, electricity, coal briquettes, and kerosene. Institutional support is also required for research and development of an expanded fuelwood program, to develop and help design programs to promote improved wood stoves and charcoal kilns, and to help strengthen management of the large existing forest resources.

Financial and Institutional Issues

16. The preceding paragraphs have outlined what are likely to be extensive investment programs in both commercial and non-commercial energy to meet energy requirements in the domestic economy by the year 2000. In the petroleum sector, some 4,000-6,000 new wells will be needed over the next 15 years to maintain currently producing fields as well as develop new ones. In addition, support facilities and gas and oil pipeline networks will need expanding. Total investment needs to achieve and maintain 5% annual production growth are estimated at around \$1.5 billion, or around \$100 million per year -- more than double the existing rate of investment. Because much of this investment comprises production overheads, it is estimated that about \$2.0 billion in total investment would allow growth of around 10% per annum.

17. Capital expenditures in the power sector depend on whether the Government decides to meet additional generating needs by investing mostly in gas-fired power stations or to proceed with large hydro schemes such as Paunglaung and Bilin. Mission estimates indicate that the gas option would meet generating needs through the mid-1990s at approximately

half the cost of hydro, resulting in almost \$500 million in investment savings. These findings, and the relative advantage of gas generation (para 12) are, however, tentative and need to be confirmed by a detailed least cost expansion system study which would carefully consider all power development options - hydropower, oil, natural gas, and coal. In evaluating the hydropower schemes, it will also be necessary to consider any irrigation benefits. As decisions regarding new power additions need to be made soon, this study is a high priority. Including transmission and distribution, overall investment needs in the power sector are estimated at about \$1.2 billion if the gas option is pursued and about \$1.7 billion if Paunglaung and Bilin are chosen. The gas option would, however, entail somewhat higher investment in the gas sector, including wells and pipelines.

18. Given the growing fuelwood problem, there is a strong case to be made for increasing the budget for fuelwood development. Compared to other sectors, the estimated investment required, at \$37 million, is relatively low. To ensure their effectiveness, however, it is important that these funds be accompanied by institutional and organizational strengthening, including programs to identify and promote suitable fuelwood species and establish village woodlots. These, mission estimates indicate, would be a significantly cheaper means of meeting fuelwood needs than mechanized plantations.

19. It is not realistic to expect the Government to be able to finance these investments, which total more than \$3 billion (Kyat 25 billion), out of the public sector budget. Spread over 15 years, annual expenditures would amount to 20% of total public sector investment in 1983/84. As the budget deficit already significantly exceeds prudent levels and is being covered by borrowings from the banking system, financing these levels of investment through the budget, whether as Government equity or as borrowings by the corporations would simply result in even greater borrowings. These would further strain the economy and would be likely to manifest themselves, for instance, in even greater differences between official and unofficial price levels. Furthermore, if the investments were financed by borrowings by the corporations, in the absence of price adjustments to enable them to service those debts, such borrowings would merely aggravate their already tenuous financial positions. Already, those corporations with large investment programs -- MOC, PIC, and EPC -- are in considerable financial difficulty. Price increases have been few and largely inadequate to meet cost increases in recent years, especially those associated with debt service. The corporations are consequently being forced to make new borrowings for purposes of meeting their debt service needs, with the result that they are falling ever deeper into debt. Immediate price increases are required to enable them to meet all their current expenses internally. PIC is engaging in a program to greatly increase exports based mainly on onshore gas. The mission estimates that, at present domestic crude oil and natural gas prices, these export projects, when they are fully on stream, would generate sufficient profits to offset domestic losses. However, if natural gas and crude oil prices are

increased to cover the costs of an expanded production program, increases in domestic retail prices of up to 60% could be needed.

20. To meet the large investment needs, there appears little alternative but to put the corporations in a financial position where they can at least fully cover current and projected debt service needs without further borrowings. To achieve this objective, prices would need to be adjusted. Ideally, however, the price increases should be sufficient to enable the corporations to achieve and maintain reasonable balances between debt and equity in their financial structures. This would entail price increases which permitted the corporations to meet part of their investment needs from internal resources as well as cover their debt service payments. To those prices it would be desirable to make selective adjustments, reflecting national policy considerations.

21. For petroleum, the direct cost increases associated with the program to expand production are estimated to result in a doubling of the existing crude oil price to about \$10.70 per barrel and in a sizeable increase in the natural gas price to about \$1.00 per thousand cubic feet. Final prices would include a refining margin for PIC, and a distribution margin for PPSC. It is estimated that these would result in a doubling of the existing transfer prices from PIC to PPSC and in retail petroleum product prices. Petroleum prices should also include a royalty calculated on the basis of remaining reserves that reflects the cost to the economy of progressively depleting these reserves, as well as a possible road user tax.

22. In the power sector, a review of the financial prospects for EPC based on the current investment program (including hydro) has indicated that sizeable increases in revenue earnings are required. The first adjustment of the tariff is currently scheduled for 1986. There is, however, still much uncertainty surrounding the investment program, and the full amount by which revenue earnings should increase will depend on a number of factors, including the growth in demand, the gas-hydro generation balance, the success of the loss reduction program, and the price of natural gas and petroleum products. In the process of adjusting the average tariff to reflect overall financial needs, it is also desirable to adjust individual tariff categories in accordance with marginal costs, thereby charging individual consumers the actual cost of producing and delivering power, and encouraging its efficient use.

23. Over the years, the Government has been able to maintain a comparatively low rate of inflation and it understandably would like to be able to continue to do so in the future. In deciding on increases in energy prices, the Government will therefore also be considering the adverse impact on consumer prices. Burma's energy needs are, however, critical, and failure to meet them would inevitably result in slow economic growth. The resources required are enormous and, as discussed above, financial needs clearly will have to be met through a combination of domestic and external borrowings and self-financing by the corporations. All of these point strongly to the need for price

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increases, either for purposes of making direct contributions to investment, or servicing the debts. While the Government has difficult choices to make regarding energy price increases, these would appear to provide the only realistic option for meeting this vital sector's development needs while at the same time maintaining the financial viability of the corporations and sound overall economic policy. Realistic prices would also assist the Government in taking efficient investment decisions regarding the choice and development of additional resources, capture for the Government part of the profits currently being made on unofficial resales, and encourage efficient energy use by consumers.

24. In the case of petroleum, an alternative approach which would include foreign cooperation would appear viable. MOC has on its own done a commendable job in finding new oil and gas resources in recent years, and there is no doubt that some production increases can be accomplished in the future based on current efforts. However, as discussed above, accomplishing the sizeable production increases which are believed feasible would inevitably strain available Burmese capital and manpower. To help achieve the proposed production increases and foreign exchange earnings quickly, serious consideration should be given to the infusion of latest foreign technology, practices, and financial resources. This could be accomplished by inviting consultants and operators to assist in the various aspects of petroleum operations in the form of service contracts. Further technical advancement would necessitate increased financial assistance, foreign and domestic in the development of hydrocarbon resources.

25. Over time, it will also be necessary for the Government to strengthen planning and coordination between institutions in the energy sector to ensure that energy supply and demand are better integrated. The present institutional arrangements are characterized by a multiplicity of ministries and corporations and a lack of effective central coordination. Within individual ministries, coordination appears reasonably good, but between ministries it is weak. There is a need for a body to monitor the energy implications of the plans of individual corporations and ministries to ensure their consistency with each other and the national energy policy, as well as to draw up overall energy development plans and policies. The recently created Ministry of Energy, which was formed by removing the four energy related corporations -- EPC, MOC, PIC, and PPSC -- from the Ministry of No. 2 Industry, and the creation of an Energy Planning Department provide a good basis for strengthening energy planning and coordination. However, to enable comprehensive energy sector planning it would also be desirable to include all energy sources, i.e., forest, other renewables such as coal resources in addition to petroleum and electricity, in the planning purview of the Energy Planning Department.

26. In summary, the energy potential of Burma is large and varied, while its development has been comparatively slow. While this may have constrained economic growth to date, it also provides a ready basis for an acceleration in future economic growth and increased exports. To

realize that potential, however, it will be necessary to undertake a major investment program, to improve technology through an infusion of technical assistance, and to place the institutions and programs on a sound financial footing. It will also be necessary to strengthen planning and coordination in the sector. While such a program may not appear easy to implement, in few countries would it pay off as richly as it would in Burma.

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