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EVALUATION OF
SUDAN
ENERGY POLICY AND PLANNING
PROJECT
(SEPAP)
for
UNITED STATES
AID FOR INTERNATIONAL DEVELOPMENT
(AID)
BUREAU FOR SCIENCE AND TECHNOLOGY
OFFICE OF ENERGY

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I. INTRODUCTION AND SUMMARY

A. INTRODUCTION

1. Background

In August 1980, the Government of Sudan (GOS) and the U.S. Agency for International Development (AID) signed a project agreement for an energy policy and planning project (SEPAP). The project had two principal objectives:

- o Preparation of a national energy assessment for Sudan which would include: (a) a supply-demand analysis for all uses of energy and all fuels; (b) a strategy analysis to meet energy requirements; and (c) a policy analysis to establish priorities among the various strategies; and
- o Institutional development of Sudan's National Energy Administration, a unit of the Ministry of Energy and Mining (MEM).

AID agreed to make available to the Government of Sudan a team of energy specialists including two long term resident advisors and a number of other specialists who would be available on an intermittent basis. Initially, a 65 person-month level of effort by U.S. experts was contemplated over 18 months, at a cost of \$650,000. The Government of Sudan was expected to provide approximately 100 person-months of effort. To carry out the project a contractor team consisting of International Science and Technology Institute (ISTI), of Washington, D.C., a minority-owned small business, with Energy Development International (EDI), as subcontractor, also of Washington, D.C. and a small business, was selected without competition.

The project began in January 1981 and expanded over time largely in response to GOS requests for additional services and support for

project activities. The project was terminated in March 1984 at a total cost of over \$1,500,000 and LS230,000.

The SEPAP project which was an AID/Washington funded project is now followed by the Energy Planning and Management Project (EPM), an AID/Khartoum funded project, which will continue to provide technical assistance to GOS.

The SEPAP project has been instrumental in developing the capabilities of Sudan's National Energy Administration. Basic energy supply and demand data have been assembled, energy issues have been identified and addressed, a national energy assessment has been completed and the process for a national energy plan has been initiated.

During the course of the project a major effort has been made to provide staff support to the Minister of Energy and Mining. Issues involving the allocation and distribution of petroleum products have been extensively analyzed. Other issues addressed have included electricity supply problems, alternative uses of Sudan's recently discovered petroleum resources, and possible ways to exploit the country's renewable energy resources.

While some training was expected to be conducted as part of the initial scope of work, the training component of the project expanded considerably during the course of the project. On-the-job training has been provided to NEA staff. Extensive classroom training has also been provided. The Petroleum Training Program managed by the Department of Energy (DOE) was incorporated into the project. Additional training was also coordinated with other AID supported training programs such as the Energy Management Training Program at Stony Brook/Brookhaven Laboratory (SUNY) and various master's level and short courses under the Conventional Energy Training Program managed by the Institute for International Education (IIE).

2. Evaluation

According to the terms of the original Project Implementation Order/ Technical Services (PIO/T) for the Sudan Energy Policy and Planning Project, AID was required to "undertake an end-of-project evaluation to determine the potential usefulness of the national energy assessment, to evaluate the contractor's performance and to appraise the quality of the contractor's participation with the Government of Sudan."

Since the SEPAP effort expanded markedly from the original effort contemplated in 1980 and since AID is continuing to provide technical assistance for energy policy and planning under the EPM project, AID considers that the evaluation must be somewhat broader than the one indicated in the PIO/T. Accordingly the objectives of the SEPAP evaluation are to :

- o Provide advice and guidance for the Mission and the EPM contractor regarding policy and investment issues which now need to be addressed, as well as how to increase the effectiveness of key government and private sector institutions in Sudan;
- o Assess the effectiveness of the entire project effort to date highlighting major accomplishments or problem areas; and
- o To provide guidance to AID about the most effective ways to carry out energy planning and policy development activities which can be applied in other AID assisted countries.

3. Scope of Work for Evaluation

Arthur D. Little was contracted to conduct an evaluation of the SEPAP project and prepare a report which addresses the following subjects:

- o General Project Effectiveness and Impact
- o Institutional Impacts
- o Data Collection and Presentation
- o Contractor Performance and Personnel
- o Computer Hardware and Software
- o Training
- o Special Staff Studies
- o Library

A team consisting of senior staff familiar with evaluation procedures, AID programs, energy analysis, energy assessments, and manpower and training issues conducted this evaluation. Two members of the team visited Sudan in February 1984. The evaluation entailed briefings by AID staff both in Washington and Khartoum; interviews with ISTI/EDI staff both in Washington and Khartoum; interviews with NEA staff, MEM and other GOS officials, and officials of parastatal agencies; and review of project reports. This report presents the results of this evaluation.

4. Evaluation Report

This report is organized in four sections as follows:

- o This section (Section I, Introduction and Summary) presents the background of the SEPAP project and the summary of our findings and recommendations;
- o Section II, Project Development, presents the historical development of the SEPAP project, its scope, expectations, emphasis and evolution and sets a clear reference for evaluation;

- o Section III, Project Performance, presents the output and achievements of the project without critical comment, that is it presents the scope of the project's output without judgment as to its quality; and
- o Section IV, Project Evaluation presents a critical evaluation of the project's output and addresses all the subjects indicated in the scope of work for this evaluation.

B. SUMMARY

The SEPAP project has been a resounding success. The project generally met the original objectives as indicated in the PIO/T in developing an energy data base, identifying energy issues, recommending means to solve energy problems, and providing training and support for indigenous personnel and institutions.

1. Potential Usefulness of the National Energy Assessment

The National Energy Assessment created a benchmark data base and provided a clear understanding of energy issues in Sudan. The National Energy Assessment provided a basis for the National Energy Plan which will include policies, programs and investment strategies to tackle Sudan's pressing energy problems.

2. Quality of Contractor's Performance

The overall quality of the contractor's performance was good. In general, ISTI/EDI provided personnel with appropriate professional caliber and background. The project resident staff coordinated all the project activities, identified energy issues, participated in energy policy debates and became the links with ISTI/EDI management in Washington, ISTI/EDI consultants, AID, MEM and all energy and economic

development efforts in Sudan. Short term personnel performed specific tasks in Sudan, provided specific advice to MEM officials and provided training to NEA staff.

The contractor faced a very broad scope of work and performed admirably to cover all aspects of the work. The contractor's greatest contribution and basic performance was in institution building. The quality of the technical advice provided was good. The quality of reports was good in substance, average or less than average in presentation. Project management and quality control could have been tighter.

The performance of the SEPAP project can be characterized as laden with enthusiasm and energy. The project concentrated on breadth and issues. The EPM project should be more focused -- more emphasis should be placed on project management, schedules, technique, knowledge transfer and quality of the output.

3. Ability of Contractor to Work Effectively with Sudanese

The contractor worked well with Sudanese counterparts and in the Sudanese environment. The project resident staff was considered part of NEA and participated in National Energy Assessment and National Energy Plan committees. Short term personnel by and large involved NEA counterparts in their assignments.

The contractor took steps to assure that the Assessment and the Plan are the result of a collaborative effort. At the beginning of the project the contractor performed most of the data collection and analytical work. As the project progressed the NEA assumed more and more data collection and analytical responsibility and the contractor provided more and more technical assistance.

4. Policy and Investment Issues to be Addressed by the EPM Project

The same basic issues addressed in the SEPAP project should be further elaborated in the EPM project. These are: foreign exchange availability, electricity and petroleum pricing, electricity and petroleum investments and commercialization of renewable resources. The basic issues as identified by SEPAP are the following:

- o Without major initiatives, petroleum and electricity supply shortages are the limiting factor in economic growth;
- o The petroleum and electricity shortages forced greater reliance on fuelwood which causes deforestation and desertification and accelerates environmental damage;
- o Petroleum shortages result from a shortage of foreign exchange, the current financing and importing arrangements, and the inefficient allocation system;
- o The allocation system encourages black market, discourages efficient distribution of products and discourages conservation;
- o Major initiatives are needed to increase the availability of petroleum, keep prices high and reform the allocation system;
- o Electricity shortages result from inadequate investment (particularly in the distribution system and in equipment maintenance), shortage of skilled personnel, and poor management;
- o The electricity system is being developed in a piecemeal fashion with thermal plants exacerbating the foreign exchange problem;

- o Major initiatives are needed to reform the electricity system's planning, financing, construction, maintenance, pricing and management elements;
- o Petroleum and electricity investments need to be coordinated and jointly considered from the national cost/benefit point of view in terms of impact on foreign exchange and impact on economic growth; and
- o Petroleum and electricity investments need to be considered in conjunction with other infrastructure investments such as the road network, the railroad system, and from the national cost/benefit point of view in terms of impact on foreign exchange.

5. Impact on Effectiveness of Key Institutions

The project had an impact on the effectiveness of three key institutions: the NEA, the National Electricity Corporation (NEC) and the General Petroleum Corporation (GPC). The project virtually created the NEA and established it as a viable institution. The emphasis in the project on electricity supply and petroleum distribution highlighted the major issues in these two sectors and the actions required to improve the institutions' effectiveness. The NEC is undergoing organizational changes to be more effective; the GPC too is revising its procedures to implement a more effective allocation system.

The project established links for communication and cooperation with agencies active in energy or related matters. It institutionalized energy debate by establishing committees to identify and deal with specific energy issues with representation from government agencies, the private sector, academia and other institutions. Thus, these

institutions found an opportunity to participate in the energy policy debate and influence the development of the country's energy program.

By promoting the virtues of private sector development the project promoted the role of the private sector but it did not have an impact on the effectiveness of the private sector. Private sector development is a major AID objective in Sudan (and elsewhere) and the project's recommendations (e.g., increasing the participation of the private sector in petroleum distribution, increasing domestic private sector capability to manufacture some of the capital equipment for the electricity system, and developing a capability to produce indigenous fuels on a commercial scale) are consistent with this objective.

6. Effectiveness of Project Effort

When the project started, NEA existed in name only, energy data was non-existent, policy issues were not addressed. The project responded to Government of Sudan needs by providing technical assistance in all aspects of energy planning, and in strengthening the petroleum and electricity sectors.

To the extent that project objectives were to organize data, build an institution, provide policy support and develop an energy strategy, these have been met. The project:

- o Organized energy data -- the National Energy Assessment includes the first data base; NEA is continuing to build data; other agencies including the World Bank now refer to NEA as a recognized source of energy information;
- o Built an institution -- NEA has been built completely within this project; it is now a functioning organization with demonstrated capability and output and some policy influence;

- o Provided policy analysis -- petroleum and electricity investment and pricing decisions have been influenced as a result of this project; the project provided guidance for policy development and planning; and

- o Provided the basis for an energy strategy -- this fall the Minister of Energy and Mining will present Sudan's first comprehensive energy plan to the National Assembly, the Council of Ministers and the President. The plan will propose policies, programs, and investment strategies to tackle the nation's pressing short and long term energy problems.

To the extent possible, the project has been a collaborative effort as a result of conscious effort on the part of the project resident staff. Throughout the term of the SEPAP project the project team considered that the process of planning, i.e., developing indigenous knowledge and expertise, applying it in pursuit of a goal and involving many parties to build a consensus is as important as the final product. However, particularly during the first half of the project all the leadership and direction came from the U.S. participants. The Sudanese became more involved towards the latter part of the project.

The project has been well received by the GOS which wants to continue it through the EPM project. The latter is likely to be the main support of NEA, just as SEPAP was. However, it is most likely that the GOS will seek to "lengthen the apron strings" somewhat and use the EPM project more as a vehicle of true technical assistance and less as a resource for total reliance.

The project has been effective in arguing the merits of the price mechanism as a means to allocate scarce resources efficiently.

However, when one makes a change in the resource allocation system, everything does not adjust instantaneously. It takes time for the dynamics of the new system to take place. In this interim certain groups of the population may be negatively impacted, so some welfare mechanism is needed to ease hardships for the transitional phase.

A dynamic and efficient resource allocation system requires a market economy such as the United States where everyone participates. Sudan is not the United States and therein lies the biggest problem in instituting efficient and dynamic resource allocation systems through the price mechanism. To be effective, an environment for the price mechanism to work must exist. The creation of such an environment is and should be a high priority for AID assistance in Sudan (and for that matter other developing countries).

The EPM project should be strongly coordinated with private sector development initiatives. It is not sufficient to counsel efficiency improvements, service orientation and free enterprise without counseling "how" to achieve these objectives and providing funds and assistance to develop private sector institutions.

7. Relevance of Project Experience to Other Countries

The ingredients that made this project a success are the following:

- o Dynamic and committed parties that initiated the project. The MEM Minister and the Mission Director both had a strong interest in energy, recognized energy as an important element in the country's economic development, and knew how to interest and convince their respective government bureaucracies to initiate the project;
- o Dynamic and committed contractor. The president of EDI was knowledgeable in Sudan, knew the issues and was

professionally capable to render technical advice on the issues. Thus the quality control he exerted on the project reflected knowledge and expertise specifically in energy planning as well as Sudan, not just management procedures and budget control. The residents selected for this project were dynamic and committed individuals with great interest in Sudan's welfare. Several of the project staff were accomplished experts in their fields and provided practical advice to Sudanese counterparts. The project was an "important" project for the contractor, not just "another" project and received special attention; and

- o Cooperative contracting attitude by AID. The project went through many changes in the course of its performance. It expanded in both time and budget to more than double the original estimate and experienced changes in emphasis and content resulting from requirements created by a fluid and changing situation as the development of NEA and energy issues evolved.

It is considered that the above three elements are important ingredients for success in energy planning projects in developing countries.

II. PROJECT DEVELOPMENT

A. INTRODUCTION

The Ministry of Energy and Mining (MEM) in Sudan was created in 1977 in order to focus on energy and its importance to development and modernization of the nation in recognition of the critical energy problems facing Sudan. To strengthen this focus on energy problems the Minister of Energy considered that an overall examination of Sudan's current and future energy requirements was necessary to better understand the implications of energy in national development and to determine what actions would improve its energy situation.

The Minister of Energy and Mining had seen various approaches to the preparation of comprehensive country energy studies, including one prepared for Egypt by the U.S. Department of Energy. This resulted in the Minister asking the U.S. Ambassador in Sudan if the U.S. Government could be of assistance in preparing an overall assessment of the energy situation in Sudan. This inquiry was forwarded to Washington with the Embassy's endorsement.

In early 1980, meetings between AID, the Department of State and the Department of Energy resulted in an agreement that assistance would be provided by AID, funded and directed by AID's Office of Energy. Following this agreement a team composed of AID Office of Energy, and Energy Development International (EDI) officials, undertook a preliminary project analysis and prepared a statement of goals and objectives and preliminary estimates of time and personnel necessary for a program of assistance to Sudan. On the basis of this preliminary project analysis a limited Scope of Project Agreement between the U.S. and Sudan was signed for a Sudan Energy Policy and Planning (SEPAP) Project. A Project Implementation Order/Technical Services (PIO/T) was prepared and, at the end of 1980, a contractor

was selected to perform the work described in the PIO/T. A contract was signed on January 2, 1981 with International Science and Technology, Inc. (ISTI) as prime contractor and Energy Development International (EDI) as subcontractor to perform the work indicated in the PIO/T, for a budget of \$649,463 and an estimated completion date of September 30, 1982. Subsequently the contract was amended eight times. The project's final budget has amounted to \$1,534,887 and LS237,435 and the final completion date was March 31, 1984.

The chronology of the development of this project is shown in Table 1.

B. PROJECT SCOPE

In order to evaluate the SEPAP project it is important to review the objectives and scope of work as they evolved from the preliminary project analysis to the U.S.-Sudan agreement to the PIO/T and to the contract and its amendments.

1. Preliminary Project Analysis

a. Issues

The preliminary project analysis identified the following energy related issues faced by Sudan in 1980:

o Balance of Payments

Sudan faces an extreme foreign exchange shortage which translates into energy shortage. Part of the balance of payments problem is due to petroleum imports. Increasing the efficiency with which petroleum is used or increasing domestic energy supply can significantly alter foreign exchange constraints on economic growth and investment.

TABLE 1

CHRONOLOGY OF SEPAP PROJECT

		<u>ATP Budget</u>	<u>Schedule</u>
Mid-80	Preliminary Project Analysis A Design for a National Energy Assessment	65 person-months	18 months
08/30/80	Limited Scope Grant Project Agreement Between U.S. and Sudan for Energy Policy and Planning project	\$650,000 +\$ 89,000 (GOS)	18 months
09/30/81	Amendment to Limited Scope Grant Project Agreement to cover the cost of in-country training courses	\$741,000 +\$114,000 (GOS)	
11/20/80	Project Implementation Order/Technical Services (PIO/T) Energy Policy and Planning	\$650,000	09/30/82
01/02/81	ISTI/EDI Contract Award to prepare National Energy Assessment	\$649,463	09/30/82
06/26/81	EDI Request for Additional Funds in response to request by Minister for expanded scope Additional 85 person-weeks, \$110,000		
03/22/82	Amendment 1 to provide funds for additional training and assistance	\$739,981	09/30/82
09/24/82	Amendment 2 to extend performance period	\$739,901	10/31/82
11/12/82	Amendment 3 to provide funds for additional training	\$758,899	10/31/82
11/12/82	Amendment 4 to provide funds for additional technical assistance and training and extend performance period	\$1,120,106	07/31/83
06/22/83	Amendment 5 to allow local currency adjustment	\$1,120,106	07/31/83
08/24/83	Amendment 6 to provide funds for additional technical assistance and extend performance period	\$1,118,380	10/31/83
09/23/83	Amendment 7 to provide funds for additional technical assistance and extend performance period	\$1,534,887 and LS 237,435	01/30/84
01/31/84	Amendment 8 to extend performance period	\$1,534,887 and LS 237,435	03/31/84

o Effects of Shortages on Prices and Production

Fuel shortages have a sizable impact on both the price of output and the agricultural sector. Fuel shortages during peak plowing and planting seasons restrict agricultural production by limiting the number of acres that can be cultivated during the appropriate season. Fuel scarcity amplifies the problems of an already inefficient agricultural transportation system, reducing the ability to bring products to collection points and raising the cost of doing so.

Energy shortages adversely affect industry and commerce. The unavailability of gasoline makes transport of parts and materials more unreliable than it normally is thus lowering productivity and capacity utilization. Shortages and inconsistency in electricity supply result in lost output, lowered productivity and the increased expense of maintaining private standby power generation capacity.

o Rural Energy Needs

Increased use of fuelwood results in environmental damage in the form of deforestation around certain population centers, and the advancing of the desert in areas of marginal vegetation (such as the arid Northern half).

o Electricity Supply

The inadequacy of electricity supply is one of the most uniformly acute constraints on industrial sector productivity and growth. Electricity supply bottlenecks are a major impediment to foreign investment and industrial

expansion. Electricity supply problems contribute directly to a further worsening of energy supply-demand balances by leading to the increased use of diesel generators for industries and institutions that cannot afford the unreliability of the central power supply.

o Transport and Energy

Major centers of population and economic activity are widely dispersed over the million square miles of Sudan's territory. The inability of the railroad system to meet transport requirements has a deleterious effect on energy consumption. Increased traffic by road, a highly energy intensive mode of transportation, aggravates the energy-intensity of transportation and significantly increases petroleum consumption which cause more shortages. Limitations of petroleum hamper freight transport, especially to and from the more remote areas of the country. Transportation bottlenecks impede movement of perishable agricultural products to market, thereby affecting income directly.

o Energy for Economic Development

There is a short-term need to limit and even lower the consumption of imported fuels by increasing the efficiency with which these fuels are used. For the long-term it is important to increase energy inputs available for economic development. Sudan's long-term economic development strategy must be linked to a long-term energy strategy. Because the shortage of imported energy is inseparable from balance of payments problems, any energy strategy must also be integrated into a larger foreign exchange strategy as well.

Sudan's energy strategy must also include a program for energy resource development -- both in terms of conventional resources such as petroleum and hydropower, but also in terms of such renewable resources as biomass, sugar derivatives, wind and solar power and geothermal energy.

b. National Energy Assessment

The above energy-related problems constituted the rationale and the central concerns for a national energy assessment. The structure of an assessment to address these concerns was considered to be the following:

o Supply-Demand Analysis

The first step in the assessment would be to construct a consistent set of information on energy demand and supply considering all uses and all fuels. This would entail the following:

- Data collection on energy use--agriculture, transportation, industry, urban and rural households, small scale industry;
- Demand projections;
- Energy resource evaluation;
- Electricity supply;
- Energy pricing; and
- Supply-demand balance.

o Strategy Analysis

The second step in the assessment would be to examine various energy strategies that address the energy issues identified above. These strategies would be aimed at

increasing the reliability of energy supply, reducing the balance of payments burden of energy supply, increasing the energy self-sufficiency of the country and, in general, satisfying the energy requirements of economic and social development in the most cost-effective manner possible.

o Policy Analysis

The last step in the assessment would consist of two elements; establishing priorities among the various strategies analyzed in the previous step, and definition of programs or project areas required to implement those strategies found to have the highest priorities.

c. Project Implementation

The preliminary project analysis considered that the project would accomplish its goals only if it is carried out as a close collaboration between members of the U.S. team and analysts and policymakers in the Ministry of Energy and Mining. It was considered that the assessment would serve the professional development of energy analysts in MEM through their active participation in all phases of the assessment. They would be the principal agents in carrying out the assessment, with assistance and guidance provided by the U.S. team. Lastly, it was considered that the assessment would be performed within the organizational framework of the newly (May 21, 1980) formed National Energy Administration (NEA) thus assisting in the development of that institution.

2. U.S.-Sudan Project Agreement

The Project Agreement (ProAg) was prepared on the basis of the recommendation of the preliminary project analysis. It defined the

SEPAP project as consisting of technical assistance in the preparation of a national energy assessment for Sudan and as assisting Sudan in developing a comprehensive energy strategy. The energy assessment would include the following components:

o Analysis

- Supply-demand analysis for all uses of energy and all fuels covering the current situation and projections for future demand supply to the year 2000;
- Strategy analysis to identify alternative methods of increasing the reliability of energy supply, reducing the balance of payments, burden of costs, increasing energy self sufficiency and finding cost effective means to meet energy requirements; and
- Policy analysis to establish priorities among the various strategies in order to define projects or programs consistent with these priorities.

o Institutional development of the National Energy Administration with the active participation of Ministry of Energy and Mining personnel in all phases of the assessment.

The ProAg considered that the overall assessment, although centered in the Ministry of Energy and Mining, would require the active cooperation of many other Ministries and parastatal organizations including Planning, Finance, Transportation, Agriculture, Electricity, Sugar, and River Transport. It was agreed to establish an overview committee with representation from these agencies to assure the required participation of personnel of these agencies and access to pertinent information, and to provide guidance on overall policy issues so that conclusions and recommendations from the assessment will find acceptance and implementation.

3. Project Implementation Order/Technical Services (PIO/T)

The Project Implementation Order/Technical Services (PIO/T) was also prepared on the basis of the above preliminary project analysis and authorized AID to contract with the Small Business Administration for the services of International Science and Technology Institute, Inc. (ISTI) an 8(a) minority contractor, with Energy Development International (EDI) as subcontractor, to perform a national energy assessment for Sudan. The statement of work indicated the purpose of the project to be to assist Sudan in preparing an assessment of its current and future energy requirements and resources in order to:

- o Formulate national energy policies coherent with the country's resources and development goals;
- o Utilize all energy resources more efficiently and in keeping with national priorities;
- o Increase the production and utilization of indigenous energy resources, both conventional and alternative, to the maximum feasible extent; and
- o Develop and strengthen the capabilities of Sudanese personnel and institutions in the various energy fields as well as overall energy planning.

Toward these ends the national energy assessment would:

- o Collect and develop data on energy uses, resources, prices, and estimated future energy supply and demand;
- o Identify key impediments to the achievement of the above goals and recommend means for removing the obstacles, including Government of Sudan (GOS) policy changes as well as projects for Sudanese and/or outside financing; and

- o Provide training and support for Sudanese energy personnel and institutions in the process of performing the work.

The work to be performed under the national energy assessment consisted of the following elements:

- o Data collection for all energy uses of all energy sources.
- o Energy Supply and Demand Projections
 - Demand projections by various sectors, based upon past consumption patterns, energy cost projections, activity levels projected under national development plans, alternative energy sources potentially available and other factors, including alternative development paths; and
 - Supply projections for all major indigenous sources of energy, based on secondary estimates and on estimates of potential from new indigenous sources identified.
- o Strategy Analysis
 - Energy Resources--Analysis of the potential for expanding indigenous production of energy resources, for reducing unit costs, and/or for accelerating the use of specific resources that are most competitive in terms of national development objectives;
 - Energy Uses--Analysis of energy uses and exploration of the possibilities for using alternative resources, modes or devices so as to increase energy efficiency and thus conserve energy without decreasing overall production levels;

- Options for Government--Analysis of current and past government policies affecting energy supply and demand, to determine what changes might encourage the production of energy from appropriate sources, improve the efficiency of energy use, and promote conservation generally;
 - Identification of Related Energy Projects--Identification and description of types of energy programs and project activities that might be initiated and which would be carried out in cooperation with AID or other donors.
- o Training and Institution Building
- Development and strengthening of the capabilities of Sudanese personnel and institutions in the energy field;
 - Assistance in the development of professional skills of energy analysts in the Ministry of Energy and Mining through the performance of the involved in all phases of the national energy assessment;
 - Assistance and counsel to the Government of Sudan in its efforts to develop the projected National Energy Administration in Sudan and to upgrade the skills of Sudanese energy professionals.
- o Strategic Options and Recommendations--conclusions and recommendations as appropriate for follow-up action by Sudan and assistance agencies.

4. ISTI/EDI Contract

The ISTI/EDI contract was prepared on the basis of the above PIO/T and authorized ISTI/EDI to implement the SEPAP project. The contract amendments do not significantly change the statement of work. The changes pertain to changes in funding and completion date for additional professional services in the areas generally covered in the original statement of work.

III. PROJECT PERFORMANCE

A. PROJECT ACTIVITIES

Project activities can be grouped in two types:

- o Energy information and analysis; and
- o Institutional development.

Included in the first group are data collection, information development and issue analysis activities which result in a report. Such activities entail substantive contribution on the part of project personnel in the documentary output of NEA. Included in the second group are activities of organizational, advisory, and support nature which build the capability of NEA. Such activities entail participation in meetings, providing guidance, advice and training to the staff, developing linkages with government and private sector organizations involved in energy and economic development matters, and providing advice to the Minister of MEM. These activities do not necessarily result in reports; confidential memoranda and reports do document advice provided to the Minister, and training reference materials do document training, but the objective of this set of activities is "process" rather than "product."

1. Energy Information and Analysis

The major output of this group of activities is the National Energy Assessment which presents a benchmark data base and a clear understanding of energy issues in Sudan. Supporting the Assessment are many reports which analyze energy problems, develop energy data and address energy, economic and environmental issues. The National Energy Assessment is followed by a National Energy Plan. Similar to the Assessment there are several reports supporting the Plan.

Project activities with substantive output include the following areas:

- o Energy Utilization
 - Agricultural use
 - Industrial use
 - Households/commercial use
 - Transportation use

- o Energy Supply and Conversion
 - Petroleum products
 - Electric power
 - Fuelwood, biomass, other renewables

- o Energy Distribution
 - Petroleum allocation
 - Electricity distribution

- o Supply Demand Balance
 - Base year estimates
 - Economic development scenarios
 - Projections

- o Energy Economics
 - Petroleum pricing
 - Electricity pricing
 - Petroleum production
 - Domestic use vs. export
 - Kosti refinery vs. pipeline

 - Electricity generation
 - Hydro vs. thermal
 - Short term improvements vs. long term new plants
 - Cogeneration, self generation, conservation

- o Economic and Environmental Impact
 - Energy shortages and GDP losses
 - Deforestation
 - Agricultural energy consumption inefficiencies
 - Dam siltation

- o Analytical Techniques
 - Survey methods
 - Estimation techniques

Table 2 shows a listing of the reports produced under the guidance and with the participation of the project team. These reports are formal written documents. Numerous memoranda, work plans, trip reports, issue papers and progress reports have also been produced and are part of the project output.

2. Institutional Development

The major output of this group of activities is the establishment and development of NEA itself into a viable institution. Project activities include advising NEA on organizational, staffing and compensation matters, training the staff, participating in policy deliberations and responding to requests by the MEM Minister for advice on energy and institutional matters.

Project activities in institution building included the following areas:

- o Creation of organizational structure to analyze energy issues;

- o Recruiting promising staff for NEA from academic institutions and other energy agencies;

TABLE 2

SEPAP REPORTS

Reports Supporting the National Energy Assessment

- o Energy Use in the Industrial Sector of Sudan; June 1981.
- o Investigation of Petroleum Supply and Distribution in Sudan; June 1981, Revised Sept. 1981.
- o Recommendations for the Short-Range (1981-1986) and Reliability Improvement Programs; Aug. 1981.
- o Long-Range Electricity Futures for Sudan: Two Scenarios, 1982-2000; Sept. 1981.
- o An Examination of the Impact of Energy Supply Problems on Sudanese Industry and a Review of Energy Use and Energy Efficiency; Nov. 1981.
- o A Comparison of Sudanese Export Performance with Key Petroleum Imports; Dec. 1981.
- o Traffic Reform and Energy Conservation for Vehicles in the Capital-Khartoum Area; Dec. 1981.
- o The Causes and Effects of Debris Accumulation at the Roseires Hydro-Electric Dam - An Initial Survey; May 1982.
- o Sudan: An Assessment of Decentralized Hydropower Potential; July 1982.
- o Renewable Energy Assessment for the Sudan; Sept. 1982.
- o A Review of Laws Covering Importation of Energy Intensive Goods; April 1983.
- o The Nature of Land Laws in Sudan (with specific reference to forestry); April 1983.
- o The Problem and Causes of Debris Accumulation at Roseires Dam: An Initial Survey; April 1983.
- o Current Population of Sudan and Projections to the Year 2000; April 1983.

TABLE 2
(Continued)

- o Sudan National Energy Assessment
 - Executive Summary; Oct. 1983.
 - Annex 1: Base Year (1980) Energy Supply/Demand Balances and Demand Projection Methodology; Mar. 1983.
 - Annex 2: Transportation Sector; April 1983.
 - Annex 3: Forestry and Woodfuels Resources; May 1983.
 - Annex 4: Agricultural Sector; May 1983.
 - Annex 5: Household Sector; May 1983.
 - Annex 6: Industrial Sector; June 1983.

Reports Supporting the National Energy Plan

- o A Report on Fuel Oil Supply to Power IV Project; July 1983.
- o Cost Estimate for Kosti Mini-Refinery; Aug. 1983.
- o Report on Energy Management and Conservation; Dec. 1983.
- o Report on Energy Resources; Dec. 1983.
- o Energy Demand Forecast; Dec. 1983.
- o Integrated Land Use Management (ILUM); March 1983 (Expected).

- o Establishing an incentive system to monetarily reward good performance;
- o Establishing an ongoing energy information and analysis capability to:
 - Conduct the National Energy Assessment;
 - Update the National Energy Assessment;
 - Develop the National Energy Plan;
 - Analyze energy problems; and
 - Analyze energy policy issues.
- o Training staff in energy planning and analysis by:
 - Informal training through interaction on project tasks and interchange of experience and ideas; and
 - Formal training on specific energy related subjects through structured classroom instruction and seminars; Table 3 shows the formal training program implemented in this project.
- o Institutionalizing energy debate by establishing committees to identify and deal with specific energy issues with representation from various government agencies, the private sector, academia and other institutions; the following committees have been active in this project:
 - National Energy Assessment (NEA) committees
 - Industry
 - Agriculture
 - Households/Commercial
 - Transportation
 - National Energy Plan (NEP) committees
 - Overall NEP
 - Energy demand

TABLE 3

IN-COUNTRY FORMAL CLASSROOM TRAINING PROGRAM

<u>Date</u> <u>Mo./Yr.</u>	<u>Title of Program</u>	<u>Instructors</u>	<u>Affiliation</u>	<u>Objectives of Program</u>	<u>Approximate</u> <u>Duration</u> <u>of Program</u> <u>(Hours)</u>	<u>Approximate</u> <u>Number of</u> <u>Participants</u>
02/81	Energy Assessment Overview and Methodology	Hale	FDI	Define energy assessment; describe methodology; identify sources of data by sector; identify uses of reference energy system; identify points of consumption for which energy use can be estimated based on readily-accessible data.	2	11
03/81	The Reference Energy System	Cough	ISTI	Describe how petroleum products are refined marketed and distributed (in W. Europe).	1.5	9
04/81	Energy Demand Analysis and the Use of Generic Data	Cough	ISTI	Describe distribution process in the Sudan.	2	10
04/81	Petroleum Products Markets: The Western European Case	Potter	Independent Consultant	Discuss concepts of: firm capacity; ready capacity; reliability levels.	4.5	11
05/81	Petroleum Products Distribution	MacDonald	FDI	Background knowledge.	4.5	12
06/81	Electricity Supply Planning and Issues (Part 1)	Dhar	Consulting Firm	Background knowledge of petroleum sector.	6	9
07/81	Introduction to Energy Issues	Bess Mikhtar	ISTI NEA	Background knowledge of petroleum sector.	2.5	13
07/81	Petroleum Issues	Beshir El Zein	NEA NEA	Background knowledge of petroleum sector.	2.5	15
07/81	Petroleum Distribution and Transport	El Dawla	NEA	Background knowledge of electricity sector.	2.5	13
07/81	Electricity Generation and Distribution	Gindi Bagi	NEC NEA		2.5	11

TABLE 3
(Continued)

<u>Date</u> <u>Mo./Yr.</u>	<u>Title of Program</u>	<u>Instructors</u>	<u>Affiliation</u>	<u>Objectives of Program</u>	<u>Approximate</u> <u>Duration</u> <u>of Program</u>	<u>Approximate</u> <u>Number of</u> <u>Participants</u>
07/81	Renewable Energy	El Faki Abdul Salaam	NEA NEA	Background knowledge of renewable energy sector.	2.5	16
08/81	Reference Energy System Analysis	Kyle	Independent Consultant	Identify uses of reference energy system.	2	9
10/81	Electricity Supply Planning and Issues (Part 2)	Dhar	Consulting Firm	Use rules of thumb for planning electricity supply targets.	6	9
10/81	Industrial Energy Audit Techniques (Part 1)	Milukas Thorne	Independent ISTI/EDI	Background knowledge of energy audit uses and techniques.	4	15
11/81	Renewable Energy Resources and Technology (Part 1)	Gross	ISTI/EDI	Background knowledge of renewable energy application and technologies.	12	8
02/82	Renewable Energy Resources and Technology (Part 2)	Salame & 9 others	EDI Local Independent Consultant	Background knowledge on: Biomass, forestry resources, wind, photovoltaic, stoves, passive solar.	13	23
04/82	Computer Programming	Awad Hag Ali	Local Independent	Introduction to BASIC programming	24	12
04/82	Petroleum Economics and Allocation	Potter Prast	Independent Consulting Firm	Background knowledge on petroleum pricing, purchasing and allocation.	12	10
05/82	Energy/Economic Analysis: Petroleum Products	Meier	Consulting Firm	Discussions on topics of interest to high-level officers in Ministry and NEA.	15	15

TABLE 3
(Continued)

<u>Date</u> <u>Mo./Yr.</u>	<u>Title of Program</u>	<u>Instructors</u>	<u>Affiliation</u>	<u>Objectives of Program</u>	<u>Approximate</u> <u>Duration</u> <u>of Program</u>	<u>Approximate</u> <u>Number of</u> <u>Participants</u>
06/82	Industrial Energy Audit Techniques (Part 2)	Milukas Thorne	Independent ISTI/EDI	Review basic principles of industrial energy conservation. Identify and use portable energy audit equipment; use energy questionnaire for data gathering.	30	15
10/82	Petroleum Distribution	McCoy	Consulting Firm	Discuss distribution issues with staff of other Ministries and agencies.	15	9
03/83	Information Systems	Jahani	Independent Consultant	Background knowledge on energy information systems.	18	24
04/83	Energy Costing and Pricing	Gellerson	Independent Consultant	Theory with practical exercises.	12	8
06/83	Computer Operation and the Use of Software Packages (Part 1)	El Shafel Fawz Sobbi	NEA NEA NEA	Computer literacy and practical applications. (Osborne Computer)	20	13
09/83	Computer Operation and the Use of Software Packages (Part 2)	El Shafel Fawz Sobbi	NEA NEA NEA	Same as Part 1.	30	13
11/83	Project Evaluation	El Faki	NEA	Background knowledge on project evaluation techniques.	30	15

- Renewable energy
 - Energy conservation
 - Energy supply
 - Debottlenecking
 - Technoeconomic options
 - Plan implementation
- o Developing internal resources to serve the objectives of NEA
 - Energy Library
 - Information systems
 - Quarterly Energy Reports
 - Database management and models
 - Computer center--IBM PC, Hyperion
- o Developing links for communication and cooperation with agencies active in energy or related matters such as:
 - National Energy Corporation (NEC)
 - General Petroleum Corporation (GPC)
 - MEM Department of Forestry
 - Institute for Energy Research (IER)
 - Renewable Energy Institute (REI)
 - Institute for Environmental Study (Ford Foundation)
 - Private sector petroleum companies (Shell, Agip, Total)
 - Private sector petroleum exploration contractor (Chevron)
 - Donor country energy projects
 - USAID Renewables and Biomass Projects
 - West German Renewables Project
 - ITED human settlement project
- o Participating in activities impinging upon energy planning such as:
 - Conference on women and the environment
 - UN renewables conference in Nairobi

- AID workshop on energy planning in developing countries (Reston Conference)
 - UNIDO public sector industries survey
 - U.S. Department of Energy energy training program
- o Supporting the MEM Minister such as the following:
- Assist Minister in formation of high level Ministry-wide energy policy advisory committee and participate in committee deliberations;
 - Analyze NEA organizational structure and staffing requirements;
 - Analyze petroleum products supply and distribution system--purchasing, pricing, allocation, distribution and recommend measures to improve the system;
 - Analyze electricity system--demand forecast, capacity expansion and alternative supply scenarios and recommend measures to improve the reliability of the system (reduce frequency, duration and impact of power outages) and reduce the system's projected dependence on imported petroleum (reduce foreign exchange impact);
 - Review studies performed by other donors, e.g., Nile Water Study, hydro-assessment projects, World Bank studies;
 - Assist in writing speeches and releases such as the impact of petroleum imports on domestic economy, and generally provide advice upon request.

Table 4 shows a sample of reports (some confidential) prepared for the MEM Minister directly or for his subordinates for the eventual use by the Minister. These reports are formal written documents. Numerous memoranda and briefing papers to MEM officials have been produced in addition.

TABLE 4

SEPAP SAMPLE REPORTS PREPARED FOR MEM OFFICIALS
(Minister, Undersecretary, Director General of NEA)

- o General Review of Short-term Measures Required to Provide Early Improvement in the Petroleum Distribution Patterns within the Country; April 1981.
- o Impact of Petroleum Imports on the National Economy; December 1981.
- o Concept Paper and Recommendations: Organization of and Priorities for the National Energy Administration; November 1982.
- o Petroleum Supplied for the Southern Region; March 1983.
- o Information for Sudan National Energy Planning Purposes from White Nile Petroleum Company and Chevron Overseas Petroleum, Inc.; June 1983.
- o Energy Pricing in Sudan; June 1983.
- o Causes of the Difficulties with the Present Petroleum Allocation System; November 1983.
- o Function and Role of Government in the Petroleum Sector, the Future Role and Organizational Structure of the General Petroleum Corporation; December 1983.
- o NEA Management: Organizational Structure, Review of Staff Qualifications; January 1984.
- o Petroleum Arrangements and Development of Natural Resources; January 1984.

B. STAFFING

The project team consisted of two resident analysts in Sudan supplemented by short term specialists who visited Sudan for periods generally ranging from 2 to 8 weeks to work on well defined special assignments. The resident analysts provided continuous technical assistance and policy advice to NEA and MEM in data and issue analysis, demand forecasting strategy development, and options analysis, and contributed strongly to the institution building of NEA.

Messrs. Bess, Cough and Daudon of ISTI served as resident project staff. Their schedule of participation is shown in Figure 1. Twenty-eight specialists and management or policy advisors made 48 visits to Sudan for short term assignments. Table 5 shows the project participants, their affiliations, level of expertise and areas of involvement in the project.

C. ISSUES

The energy issues as identified by the preliminary project analysis in 1980 have been summarized in Section II above. The issues as identified by SEPAP in early 1984 are summarized below:

o Overview

Since the mid 1970's Sudan's demand for petroleum and electricity has increasingly outstripped the financial ability of the country to supply them. The resulting shortages of these energy sources, together with population growth and increasing urbanization have fostered greater reliance on fuelwood. Energy demand for all energy sources is expected to continue to grow at a high rate for the next 10-15 years. Without major initiatives, petroleum and

FIGURE 1

RESIDENT PROJECT STAFF SCHEDULE OF PARTICIPATION

<u>Name</u>	<u>Affiliation</u>	1981				1982				1983				1984
		* Q1 *	* Q2 *	* Q3 *	* Q4 *	* Q1 *	* Q2 *	* Q3 *	* Q4 *	* Q1 *	* Q2 *	* Q3 *	* Q4 *	* Q1 *
Bess	ISTI					_____								
Cough	ISTI	_____				_____								
Daudon	ISTI													_____
Harris *	EDI													_____

* Not resident staff, but on extended visits in 1983.

Note: Q = Quarter.

TABLE 5

LIST OF SHORT-TERM CONSULTANTS ENGAGED IN SEPAP PROJECT

Name (Alphabetically)	Affiliation	Approximate		Purpose of Visit(s)	Level*		
		Number of weeks In Sudan	Number of Visits		1	2	3
Dhar	Consulting Firm	6-7	3	Electricity supply		x	
Doernberg	EDI	4-5	2	Energy assessment		x	
Gellerson	Independent	6-7	2	Electricity and petroleum pricing		x	
Gross	EDI	3	1	Renewable energy assessment report			x
Hale	EDI	8-10	7	Policy and Management			x
Harris	EDI	18-20	3	Allocation, manpower, organization			x
Jahani	Independent	3	1	Information systems, VISICALC		x	
Keezing	EDI	6	1	Information systems	x		
Kyle	Independent	4	1	Energy assessment; supply demand balance	x		
Laukaran	Independent	4	1	Renewable energy resources		x	
MacDonald	EDI	7	2	Petroleum distribution and allocation		x	
McCoy	Consulting Firm	3-4	1	Petroleum distribution and allocation			x
Meier	Consulting Firm	2	1	Seminar: Energy and Economic Analysis			x
Milukas	Independent	3-4	1	Energy conservation	x		
Monaghan	EDI	2	1	Petroleum allocation			x
Munson	EDI	4-5	2	Information systems -- Energy planning		x	
Murphy	Consulting Firm	3	1	Geological review-National Energy Plan			x
Potter	Independent	3-4	2	Petroleum distribution and allocation			x
Prast	Consulting Firm	3-4	2	Petroleum allocation			x
Robinson	Consulting Firm	2	1	Industrial audit			x
Rogers	Independent	7-8	2	Supply/demand balance, forecast	x		
Roulette	EDI	3-4	2	Library	x		
Ruzas	Independent	12	1	Economic losses study	x		
Salame	EDI	6-7	1	Renewable energy assessment report	x		
Solomon	EDI	6	2	Energy conservation - transp. and agriculture		x	
Taylor	Independent	6	1	Siltation at Roseires Dam			x
Thorne	EDI	4-5	2	Energy conservation			x
Westefield	EDI	2	1	Energy conservation-National Energy Plan			x
28	EDI-13	Approx.	48		7	8	13
	Others-15	148			(Visits) 9	15	24

* Level 1 = Graduate student; doctoral candidate; analyst.
Level 2 = Ph.D. member of university faculty; senior analyst.
Level 3 = Executive; professional with wide experience in field.

electricity supply shortages will increasingly become the limiting factor in economic growth, the rate of deforestation and desertification, already high, will accelerate and will continue the environmental damage.

o Petroleum

- Petroleum shortages continue to disrupt the economy, jeopardizing prospects for growth. Chronic shortages in regions depress local economies and eliminate the potential for any growth. The direct losses resulting from these disruptions are estimated at LS 100 million in the agricultural sector alone for 1983.
- Petroleum shortages result from the current financing and importing arrangements, and the inefficient allocation of available products. The oil bill consumes over 75 percent of Sudan's export earnings (mostly generated by the agricultural sector).
- Because of credit problems, Sudan imports its petroleum on poor terms. It relies on unscrupulous traders with questionable business practices. The result is an overpayment in annual terms of some \$50 million over the cost of petroleum under spot market prices. The flow of imported petroleum is sporadic. Delays occur regularly in shipments. Consequently it is difficult to plan and manage refining and distribution of products. Existing infrastructure (storage facilities, pipelines, and railway) are underutilized.
- The allocation system, ostensibly in place to minimize petroleum problems, instead magnifies them. The

current system is inefficient and rigid, favoring politically connected large consumers and those in urban areas over small businesses, farmers and rural users. A thriving black market (with prices sometimes double the official rate) reallocates fuel, but at a high cost to the consumer and the economy. Any response to price increases is almost completely negated by the constraints of the allocation process.

- In the short term the size of the oil bill in relation to export earnings threatens to bankrupt the country. Sudan cannot now pay for the oil it consumes. It cannot afford to pay excessive interest and purchase charges. The current allocation system does not encourage (indeed blocks) efficient fuel consumption. It counteracts the intended effect of price increases; price increases do not translate into greater supply nor do they result in demand reductions. Conservation and demand reduction programs require a setting where direct responses to price changes can occur. Thus major initiatives are required to increase the availability of petroleum, keep prices high and reform the allocation system.

- Over the longer term, development programs in the transport sector will impact the petroleum situation. Currently more than half of all petroleum products are consumed in the transport sector. This proportion will increase if programs favoring fuel inefficient (road) transport links over fuel efficient ones (rail and river) are pursued. Similarly, thermal generation programs for the electricity sector exacerbate foreign exchange requirements.

- The development of petroleum and natural gas reserves in Sudan are expected to ease the situation. Sudan expects to begin exporting about 50,000 barrels per day by 1986, generating some \$150-200 million worth of foreign exchange per year. These revenues will improve conditions significantly for the petroleum sector and the economy as a whole. However, the impact of the improvement will be minimal without importation and distribution reforms and policy changes.

o Electricity

- The electricity system has been steadily deteriorating since the mid-1970's. Since 1981, Khartoum has not experienced a week without a significant power loss, whether caused by generation, transmission or distribution system failure. Over this period, economic losses due to power shortages and voltage fluctuations have been enormous. The problems result from the following inadequacies:

- The level of investment in the NEC system has been inadequate, particularly in the distribution system and in equipment maintenance. This is tied to the reluctance of senior Government of Sudan officials to impose the higher electricity prices that additional investment implies, which in turn is tied to a lack of appreciation on their part of the economic benefits that would accrue from such investment;

- The NEC lacks clearly defined objectives and measurable performance standards for the system it

manages. The concept of managing the total system -- planning, financing, constructing, maintaining, billing, manpower development, etc. -- to serve a known pattern of electricity demand with a selected level of reliability is poorly comprehended. Tied to this are the pervasive public sector problems of poor terms of service and consequent underqualified personnel, over-employment, uncoordinated and shortsighted development projects and political limitations on the authority of top NEC management to reform the system.

-- The electricity system has been developed by the availability of foreign concessionary loans and piecemeal grants to a standard of performance far below that which is desirable from a macroeconomic perspective. Little thought or effort has been devoted to improving system performance using local resources.

- For the short term, prospects are good. Organizational changes and improvements are already underway at the NEC. Coupled with improvements in metering, billing and collection procedures, recent electricity tariff increases should improve NEC finances (though the new tariffs are still below the long run marginal cost of electricity) and help to discipline consumption habits. The generation and transmission systems are also being upgraded to a level that should be sufficient for 2-3 years -- assuming that fuel oil for power plants is available -- while distribution system failures apparently will continue to cause frequent local outages.

- Longer term prospects are uncertain. As presently formulated the Power 4 Project is an extension of Power 2 and 3 projects; it includes gas turbines, mobil generators, transformers and other items that are not covered under Power 2 or 3. The Government of Sudan views Power 4 as the largest single package of foreign assistance to the electricity sector. However, the program is not comprehensive, increases dependence on petroleum and exacerbates the foreign exchange problem.

-- The electricity sector does not use domestic resources. Underdeveloped domestic resources include the private sector, for capital, expertise and production of simple system components, such as transformers; several run-of-the-river hydro-power sites (where according to a new Swedish study, baseload electricity can be generated and delivered to Khartoum for about one half the cost of Power 4 thermal generation); and domestic crude from the new pipeline or small oil fields, usable in several configurations at relatively low opportunity cost.

-- The failure to coordinate electricity and economic development planning and develop domestic resources to a greater extent are partly responsible for Sudan's poor economic performance over the past 10 years. Improved performance of the electricity system and also of the economy as a whole depend on recognition by the government of Sudan and donor thinking to coordinate development of the electricity system in a comprehensive way and not in a piecemeal way of assembling project packages.

o Fuelwood

- Large scale land clearing for agriculture, unregulated and inefficient charcoal production, overgrazing, uncontrolled burning, climatic change -- these have accelerated deforestation and desertification, undermined the resource base for the rural economy and driven many people from their traditional homes to shanty towns ringing Khartoum, El Obeid and other urban areas. As urban populations grow, reliance on charcoal increases, thus accelerating the rate of forest "mining" or exploitation. As the resource base contracts and recedes from population centers -- increasing transport costs and gasoil consumption -- fuelwood (charcoal and firewood) supplies shrink and prices rise, placing a greater burden on rural and low income urban consumers.

- The fuelwood problem in Sudan is further compounded by the failure of two major parts of the Ministry of Agriculture -- the Agriculture and Forestry Departments -- to coordinate resource management and development activities. In fact, these two sectors more often work at cross purposes -- agriculturalists pushing for additional clearfelling to open up more lands for production, and foresters calling for banning tree cutting and the formation of larger forest reserves.

- Several approaches offer hope of slowing and possibly reversing deforestation. First, LPG and kerosene can be substituted for fuelwood for home cooking in selected locations. Though the foreign exchange cost of this is high, this may be the cheapest solution for

population concentrations far from fuelwood producing areas, such as Atbara. Second, the development and adoption of improved, energy efficient technology in fuelwood production and consumption translates into a reduced rate of treefelling. Finally, and most important, is integrated land use management -- integrating agriculture and forestry.

IV. PROJECT EVALUATION

A. GENERAL PROJECT EFFECTIVENESS AND IMPACT

1. Conformity with Objectives

Generally all the project objectives as expressed in the preliminary project analysis, the U.S.-Sudan Agreement, the PIO/T and the ISTI/EDI contract have been met. The main emphasis of the project as indicated in these guiding references were primarily information development -- conduct of a national energy assessment, and secondarily institutional development. Soon after work started, it became increasingly apparent that significantly more emphasis should be given to institution building than originally contemplated.

When the project started, NEA existed in name only, energy data was non-existent, policy issues were not addressed. The project responded to Government of Sudan needs by providing technical assistance in all aspects of energy planning, and in strengthening the petroleum and electricity sectors.

To the extent that project objectives were to organize data, build an institution, provide policy support and develop an energy strategy, these have been met. The project:

- o Organized energy data -- the National Energy Assessment includes the first data base; NEA is continuing to build data; other agencies including the World Bank now refer to NEA as a recognized source of energy information;
- o Built an institution -- NEA has been built completely within this project; it is now a functioning organization with demonstrated capability and output and some policy influence;

- o Provided policy analysis -- petroleum and electricity investment and pricing decisions have been influenced as a result of this project; the project provided guidance for policy development and planning.

- o Provided the basis for an energy strategy -- this fall the Minister of Energy and Mining will present Sudan's first comprehensive energy plan to the National Assembly, the Council of Ministers and the President. The plan will propose policies, programs, and investment strategies to tackle the nation's pressing short and long term energy problems.

The project has been a collaborative effort as a result of a conscious project effort on the part of project resident staff. Throughout the term of the project and particularly since the inception of the National Energy Plan effort, the project team considered that the process of planning, i.e., developing indigenous knowledge and expertise, applying it in pursuit of a goal and involving many parties to build a consensus is as important as the final product.

The assessment process began with the start of this project and was completed by early 1983. The Assessment established a data base and a clear understanding of energy issues. The planning process began in May 1983 and is expected to be completed by the summer of 1984. The Plan will present a set of policies and programs to develop each domestic energy resource according to its potential, within the context of overall development objectives. It will elaborate preconditions for success in energy management and conservation, i.e., ensuring adequate investment in energy supplies, and pricing petroleum and electricity at or near their economic cost. The National Energy Plan builds on the National Energy Assessment documents and working relationships that have been developed over the three year course of this project.

The project has been influential in effecting energy policy changes in pricing, allocation, investment, and demand management strategies. For example:

- o Petroleum prices -- currently there are no overall subsidies but there are crossfuel subsidies, i.e., gasoline and jet fuel are above world prices, distillates used for heating and industry are subsidized. Overall lack of subsidy is the result of project emphasis.
- o Electricity prices -- current tariffs cover operating costs. The first phase of a two-phase program for sharp rate increases has been implemented. NEC cannot raise its own cash and the Government owns its capital as an investor receiving an 8% return. Thus NEC has no operating subsidies but still has a capital subsidy. Reduced subsidies is the result of project emphasis. Efforts to improve maintenance and efficiency of operations are also the result of project emphasis.
- o Petroleum allocation -- proposed creation of a new "Petroleum Facility" with financial inputs from AID, private petroleum companies, Saudi Arabia and GOS to improve efficiency in petroleum distribution from purchasing from international sources, to allocation, to final delivery is the result of project analysis.
- o Electricity investment -- electricity investments have traditionally been viewed by both the World Bank and NEC as a series of uncoordinated projects and emphasized new thermal plants which exacerbated foreign exchange problems and allowed further deterioration of existing systems. The project was instrumental in obtaining more than \$20 million in CIP funds for transmission upgrading to save the present system.

- o Efficiency improvement -- the project was influential in pressing for efficiency improvement everywhere (GPC, NEC, agriculture, industry, municipal government) by demonstrating the impact of poor performance on the economy. New traffic rules in Khartoum resulting in energy conservation are the result of project analysis.

- o Petroleum investment -- the project influenced decision not to invest in a Kosti Refinery; it analyzed various alternatives to move oil from production locations to consumption locations, and influenced decisions for petroleum extraction investments, pipeline routing, rail tank car purchases. If the new Petroleum Facility concept develops, petroleum companies, AID, and Saudi Arabia will make direct investments.

2. Perceptions by GOS

The leadership of NEA and MEM (MEM Minister, Undersecretary, former NEA Director General and current acting Director General) view this project as a great success. They evaluate the project on broad grounds and summarize the contribution of the project and implicitly the performance of the contractor as follows:

- o When NEA started it had "ideas", "objectives" and a handful of experienced people; the project helped organize NEA, develop its capabilities and build it to a viable, respected institution;

- o The National Energy Assessment was the first unified look at energy problems in Sudan;

- o The project caused the first examination of the linkage of energy and economic development of the country;

- o The project caused coordination of GPC and NEC investments (GPC asphalt plant with NEC thermal plant) and coordination of output (GPC production feeding Power IV generating stations);
- o The project instilled the concepts of a free market economy and influenced pricing decisions for electricity and petroleum products;
- o The project provided an opportunity for all actors in the energy sector and those impacted by energy shortages to express their views openly and constructively; the project created a forum to identify issues and rationally discuss issues;
- o The project opened up financial resources which have significantly aided Sudan -- CIP for NEC, World Bank for Power IV, AID and Saudi funds for petroleum;
- o The project became a conduit for training, expanding the horizons of technically trained staff such as engineers and economists;
- o The project identified commercialization opportunities in non-commercial fuels and brought forth the importance of renewable resources in the energy sector;
- o The contractor, with minor exceptions, performed admirably. The contractor has been instrumental in accomplishing all of the above items; at the beginning of the project the contractor shouldered all the burden of the project from data collection to analysis to advice to the Minister; towards the end of the project the contractor has provided more technical assistance, as expected, and less "hands on" work; and

- o The GOS wants to build up NEA to really shoulder planning for all energy activities; because NEA is young and new and because NEC and GPC have their own planning capabilities some resistance exists in allowing NEA to take initiatives; however, the NEA will win the trust of all concerned to coordinate energy policy and planning and eventually will succeed in its mission; the NEA is determined to continue its mission when AID support ceases.

Lower level staff also are highly supportive of the project and the performance of the contractor as summarized above.

B. INSTITUTIONAL IMPACTS

1. Institutional Development

The SEPAP project virtually created all of NEA's capability in energy analysis, planning and policy development. NEA is now a functioning institution with resources (staff, consultants, data base, computers, library) and a domain. It aspires to be the "think tank" of MEM -- in the model of Brookhaven or Argonne National Laboratories in the U.S.

NEA's charter conflicts somewhat with interests at GPC, NEC, REI, NRC and Ministry of Planning and Finance. NEA was in fact created precisely to integrate these interests, to provide a global view in energy policy and development as these individual agencies repeatedly demonstrated a narrow view in the planning and policy initiatives. For example:

- o GPC's pricing, allocation and investment policies are not viewed from a total national benefits and costs point of view;

- o NEC's pricing and investment policies would have disastrous foreign exchange implications;
- o REI's renewables projects are not coordinated with other projects;
- o The Ministry of Planning and Finance does not have the in-depth knowledge to assess the costs and benefits of energy strategies.

There are bureaucratic rivalries among the above agencies and accepting NEA as an equal or policy influencing body is difficult. This is why strong leadership at NEA is necessary and strong support by AID such as with the SEPAP and EPM projects is important. This support legitimizes NEA and gives it the aura of competence and connections.

The three undisputed areas of operation granted to NEA by its competitors are:

- o Development and analysis of energy "data";
- o Analysis of "global" energy problems, e.g., not of petroleum, not of electricity, but, say, analysis of the impact of combined petroleum and electricity projects; and
- o "Packaging" project proposals because NEA knows the "language" and "requirements" of foreign donors and knows how to process such proposals.

In conducting the National Energy Assessment and the National Energy Plan, the NEA formed committees (Agriculture, Industry, Technoeconomic Options, Implementation, and so on) which are made up and even chaired

by representatives from other entities involved in energy and economic development planning (NEC, GPC, Ministry of Agriculture, Ministry of Planning and Finance, and so on). The NEA performs staff functions for these committees. Through these committees consensus is reached and the resulting energy policies and programs thus should reflect coordinated action.

The project has been instrumental in creating interagency linkages and coordination. However, because the project has brought along a philosophical point of view, some tensions have developed. The project has advocated relentlessly utilization of the price mechanism for the allocation of scarce resources. The argument is made that the efficient use of energy resources will maximize economic benefits and enhance the opportunities for economic development. The argument is also made that investment (in facilities and human capital) must be made which must be paid for. Lastly supplies must increase which also need to be paid for. In short, the philosophical views of the project are: increased investment, increased supply, efficient operations, and economic pricing. The project promotes the idea of "you get what you pay for." Not everyone in Sudan agrees or understands this philosophical view. In particular some at GPC and NEC consider the roles of these organizations to be "public service." The project unequivocally promotes separation of energy distribution from welfare considerations (although it has advocated "lifeline" electricity tariffs). Further, project analyses have identified significant financial losses resulting from petroleum purchasing inefficiencies, thus tensions develop.

We believe the NEA will need continued support from AID to strengthen it. The EPM project will provide the necessary support. Project support enhances NEA's analytical capability and brings in a positive influence in objective thinking.

2. Personnel and Facilities

The number of professional staff at NEA as of February 1984 was 58. All of the professional staff have degrees, most in engineering and scientific disciplines. Some 40 of the 58 graduates (about two thirds) have been or are associated with some foreign training. Most of the staff is young without any prior work experience, that is, most of the staff have come to NEA directly from the university. About one third of the staff has had prior work experience. Table 6 shows the roster of NEA and its qualifications.

Being part of MEM, NEA is a central government unit and its organizational and salary structures are subject to civil service regulations. This is a major constraint for NEA's development because it hinders attracting the best talent. Government corporations, such as GPC and NEC, and institutes, such as REI and NRC have higher salary schedules and better benefits than civil service. Thus they tend to attract the best talent. In fact, making NEA an institute or a government corporation is a popular suggestion entertained at every level of the NEA and the Minister's office. Initiatives to make NEA a non-civil service agency have been tried and did not come to fruition because of resistance from existing agencies such as GPC and NRC.

When staff are seconded from other agencies to NEA, they retain the benefits of the "home" agency. As all non-civil service agencies have better compensation and benefits schemes than civil service, an anomalous situation is created of wide disparity among or between ranks. For example, a staff member who came from GPC may be reporting to an NEA section leader who rose through civil service ranks, and have a total compensation significantly better than his administrative superior.

LIST OF NEA PROFESSIONAL STAFF AND QUALIFICATIONS

	<u>Degree(s)</u>	<u>Year</u>	<u>Subject</u>	<u>Country of Study</u>	<u>Length of Time at NEA * (Years)</u>
<u>NATIONAL ENERGY ADMINISTRATION</u>					
Ismail Abdel Rahim Gizouli	BSc	1971	Mathematics and Physics	Sudan	3.00
	MSc	1979	Statistics and Operational Research	UK	
<u>COMMERCIAL ENERGY DIVISION</u>					
Ahmed El Zein El Hassan	BSc				
	MSc	1983	Energy Modeling	USA	
<u>PETROLEUM SECTION</u>					
Hassan Beshir Nimir	BSc	1978	Chemical Engineering	Iraq	2.00
Ibrahim Adam Hussein	BSc	1980	Chemical Engineering	Romania	3.25
Sherif Osman Abdel Rahman	BSc	1981	Petrochemical Engineering	USSR	2.25
Nageeb Mukhtar Mohd	MSc	1981	Petrochemical Engineering	USSR	2.50
<u>RESOURCE SECTION</u>					
Abdu Bakr Mahgoub	BSc	1977	Petroleum Engineering	Yugoslavia	2.00
	MSc	1981	Chemical Engineering	Yugoslavia	
Ahmed Khalid Hamed Ali	BSc	1981	Geology	Saudi Arabia	2.25
Osama Mohd Osama	BSc	1982	Geology	Iraq	0.75
Ahmed Zackaria Ahmed	BSc	1978	Physical Mathematics	Sudan	2.50
<u>CONSERVATION SECTION</u>					
Fatima Ibrahim Aniss	BSc	1980	Chemical Engineering	Sudan	3.00
	MSc	1983	Energy Resources	USA	
Abdallah Mohd Abdallah	BSc	1982	Mechanical Engineering	UK	0.50
Balgis Soliman Abdel Godir	BSc	1980	Agriculture	Sudan	3.50
Fatin Ali Mohd Adam	BSc	1980	Agriculture	Sudan	2.75
Maha Ali El Sayed El Faki	BSc	1981	Chemical Engineering	Sudan	2.00
Mahmoud Mohd Rashad	BSc	1980	Mechanical Engineering	Egypt	3.00
<u>ELECTRICITY SECTION</u>					
Mussad Abdallah	BSc	1975	Mechanical Engineering	Sudan	

TABLE 6
(Continued)

	<u>Degree(s)</u>	<u>Year</u>	<u>Subject</u>	<u>Country of Study</u>	<u>Length of Time at NEA (Years)</u>
<u>RENEWABLE ENERGY DIVISION</u>					
Abdel Halim	BSc	1969	Chemical Engineering	Sudan	2.00
<u>BIOMASS SECTION</u>					
Ali Abdel Karim Abdallah	BSc	1977	Agricultural Biochemistry	Sudan	3.00
Bakri Osman Hamad	BSc	1979	Mechanical Engineering	Sudan	3.50
Abdallah Abdel Mutaal	BSc	1980	Agriculture	Sudan	3.25
Kawther Ahmed Medeni	BSc	1982	Chemistry & Zoology	Sudan	0.75
Ali Ahmed Osman	BSc	1981	Forestry	Sudan	2.50
Igbal El Sadig Mohd Ahmed	BSc	1980	Forestry	Sudan	3.50
Taj El Din Hassan Mohd	BSc	1979	Forestry & Wood Technology	Egypt	3.00
<u>WIND AND SOLAR SECTION</u>					
Abdel Salaam Ahmed A. Halim	BSc	1975	Agriculture	Sudan	3.25
	MSc	1980	Forestry	Sudan	
Ekhlas Gasim Sheikh Mohd	BSc	1980	Chemistry & Zoology	Sudan	1.50
Ahmed Osman Ahmed	BSc	1981	Mechanical Engineering		1.75
Abdel Moneim Mohd A. Razig	BSc	1981	Mechanical Engineering	USSR	2.00
Abdel Axim Mohd Ali	BSc	1981	Physics & Mathematics	USSR	2.50

* At end of February, 1984.

An interesting example is the case of Dr. Shulli and Mr. Gizouli -- the previous Director General of NEA (and current Chairman of the NEP Committee) and the acting Director General of the NEA respectively. Dr. Shulli and Mr. Gizouli joined the government on the same day in 1970 but in two different offices of the Ministry of Commerce. The Petroleum Office of the Ministry of Commerce eventually grew to become the GPC. Dr. Shulli who had joined the Petroleum Office stayed with the GPC while Mr. Gizouli who had joined the Planning Department of the Ministry of Commerce stayed with the central government. GPC eventually acquired Total (a private sector petroleum company) and Dr. Shulli was appointed to a job at Total. Both Dr. Shulli and Mr. Gizouli are now government level 5 (akin to the U.S. GS level, the highest being 1 -- Dr. Mukhtar the Undersecretary of MEM is at level 1, most of the NEA staff are at level 9), but the route by which they arrived at this level is the key to their total compensation. Dr. Shulli continues to receive the Total package (which is even better than GPC) while Mr. Gizouli's total compensation (i.e., including all benefits) is controlled by the civil service schedule. On a financial basis (i.e., considering only cash compensation) Dr. Shulli's compensation is several times that of Mr. Gizouli's; on an economic basis (i.e., considering the value of benefits such as housing, cars, travel, guards, servants, entertainment allowances, clothing allowances) it is more than five times that of Mr. Gizouli's.

The attraction of NEA to Sudanese professionals is two-fold: (a) opportunity of foreign training and travel (which has a high social and educational value and has high leverage for career development) and (b) intellectual and professional challenge -- an opportunity to be exposed to broad national and important issues and be able to make some contribution. Thus, NEA jobs provide "psychic" income and provide great learning experience which are major inducements for young professionals, but there are limits to how far these inducements can carry more experienced staff.

We believe the NEA will need foreign support for a long time to come. However, such support will be less and less "hand-holding," and more and more true technical assistance. The demonstration effect of such technical assistance is most important for continuing to strengthen the institution. Thus the quality of project staff providing the technical assistance is the critical element in EPM and any other follow-on projects.

While NEA aspires to be a professional organization it does not maintain a work environment conducive to such aspirations. The physical facilities are appalling and they do not radiate inspiration. There are offices with three people in them sitting conversing, without a single piece of paper in evidence to indicate any work being conducted; some sleep at their desks. By contrast the physical environment of both GPC and NEC are far more businesslike and reflect a professional environment.

Some of the Sudanese habits seem to have rubbed off on the project facilities. The project office appeared woefully inadequate in terms of space and privacy and it's a wonder any work is accomplished. We suggested while in Sudan to maintain two project offices: one outside the NEA maintained in the best American standards and one at NEA maintained as best as possible. The NEA office should be used on a very regular schedule, say 12-14:30, and the outside office continuously. The two-office concept will serve the purposes of efficiency, demonstration effect and "lengthening the apron strings" which appears to be desired by NEA staff and the MEM Minister.

AID should consider providing some funds to improve the physical facilities of NEA. This will add to the attractiveness of the institution and will help it survive and improve.

C. DATA COLLECTION AND PRESENTATION

Virtually all energy data for Sudan has been compiled under this project. The Assessment presents the first consistent energy use and supply data available in Sudan. The following data have been compiled for a base year (1980):

- o Energy Use by Consumption Sector
 - Households
 - Biomass resources
 - Kerosene and gasoil
 - Electricity
 - Agriculture: Irrigation, Mechanized Agriculture
 - Electricity
 - Gasoil
 - Fuel oil
 - Industry: Textiles, Cement, Sugar, Oil and Soap, Brickmaking, Batteries, Miscellaneous
 - Kerosene and LPG,
 - Gasoil
 - Diesel
 - Furnace oil
 - Wood
 - Crop residues
 - Purchased electricity
 - Generated electricity
 - Transportation: Road, Rail, Pipeline, River
 - Gasoil
 - Benzene
 - Commercial, Government, Services: Petroleum Exploration, Road Building and Construction, Buildings, Eating Places and Laundries, Water Pumping, Street Lighting, Utilities
 - Gasoil
 - Purchased Electricity

- Generated Electricity
- Wood
- Charcoal
- o Energy Supply by Resource
 - Petroleum
 - Benzene
 - Kerosene
 - Gasoil
 - Residual
 - Electricity
 - NEC Power Systems
 - Self-Generation
 - Wood Fuel
 - Other Renewables

The above data are used for policy analysis and planning. For example, to support the National Energy Plan the 1980 base year data has been updated to a 1982 base year and forecasts made for 1995 and 2000.

The procedure used to estimate future energy demand is technically correct. Energy consumption is estimated on the basis of activity measures (e.g., passenger-miles) and technical use-coefficients (e.g., fleet efficiency, gallons per mile), not by direct projection of energy consumption. Thus energy consumption projections reflect level of projected or assumed economic activity and level of technological development in the use of energy consuming equipment.

While a great effort has been expended in compiling the data, systems and procedures for compiling, processing, storing and presenting the data are lacking. Attempts have been made to install "information systems" but this area appears to be the least well developed in the project. The two memoranda produced for this work (Information

Systems, January 1983, and Sudan Petroleum Information System: Requirements, Design and Implementation, November 1983) appear academic and off the mark. As of February 1984, the NEA was proceeding to identify information requirements, tabulation, codes and data processing methods. Implementation of an information system appears to have been delayed by delays in setting up the computer center.

Development of Quarterly Energy Profiles is similarly lacking. It is unlikely that NEA staff will be able to evolve an information system and regularly publish the Quarterly Energy Profiles without expatriate support. We recommend that information systems development (along with computer center upgrading) be considered a priority area of activity under the EPM project.

The energy forecasting procedure should be computerized under the EPM project. Also, the procedure should be improved to accommodate price elasticities, interfuel substitution and technological innovation.

Another area for improvement under the EPM project is the presentation quality of project reports. In general, SEPAP project reports are good in substance but not particularly attractive in presentation. Most of the reports have been typed in Sudan and considering the production difficulties little criticism should be leveled. Nevertheless, tabular and graphic presentation can certainly improve. Emphasis in quality of report output is an important aspect of institution building. Thus while the SEPAP project understandably had to emphasize substance and sacrifice if necessary on appearance in order to cover the immense scope of work, the EPM project should emphasize both substance and presentation.

The SEPAP reports produced under committee supervision are observably inferior to reports produced under direct SEPAP supervision. Again, under the EPM project, assistance should be provided to NEA in presenting their findings and recommendations even when the work receives little substantive project support.

D. CONTRACTOR PERFORMANCE

The performance of the contractor is exemplary. In general ISTI/EDI provided personnel with appropriate professional caliber and background who worked effectively in the Sudanese environment. The success of this project rests squarely on the extraordinary capabilities of Mr. Sanford Hale, President of EDI and Messrs. Bess and Cough the senior project resident analysts in Sudan. Equally, the success also rests on the foresight, persistence and leadership of Dr. El Amin Mukhtar, Undersecretary of MEM and Dr. Shulli and Mr. Gizouli the Director General and Acting Director of NEA respectively.

The project resident staff coordinated all the project activities, identified energy issues and became the links with ISTI/EDI, AID, MEM, and all other energy and economic development efforts in Sudan. Their energy, commitment, and creativity inspired NEA professionals and the professional development of several NEA staff has been enhanced in no small degree by the leadership and encouragement of these resident project team members. The Project Director, Mr. Hale, provided overall leadership to the project, identified and engaged short-term project staff, reviewed all reports, and was the senior link with the Minister in Sudan and AID in Washington. His professionalism, and extensive knowledge kept the project on-track.

The record of short-term personnel is mixed. Personnel ranged from high-level, experienced corporate executives to graduate students. While all of the short-term personnel had appropriate technical qualifications for their assigned tasks, not all demonstrated the same commitment as the resident staff, not all were well prepared for their visit and not all exhibited good training or skills transfer capabilities. Messrs. Gene Harris and Peter Meier appear to be the most respected "star performers" of the project.

A common complaint by NEA technical staff is that short-term personnel generally "rushed" through their work leaving the NEA staff in a daze. Short term consultants particularly at the beginning of the project tended to come in to Sudan, collect data and leave, writing their reports abroad and not contributing to any know-how transfer.

Another complaint is that the schedule of the short-term personnel was poorly organized, so that NEA staff were not well prepared to take advantage of the visiting experts. ISTI/EDI recognized the above problems and attempted to correct them in the latter phase of the project. For example, consultant terms of reference are now prepared in advance, they are reasonably detailed and expectations are clearly stated. The schedule of the short-term staff and their scope of work as related to the overall objectives of the project are now discussed in advance with the NEA Director General.

In general, NEA staff voiced the following criticisms on operational grounds:

- o Short term consultants were not those specified in original proposal or even discussed with NEA; while in general short term consultants have been good some were inexperienced and the NEA staff experienced reverse knowledge transfer (i.e., expatriates with two years experience received more benefits from NEA staff with ten years experience, than the other way around);
- o The project did not provide any financial reporting to NEA, only to AID, thus NEA had no opportunity to influence the allocation of project resources;
- o The technical assistance services provided for petroleum and electricity were good; those for information systems, modeling and econometrics were poor;

- o Commodities (e.g., computers) provided under the project have been provided without adequate consultation with NEA, again precluding NEA from participating in project resource allocation decision; and

- o The project made ineffective use of local funds -- residents' vehicles had to be acquired with local currency and English classes from U.S. Embassy resources were dictated.*

The performance of this project can be characterized as laden with enthusiasm and energy. The scope of work was enormous and the contractor attempted to meet the contractual obligations as well as possible. The contractor received little guidance from the Energy Officer at AID/Khartoum (primarily because the position was vacant much of the time) and AID/Washington (contact between EDI/Washington and AID Energy Office was maintained, however it is virtually impossible to direct a Sudan Project from Washington). The burden of performance as well as evaluation was carried by EDI.

Communications between U.S. and GOS participants was good. There were no linguistic or cultural problems. The NEA leadership welcomed the participation of project staff in NEA committees and policy deliberations have indicated that project participants provide a positive influence.

* Vehicles were rented, as project budget did not include vehicles, and project began before service for the required U.S.-made vehicles was available in Sudan. The SEPAP project had no involvement in English classes; this was an arrangement between NEA and AID/Khartoum and USIA/Khartoum.

The project staff has been responsive to the needs and requirements of AID/Washington and AID/Khartoum, so much so that doubts may be raised at NEA or MEM as to the motives of technical assistance. ISTI/EDI has acted as the analytical arm of AID/Khartoum to support AID policy initiatives such as pricing of energy products, development of petroleum and renewable resources and development of the private sector.

A recent experience illustrates the point. AID/Khartoum recommended a management review of NEC by a particular consultant. EDI agreed to conduct this review within the context of the project. While a management review of NEC undoubtedly would be beneficial, the NEA felt that expenditure of project funds for such a task would not be necessary at this time. The NEA requested a justification and while normally EDI's project assignments would not be challenged, this assignment has now become somewhat of a problem.

It should be expected that NEA will demand more say in the management of the EPM project. Accordingly, the EPM project should be managed more "tightly" than the SEPAP project. More emphasis should be placed on project management, schedules, knowledge transfer and quality of the output than applied until now. The SEPAP project concentrated on breadth; the EPM project should be more focused.

E. COMPUTER HARDWARE AND SOFTWARE

A computer center has been established recently and includes two micro-computers -- an IBM PC and a Hyperion. These are prized possessions at NEA. The staff is enthusiastic about the center and interested in computer applications. As of last February the the IBM PC was being used primarily as a word processor; the Hyperion as a technical computer.

The computers are not fully compatible with each other. Basic software of IBM could not be run on the Hyperion. Similarly, some disks produced on one computer could not be used on the other. The IBM PC is compatible with GPC equipment. The decision for the Hyperion is surprising. Service for IBM exists in Khartoum, but one may have to wait as long as a year for spare parts. Service for Hyperion is not available. (Project machines have so far been successfully repaired by bringing in parts from the U.S. and working with a local electronics technician who has relevant repair capability.) The Hyperion is slightly less expensive than the IBM PC on an initial cost basis, but the savings are false savings considering service and compatibility problems.

The NEA staff complained that an evaluation of computer requirements was not performed and that the computers purchased under the project were purchased arbitrarily without regard to NEA needs. Project specialists did actually consider NEA needs and arrived at the most cost-effective configuration according to their judgment.

We support the decision to purchase IBM PC's on grounds that they are likely to have the best support and software for NEA's needs. We recognize the opportunity for some savings by using less expensive IBM compatible equipment, but the Hyperion is the least compatible computer -- the COMPAQ is the most compatible. The April 1984 PC World indicates the following comparison for IBM compatible personal computers (PC's):

"Compatibility is a relative term. There are only a few machines that use almost all of the PC's software and expansion boards. As you move from one level of compatibility to the next, a compatible generally resembles the PC less and less in terms of its CPU, keyboard, graphics generation, and the expansion hardware it will accept. All compatibles, however, should be able to read and/or write to PC data disks.

99 44/100% System Compatible Machines

The compatible is nearly identical to the PC in all respects. The machine will run almost all PC-specific software, use the 8088 microprocessor, and accept most PC expansion boards. The compatibles at this level are:

Colby PC	Sperry PC
Columbia VP	Tava PC
COMPAQ-Plus	TeleVideo TPC-II
Electro Design IMP-12	Visual Computer

COMPAQ-Plus

When the COMPAQ first arrived in 1982 it set an industry standard for PC compatible machines that has rarely been matched. Another standard has likely been set with the release of the COMPAQ-Plus, a 10-megabyte hard disk version of the machine. Aside from the hard disk drive (which replaces one floppy in the machine), the COMPAQ and the COMPAQ-Plus are nearly hardware identical. Upgrading a COMPAQ to a COMPAQ-Plus requires the hard disk drive and its controller board and several ROM chips. The only test software the COMPAQ-Plus did not run was Xenocopy. List price: COMPAQ-Plus \$4,995, upgrade kit \$2,500. COMPAQ Computer Corporation, 12330 Perry Road, Houston, Texas 77070.

33% System Compatible Machines

The machine is relatively compatible and uses some PC software but few if any expansion boards. The system may have difficulty running programs such as Flight Simulator that make extensive calls to its BIOS ROM. The compatible may use the 8086 or 80186 microprocessor and feature a non-IBM-style keyboard. The compatibles at this level are:

Hyperion
MAD-1
Stearns Desktop

Hyperion

The Hyperion is a small, sturdily built compatible that has been on the market (in one form or another) for well over a year. The company's claim that 'IBM invented the wheel, so we refined it' falls a little flat. While the Hyperion is very easy to cart around, it is not as compatible as the company claims. The Hyperion has a number of useful features: a RAM disk, an IBM-style keyboard, a high-resolution monochrome display that is timed to turn off to protect the video components, and a built-in 300 bps modem. The system can drive a 10- or 20-megabyte disk and run a streaming tape drive. An expansion chassis with seven PC compatible slots is also available. The Hyperion has difficulty running most standard PC software -- at least under PC-DOS. Company literature claims that the Hyperion, from its "MS-DOS operating system to its internal electronic architecture," is PC compatible. Elsewhere the literature says that the machine can read and write to PC disks. But most of the software tested on the Hyperion did not run. PC-DOS 1.10 and 2.00 did, and WordStar got as far as the first menu, but the system would not read a data disk in drive B. GW BASIC samples ran, but other programs would not even boot. Attempting to run the programs under Hyperion's MS-DOS did not yeild better results. List price: \$3,195. Bytec-Comterm, Inc., 8 Colonnade Road, Ottawa, Ontario, K2E 7M6 Canada."

Some of the Hyperion difficulties described above have in fact been experienced at NEA.

The NEA computer center had the following software operational as of last February:

- o Lotus 1-2-3 (Lotus)
- o PFS File (Software Publishing)
- o Easy Writer (Information Unlimited Software)

- o Statistical Analysis Package (Microsoft, Spectrum Software or Alpha Computer Service)
- o Arabstar (became operational as of June 1984)

It is recommended that the EPM project consider enhancing the computer center a high priority activity. The center should have four PC's -- two IBM's and two COMPAQ's if service can be guaranteed. If service for COMPAQ's is not available, then all four computers should be IBM PC's.

It is recommended that the center acquire minimally the following additional standard software which are publicly available for IBM PC's at a cost of generally less than \$250 each:

- o Visicalc (Visicorp)
- o Wordstar (MicroPro)
- o DOS (IBM)
- o Fortran (Microsoft)
- o Mathematical Programming Package (Microvision)

NEA staff do not yet make good use of the computer facilities. Training in the use of PC's should be provided amply and all staff -- from the Director General to the secretaries -- should be encouraged to become conversant with the PC's. A strong computer center at NEA is a major enhancement of the institution. It will bolster the institution's image, strengthen its capability and give it a competitive advantage over GPC and NEC in attracting the best talent.

F. TRAINING

One of the major goals of SEPAP has been to train members of the professional staff of the National Energy Administration in energy planning and analysis techniques. During the first 18-24 months of the project, the Ministry of Energy and Mining placed considerable emphasis on the preparation of a National Energy Assessment report. ISTI/EDI relied primarily upon visiting consultants providing on-the-job training to fulfill their obligation to train recently hired NEA

staff members in energy planning and analysis techniques. The result was that during the first 18-24 months of the project training was given a lower priority than that of producing energy assessment reports, and such training that did take place became selective.

On-the-job training cannot be given to thirty or more NEA staff members by one consultant in the course of a three-week in-country work assignment. A small number of NEA staff members were selected to work as counterparts to each visiting consultant and to receive on-the-job training during his stay in Sudan. Those selected tended to be senior staff members, and to be re-selected as each new visitor arrived. A small number of staff, therefore, received most of the on-the-job training that was delivered by visiting consultants during the first 18-24 months of the project. The remainder of NEA's staff worked primarily as data gatherers, and received little training other than on how to use a questionnaire to collect data. How the data were to be analyzed and how the results of the analysis were to be used in the consultant's report were not discussed with those who had gathered that data. It is not surprising that many of these NEA staff members felt that their training had been neglected.

Despite these feelings, it is generally believed by NEA and the Minister of Energy and the Undersecretary that on-the-job training has been beneficial. A small group of NEA staff members have been exposed to a wide range of energy assessment techniques and have been sufficiently involved in the production of enough reports (a) to have a broad understanding of the issues faced by Sudan, and (b) to be currently leading NEA teams in the production of similar reports.

There have been a number of accomplishments in staff development, especially since AID and ISTI/EDI took over a defunct training program that had previously been run by the U.S. Department of Energy. Changes made by EDI in requiring visiting consultants to conduct classroom training sessions, in addition to providing on-the-job

training, ensured that there was an opportunity for all NEA staff members to learn - at the very least - what techniques were being used in conducting energy-related studies in Sudan.

1. In-country Training

Two types of in-country training have taken place - classroom training and on-the-job training - each having a separate purpose.

a. Classroom Training

During the period February 1981 through December 1983, ISTI/EDI either sponsored or delivered twenty-three separate units of training. Each unit was attended, on average, by twelve to fourteen NEA staff members. Between February and August, 1981, eleven units of training were delivered, each consisting of between one and three lectures of approximately two hours. These lectures were delivered by EDI resident staff and consultants, NEA senior staff, and members of local university faculties. This format changed in October 1981. Classroom training that was delivered after that date consisted of approximately three hours of lectures or discussions each day over a period of at least one week.

The overall purpose of classroom training was, at first, to provide a solid background in energy-related topics. After October 1981, the purpose became less broad. From that date, classroom training was provided by short-term consultants who were in Sudan to work on a specific energy-related task and to produce a report for NEA. This training was provided during the final two or three weeks of the consultant's visit. Its overall purpose was to provide a basic understanding of the work that was done by the consultant, and the reasons for doing it.

Table 7 shows the schedule of the structured training program and the NEA beneficiaries. (Precise records of who attended each training session do not exist for over one-half of the sessions. This table was constructed from a November 1983 questionnaire administered to all NEA staff.)

b. On-the-job Training

From the start of the project, visiting consultants who were working on specific tasks and producing reports for NEA worked with a small number of NEA counterparts, and provided on-the-job training for these staff members. The number of counterparts working with each visiting consultant was usually between two and five.

After October 1981, visiting consultants continued to provide on-the-job training for a few NEA staff members but, in addition, presented a short classroom training course to as many members of NEA's staff who might care to attend. (Prior to October, 1981 visiting consultants gave no formal classroom training.)

The overall purpose of on-the-job training has been, throughout the life of the project, to provide a specific set of technical skills that might be used in future assignments undertaken by NEA. In other words, the purpose was to ensure that a transfer of technology should take place.

c. Curriculum Materials

It is not possible to judge how appropriate curriculum materials and lectures were for topics that were covered during classroom lectures prior to October 1981. Course notes of Sudanese instructors are all that is available from most of these training sessions. However, because classroom training since October, 1981, and on-the-job

TABLE 7
(Continued)

NEA Staff Member by Unit	Energy Assessment Overview & Methodology 2/81	The Reference Energy System 3/81	Energy Demand Analysis and the Use of Generic Data 4/81	Petroleum Products Markets: The Western European Case 4/81	Petroleum Products Distribution 5/81	Introduction to Energy Issues 7/81	Petroleum Issues 7/81	Petroleum Distribution and Transport 7/81	Electricity Generation and Distribution 7/81	Renewable Energy 7/81	Reference Energy System Analysis 8/81	Electricity Supply Planning and Issues 6/81 and 10/81	Industrial Energy Audit Techniques 10-11/81	Renewable Energy Resources and Technology 11/81	Renewable Energy Resources and Technology 2/81	Computer Programming 4/81	Petroleum Economics and Allocation 4/81	Energy/Economic Analysis 5/81	Petroleum Products Distribution 10/81	Information Systems 3/81	Energy Costing and Pricing 4/81	Computer Operation and the
ECONOMIC PLANNING DIVISION																						
Ishag Adam Bashir																						
INFORMATION SECTION																						
Hour Abdel Mageed Idris																						
Abdel Moneim A-Gadir Mustafa	•					•	•			•			•		•	•					•	
Ibrahim Eissa Sobi	•		•		•										•	•					•	
El Sadig El Zubeir Mohd	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•					•	
Gaafar Ahmed Dafallah															•	•					•	
REGIONAL PLANNING SECTION																						
Mohd Fauz Mohd Ali																						•
Kawther Abdel Sadig Mohd															•			•	•		•	
Salah El Din Ali Mohd Nour				•	•	•	•	•	•	•	•	•	•	•	•		•	•			•	
Mariam Ahmed Nussa						•	•	•	•	•	•	•	•	•	•						•	•
COSTING & PRICING SECTION																						
Mohd Salik Farah													•		•		•	•	•	•	•	•
El Tayeb Ibrahim Sabeel																•					•	•
Gamal Osman Abu Bakr																						•
Hidar Daoud El Siddig																						
PLANNING & COORDINATION SECTION																						
Farah Abdel Mageed Farah																					•	
Mohammedein El Tigeni S. El Masr																					•	•
Safaa Ali Mutwali	•	•	•	•	•	•	•	•	•	•					•	•	•	•	•	•	•	•
PROJECT EVALUATION SECTION																						
Ismail Shams El Din El Shafi													•			•			•	•		
Suad Siddig Ahmed						•	•	•		•		•										
Kawther Abdel Gadir El Sherh	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•						

TABLE 7
(Continued)

NEA Staff Member by Unit	Energy Assessment Overview & Methodology	The Reference Energy System	Energy Demand Analysis and the Use of Generic Data	Petroleum Products Markets: The Western European Case	Petroleum Products Distribution	Introduction to Energy Issues	Petroleum Issues	Petroleum Distribution and Transport	Electricity Generation and Distribution	Renewable Energy	Reference Energy System Analysis	Electricity Supply Planning and Issues	Industrial Energy Audit Techniques	Renewable Energy Resources and Technology	Renewable Energy Resources and Technology	Computer Programming	Petroleum Economics and Allocation	Energy/Economic Analysis Petroleum Products Distribution	Information Systems	Energy Costing and Pricing	Computer Operation and the Energy System	
	2/81	3/81	4/81	4/81	5/81	7/81	7/81	7/81	7/81	7/81	8/81	6/81 and 10/81	10-11/81	11/81	2/82	4/82	4/82	5/82	10/82	3/83	4/83	5/83
RENEWABLE ENERGY DIVISION																						
Abdel Halim																						
BIOMASS SECTION																						
Ali Abdel Karim Abdallah						●	●	●	●	●	●				●							
Bakri Osman Hamad							●	●	●	●		●			●							
Abdallah Abdel Mutaal															●							
Kawther Ahmed Medeni															●							
Ali Ahmed Osman														●	●					●		
Igbal El Sadig Mohd Ahmed																						
Taj El Din Hassan Mohd																						
WIND AND SOLAR SECTION																						
Abdel Salaam Ahmed A. Halim																						
Ekhlis Gasim Sheikh Mohd																						
Ahmed Osman Ahmed																						
Abdel Moneim Mohd A. Razig															●							
Abdel Azim Hamd Ali													●	●	●						●	

training throughout the life of the project, has been conducted while consultants/instructors were producing reports on specific energy assessment or energy planning issues, it cannot be doubted that the curricula and such materials as were provided (frequently, only the final report) were appropriate for each topic. However, the degree to which topics (and, therefore, curricula and materials) were appropriate for the then-current training needs of NEA staff is difficult to judge, but we know that training topics were selected on the basis of the need for a specific report - not because of need for a particular set of skills had been identified in a group of staff members. However, staff skills that needed developing were closely related to work required to produce a report.

d. Critical Training Needs

In answer to a question on whether this policy (of selecting a topic for training on the basis of the need for a specific report) had met NEA's most critical short-term training needs, the Minister of Energy replied that, because when NEA was formed its staff members had no skills in energy assessment and energy planning, any training was valuable and therefore met short-term needs.

NEA considers it sufficient if no more than two or three of its staff members become proficient in any one energy planning or analysis technique. By relying entirely upon on-the-job training, therefore, to effect a transfer to a few staff members of the technology required to produce each of the energy-related reports, ISTI/EDI may be said to have met NEA's most critical short-term training needs. Long-term training requirements, however, call for a more structured approach to training.

ISTI/EDI has made a creditable start on defining the long-term training requirements of NEA and has produced an outline of a career development plan that lists training activities and course topics for an NEA staff member from his date of entry through his advancement up

the organization ladder to Section Head. At this time, the plan is in the discussion stage of its development, but since the training activities listed are identical to those already being provided for newly-joined staff members by some of NEA's sections (the Electricity Section has two trainees currently following a very similar program), discussion will most probably only focus upon course topics and where these training courses should be offered. The Management Development Institute in Khartoum has been asked to discuss how it can assist NEA in implementing a final training plan.

It is, perhaps, appropriate here to mention four training programs that were singled out by NEA (and by the Minister) for special praise. First is the on-the-job training provided by Mr. Constantin Salame while producing a report titled Renewable Energy Assessment for the Sudan - was regarded as an excellent example of how such training should be conducted. Not only did Mr. Salame accompany the NEA counterpart staff on their data-collection trips (most visiting consultants do not), but he also analyzed the data with the counterparts in their office (again, most short-term consultants do not do this). It was said of Mr. Salame's report that one could ask either of the NEA counterparts who worked on the study with him how any specific figure in the report was arrived at, and the counterpart could describe the data and the analytical process that produced the figure. Mr. Salame gave the same priority to training the NEA counterparts that he gave to producing an exemplary report, and the results of his training efforts were excellent.

The on-the-job training provided to a team of four NEA counterpart staff by Dr. Mark Gellerson was similarly praised, and classroom training courses conducted by Dr. Peter Meier and Mr. Donald McCoy were highly acclaimed by those whom we spoke to who had attended the programs.

2. Training Requirements for EPM Project

We have stressed the fact that training has taken a back seat, with the production of energy assessment reports taking first priority. While detrimental to individual staff development, this order of priorities has been necessary for the overall development of NEA as a recognized source of energy information for all branches of the Government of Sudan.

It has also been necessary, during this period, for ISTI/EDI residents and short-term consultants to perform a major share of the work in producing the energy assessment reports. But NEA does not wish to remain dependent upon expatriate consultants forever - nor does it intend to. NEA's wish, now, is to spend the next three years drawing slowly away from ISTI/EDI, reducing its dependence upon them for the performance of specific tasks, relying increasingly upon them only for advice and technical opinions. This calls for considerably increased abilities within NEA and, accordingly, for an increased emphasis upon staff development.

Training provided to NEA staff by ISTI/EDI during the period of the Energy Planning and Management (EPM) project just begun can be dramatically improved without any major changes in the methods currently used to train being made. The means by which this improvement may be accomplished include:

- o Increased emphasis on training, with the instructional objectives accompanying each task undertaken by a visiting consultant being clearly stated before the task begins.
- o Increased time being allotted to tasks undertaken by visiting consultants, to permit more time to be spent on on-the-job training.

- o Job descriptions being written for each position in NEA occupied by a professional staff member.
- o The training section of NEA being staffed by at least one person with professional training in staff development.

Recommended approaches to strengthen staff development in the EPM project are described below.

- o Although most letters of agreement with short-term consultants specifically mention assisting, advising and working with NEA counterparts to achieve specified outputs, ISTI/EDI should include in all such letters:
 - A statement emphasizing the requirement to train NEA counterpart staff. In the past, this has not been clearly stated and short-term consultants have arrived in Sudan without knowing that they will be expected to train NEA staff who work with them.
 - A description of the type of training that the consultant will be expected to deliver, e.g., on-the-job training or classroom training with field trips.
 - The requirement that outline notes (as a minimum) of the training delivered are to be provided to all class participants; and that at least one original copy, suitable for reproduction, of these notes is to be left with NEA's training department (which has been established recently) at the end of the consultant's visit.

- A brief description of the education and work experience of each NEA counterpart staff member who will work with the consultant during the field-work period of his visit; and a broad description of the education and work experience of the group of NEA staff who will attend the classroom training sessions that the consultant will conduct.

- A requirement for the consultant to submit a statement of the instructional objectives of his teaching before he arrives in Sudan. An instructional objective is the statement of the intent of the trainer in terms of skills that the trainee will be able to demonstrate, or in terms of facts, concepts, principles and rules that he will be able to apply, as a result of the training that is to be delivered.

The purpose of an instructional objective is to permit the value of the training to be discussed before it is delivered; to permit the trainer to keep the reason for conducting the program in focus throughout the period of training; and to inform the trainee what is expected of him at the end of the training period. For example, an instructional objective might state that each trainee will be able "to select suitable instruments for measuring temperature, pressure, furnace stack gas composition, and relative humidity; and to demonstrate the correct placement and use of those instruments in order to obtain accurate data during an energy audit of a textile plant, a sugar plant or a flour mill." With such an objective clearly stated, the trainer will ensure that each trainee has the opportunity to discuss the merits of each type of instrument available to him and to perform all the tasks necessary to place the

instruments and to obtain readings in each type of plant (textile, sugar, flour). Similarly, each trainee, knowing what is expected of him at the end of the training period, will ensure that he is given the opportunity to practice these skills during the program. A clear statement of instructional objectives is of paramount importance if training is to be uniformly successful.

- A requirement that the consultant should deliver a final report on the results of training that states the degree to which the instructional objectives have been achieved by each trainee.

- o Increased time - and, therefore, increased funds - should be made available for the performance of each task undertaken by a visiting consultant. Short visits force consultants to perform much of the analytical phases of their work and much of the report writing on their own - simply in order to get things done. Trainees, therefore, only minimally get involved in these phases of the work, and therefore understand little of what is being done or how conclusions are reached.

It takes twice as long (possibly three times as long) to perform a task while teaching local staff how to perform it as it does to perform the task alone. When a contractor has a fixed budget, this means that fewer tasks can be performed. This is the trade-off that must be made if the rate of staff development is to increase during the next three years. It is a trade-off that we believed NEA is prepared to accept.

- o A job description, that states clearly the specific tasks and responsibilities of a person occupying a particular job position, should be written for each job position in NEA.

NEA has some difficulty in identifying the functions a specific individual should be capable of performing. This is because there are no adequate job descriptions. One reason for this state of affairs is that when NEA was formed it took over the budget of an existing department - the General Petroleum Administration. All job positions in NEA officially carry the titles of job positions that were in the now-defunct General Petroleum Administration. Official job descriptions cannot, therefore, be written until the job titles are changed to correspond to the NEA job positions.

ISTI/EDI should take the lead in urging NEA to accept their assistance in writing "unofficial" job descriptions. We recognize that this has been done during the SEAPAP project, but job descriptions written at that time cover only the jobs of Division Heads and Section Heads. NEA needs job descriptions for junior professionals - and it needs those descriptions to be more specific than the ones that exist for senior professionals.

Written statements of specific tasks and responsibilities, accompanied by statements of qualifications and skill requirements, will prove to be of great assistance to NEA Division Heads and Section Heads in the selection of the right candidate for a training course, or the selection of the right team of counterparts to work with a visiting consultant. Job descriptions will also greatly assist the visiting consultant to plan the use of his team of counterparts, and to make sure that each member of the team acquires experience that is relevant to the requirements of his job.

Job descriptions are also essential to objective appraisal of a staff member's performance of his job. Progress report forms currently in use in NEA devote 50 percent of the points awarded to personal characteristics (attendance, initiative, cooperation, etc.) and 50 percent to an assessment of the way in which specific tasks have been performed. It is possible for a staff member to score very highly without having performed all aspects of his job during the period under review and, in fact, being incapable of performing part of his job. This can happen if one or two tasks have been performed extremely well and if the reviewer, in considering the period as a whole, overlooks the fact that other tasks have not been performed. A written list of specific tasks and responsibilities, on each of which the reviewer must make some comment, makes such an oversight less likely.

Since 70 percent of the points awarded to an individual by a Promotion Board are awarded for performance, as reported on the individual's latest progress report, the ability to ensure that performance is assessed on all the requirements of a job is especially important.

- o ISTI/EDI should help NEA to develop its human resource management capabilities - especially its ability to plan and manage staff development

At present there is no one staffing NEA's training department. Training plans have been developed and training programs have been managed by ISTI/EDI. Work should begin immediately on finding a suitable candidate for the position of Head of Training Section. (We understand that the Management Development Institute in Khartoum has offered to help NEA find a suitable candidate.) It is likely that any

- Manage the administrative activities of training records maintenance, training materials production, training facilities maintenance and program arrangements.
- Assist Division Heads to establish priorities for professional staff development.

By contrast, a supervisor of training activities may have some or all of the following specific responsibilities:

- Supervise the planning and scheduling of all training programs.
- Assist Division Heads and Section Heads to identify and quantify training needs.
- Evaluate the results of training programs.
- Monitor the preparation and presentation of training programs.
- Review and recommend training programs available from sources outside NEA.

3. Coordination With Other AID Training Programs

Three NEA staff members have returned, to date, from graduate (MSc) degree programs in the U.S. Two studied at the University of Pittsburgh and one studied at Texas A&M. Funds were provided by AID's Conventional Energy Training (CET) program which is administered by the Institute of International Education (ITE). Although not a part of SEPAP the CET program has had an important impact on the project, sponsoring participants in long-term (graduate) programs and short-term (non-degree) programs in the U.S.

Those NEA staff members who have completed graduate studies in the U.S. stated that certain skills they acquired in their U.S. training were immediately applicable (such as the approach to problem solving) and that other skills had not yet been applied (such as energy modeling) but would be used in the future. One staff member stated that all her studies in the U.S. were applicable to NEA work because she "can now understand anything to do with energy."

Of these recently-returned graduates, one is a division head, one an acting division head, and the third a section head. Undoubtedly, the training received in the U.S. has given these staff members greater maturity and greater confidence in their ability to set priorities, make decisions and direct the work of others. In Sudanese universities, students have little or no freedom of choice on courses that they will take, and do not question what they are told. Being exposed to the U.S. university system was at first a considerable shock (for which they felt they could have been better prepared), but the results have been to produce people who are capable of working on very nearly equal terms with visiting consultants.

G. SPECIAL STAFF STUDIES

Special studies for the benefit of the MEM Minister have been concentrated in the following areas: NEA organization, electricity issues and particularly prices, petroleum issues and particularly prices, and petroleum allocation. A senior project consultant (Gene Harris) spent almost the entire year of 1983 in Sudan on special assignments for the Minister.

In all cases the advice has been objective, consistent and unbiased. The advice reflected standard concepts of efficiency and economic principles. In most cases the Minister took action consistent with recommendations offered. Some examples are the following:

- o The NEA organizational structure reflects recommendations by Sandy Hale, Paul Cough and Gene Harris (project staff);

o Electricity and petroleum pricing issues have been repeatedly studied; the latest findings and recommendations by senior project consultant Mark Gellerson included the following:

- Importance of Price Mechanism

-- The benefits of setting fuel and electricity prices equal to economic supply costs are: (a) more efficient allocation; (b) lower rate of demand growth; (c) encouragement of alternative energy sources; and (d) the financial performance of NEC would be improved.

-- In addition to increasing fuel prices, every effort should be made to increase the fuel supply of reallocating foreign exchange from other sectors or allowing limited purchase of foreign exchange on the free market. Economic output will increase if both petroleum prices and supply are increased.

-- The efficient use of commercial energy is so critical to the health of the Sudanese economy that every effort should be made to avoid using petroleum pricing as a means of redistributing income.

- Electricity--NEC

-- Even after NEC tariffs are increased by the full amount planned, tariffs will be significantly less than the economic cost of supplying electricity. NEC should implement the second half of its proposed tariff increase and be prepared to impose regular increases thereafter in order to bring tariffs in line with supply costs. Tariffs should be constructed considering the market value of the Sudanese pound, which is significantly above LS1.3 = \$1.00.

-- Under old and new NEC tariffs, commercial, small farm and bulk consumers pay a decreasing block

tariff, while the NEC system is characterized by increasing marginal costs. Old and new NEC tariffs contain a fuel adjustment charge. This charge has never been put into effect. NEC should encourage and make available to at least large consumers the seasonal/time of day tariffs.

- Petroleum--GPC

- Prices of petroleum products should be in line with world prices. Petroleum prices should be set considering the market value of the Sudanese pound, which is significantly above LS1.3 = \$1.00.
- In theory, marketing companies supply products according to GPC's allocation plan. In practice, products which cannot be distributed due to transportation difficulties are reallocated elsewhere.
- Distribution margins for petroleum marketing companies are the same for all regions, while company expenses are higher in remote regions. This reduces the incentive to deliver petroleum products in remote regions.
- Local governments sometimes allow local dealers an extra margin, but this does not affect the incentive of the distribution company to deliver the product.
- Due to fuel and rail subsidies, the economic cost of fuel transportation to Khartoum is about double the financial cost (i.e., the rate actually charged).
- GPC should consider ways of increasing the distribution companies' incentive to supply products to remote regions. This can be done by allowing distribution margins to vary by region.
- A first round of electricity price increases have been implemented. The second round is pending.

Similarly gasoline price increases have been implemented. Removal of cross subsidies for all other petroleum fuels is pending. The Minister understands the value of the price mechanisms, but major policy differences have developed with GPC. The Minister ordered yet one more review of petroleum prices by the NEA, this time excluding any participation by project staff.

- o The petroleum allocation system has been studied and critiqued repeatedly; the latest round of advice came from Dennis Monaghan, senior project consultant and current resident project analyst for the EPM project; the importance of coordinating GPC, Bank of Sudan, Ministry of Finance, MEM and donor actions has been highlighted; the Minister supports the concept of providing petroleum to users that can self finance it (e.g., airlines, Chevron, export oriented agricultural schemes) outside the allocation system, but there are difficulties with GPC;
- o Findings by Dennis Monaghan and Mark Gellerson have led to the "Petroleum Facility" concept now under consideration; if implemented the chaotic petroleum situation will be eased; the concept reflects repeated advice on "economic" pricing, more supply and more participation by the private sector;
- o The Minister has been advised to take advantage of the private sector's operational distribution and marketing capabilities and expert knowledge of the international oil industry; consideration is being given to reorganization of the petroleum sector in the country along the following lines:

- Public sector -- policy control
 - Concessions;
 - Production and export levels targets;
 - Imports levels targets;
 - Government to government supply arrangements;
 - Ownership participation (50%) in existing refinery;
 - Pricing policy, regulations and taxes; and
 - Allocation policy (but implementation by private sector) and participation in public-private allocation committee.
- Private sector -- operational control
 - Oil exploration, development, production;
 - Pipeline and post facilities -- engineering, construction, operations management;
 - Refinery -- engineering, construction, operations management;
 - Marketing of crude oil exports;
 - Participation in public-private allocation committee;
 - Crude oil and product purchasing on commercial terms with foreign exchange obtained on the open market;
 - Implementation (administration) of petroleum allocation; and
 - Petroleum products, domestic marketing, distribution, transportation, storage and retail.

If the Petroleum Facility concept gets implemented the above guidelines will be implicitly adhered to.

- o The Minister was advised on the construction of a refinery at Kostî; the chosen pipeline routing and facilities investment reflect project recommendations.

H. LIBRARY

Although the shelves of the NEA library are reasonably full, there are few examples of reference books and periodicals. Most reference materials are reports produced by visiting consultants. Periodicals are sadly out of date. The most recent copy of Oil & Gas Journal is more than one year old. Subscriptions to other periodicals appear to have lapsed even earlier.

One reason for this is that hard currency, to pay for subscriptions, is difficult to obtain. However, a well-stocked library is more than an important resource for NEA staff who are actively engaged in the production of energy-planning reports. It also provides an essential ingredient in the professional development of all staff members, which is a process that cannot flourish in an environment that lacks access to the current literature.

The library is not used as often as one would expect -- probably because of the lack of reference materials. We recommend that this situation should be rectified by USAID making a cash grant to ISTI/EDI for the sole purpose of providing the library with periodicals and reference manuals that are judged to be pertinent to the work of NEA. The amount required is relatively small: a year's subscription to a weekly publication such as Oil & Gas Journal or The Economist is less than \$100. Five thousand dollars would provide a modest, but useful, collection of reference books and periodicals. Ten thousand would be better. This amount would ensure that the library has current literature in any energy-related field on its shelves for as long as subscriptions are in force. ISTI/EDI could ensure that subscriptions do not lapse within a year of their leaving Khartoum at the end of the EPM project by paying up all subscriptions to periodicals for three years immediately prior to their date of final departure.