Egypt-United States Cooperative Energy Assessment

Report on Preliminary Discussions

February 14-22, 1978
Cairo, Egypt

U.S. Department of Energy
Assistant Secretary for
International Affairs
Developing Countries Energy Program
Washington, DC 20545

April 1978

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FOREWORD

The Developing Countries Energy Program was established in 1977 in order to use the scientific, technical, planning and management expertise of the United States, in cooperation with other industrialized countries, to help developing countries meet their energy needs in a manner consistent with global resource, security and environmental concerns. The program is a cooperative venture among the U.S. Department's of State and Energy, and the Agency for International Development. Major goals of the program are to strengthen energy planning and analysis capabilities and the information base of developing countries; to encourage technologies drawing on indigenous (renewable) resources; to avoid premature commitment to high technologies; and to encourage decentralized, renewable-resource technologies for rural and community applications.

This report details the proceedings of meetings held in Cairo, Egypt from February 14 through February 22, 1978. The participants were officials of the governments of Egypt and the United States whose major concerns and responsibilities are in the field of energy. The topic of discussion was the Developing Countries Energy Program, and specifically, Egyptian-U.S. cooperation under the program. Agreement was reached to conduct a cooperative assessment of Egyptian energy development options, and the details of arranging this cooperation were arranged.

The immediate goal of the program in FY 78 is to demonstrate that the United States can, through collaborative efforts with developing countries, assist them in developing a set of credible energy strategies, using a systematic analytical approach. We feel that the amiable and productive preliminary discussions held in Cairo are a good first step in this direction.

The purpose of publishing the proceedings of the Cairo discussions is to inform members of the Interagency Advisory Group, other U.S. Government officials concerned with energy, and the citizens of the United States of the current status and outlook of the Developing Countries Energy Program.

A. N. Tardiff
Director, Developing Countries
Energy Program

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February 14-22, 1978

CAIRO, EGYPT

I. EXECUTIVE SUMMARY:

During the period February 1-22, 1978, discussions were held between representatives of the governments of the Arab Republic of Egypt and the United States. These talks resulted in an agreement to conduct a cooperative Egypt-U.S. assessment of the energy demand and supply options available to Egypt. This assessment will use a systematic methodology which relates data on the availability of energy resources to corresponding information on end-use demand sector requirements.

The assessment will provide Egyptian policy and planning officials with a tool to support decision making in energy development. While the breadth and depth of the assessment scope will necessarily be limited by data availability and time in this first year, the intent of the effort is to establish the capability in Egypt to use and further refine the methodology in the future. The Egyptian's agreed on the full cooperation of Egyptian government officials and experts, and plans were developed jointly for conducting the collaborative effort during the visit of the U.S. expert team beginning in mid-March, 1978.

EGYPT - UNITED STATES COOPERATIVE ENERGY ASSESSMENT

REPORT ON PRELIMINARY DISCUSSIONS

February 14-22, 1978

CAIRO, EGYPT

II. INTRODUCTION:

Egyptian and U.S. Government representatives met in Cairo during the period of February 14-22, 1978 to discuss a cooperative Egypt - U.S. assessment of the energy demand and supply options available to Egypt. This report summarizes those preliminary discussions.

III. Summary:

Preliminary discussion were held between U.S. representatives and the following ministries and organizations of the Arab Republic of Egypt (A.R.E.).

Ministry of Electricity and Energy
- Egyptian Electricity Authority
- Qattara Depression Authority
- Nuclear Power Authority
- Nuclear Material Authority
- Solar Energy Commission

Egyptian General Petroleum Corporation
- Chairman for Exploration and Production
- Planning and Economics Projects
- Chairman, Egyptian Petroleum Company

Egyptian Geological Survey and Mining Authority
- Institute of National Planning

In addition, meetings were held with the Ministry of Finance, the Ministry of Industry and the Ministry of Planning.

The preliminary discussions accomplished the following:

- o The background and objectives of the U.S. initiative for a cooperative energy assessment with Egypt were explained.
- o Egyptian electric energy activities and their priorities were presented.
- o Methods under consideration for the systematic identification and assessment of energy options available to Egypt were explained.
- o The cooperation of Egyptian energy resource and planning organizations was assured.
- o Arrangements to carry out the cooperative assessment were planned. The U.S. assessment team will visit Cairo for approximately one month, beginning in mid-March 1978.

IV. BACKGROUND FOR THE U.S. INITIATIVE:

In 1977, President Carter directed that a program be initiated which would address the energy problems of developing countries considering:

- o the severe impact that increased world energy prices have had on the economic and social development plans of many countries;
- o the concern of the U.S. government, set forth in the U.S. President's April 1977 energy policy statement, with respect to the implications for international security of excessive or rapid spread of sensitive nuclear technology.
- o the need for early action to assure an orderly world transition from a petroleum-based energy economy to new and renewable energy resources.

An important initial objective of the program is to demonstrate that the United States can work in cooperation with other

countries to employ a systematic method of analysis which will assist them to identify the most beneficial energy options available to those countries.

In some countries this could involve actions to reduce oil imports. In the case of Egypt, on the other hand, an option could be to maximize revenues from the export of oil by utilizing other energy resources for domestic needs.

Preliminary contacts with the A.R.E. by the U.S. Embassy indicated a willingness of the A.R.E. to participate in this initial effort. Based on that affirmative Egyptian response, Egypt was selected as the first country for cooperative assessment of energy options. Major advantages associated with a cooperative effort with Egypt include:

- o The variety of energy demand and supply options available Egypt.
- o The presence in Egypt of technical expertise on the use of alternative energy technologies.
- o The availability in Egypt of basic data on energy resources and the extent of prior economic and energy planning by Egyptian authorities.

Planning of the cooperative assessment requires having a draft report on the results of the assessment available by early summer (of 1978) for review by the Governments of Egypt and the U.S., prior to presenting the results to the U.S. President.

The U.S. is also conducting discussions with other countries with respect to the conduct of similar cooperative assessments.

V. APPLICABILITY TO EGYPT:

In the last several years, recognition of the critical role of energy demand and supply balances and their affect on every sector of national economic and social growth has resulted in considerable international interest in the development of comprehensive energy systems. In countries such as Egypt, which are aggressively pursuing a broad range of social and economic development programs, yet which have relatively limited financial and resource flexibility, the availability of such an energy assessment capability may be particularly valuable.

The primary usefulness of this assessment methodology is as a planning tool for government policy makers to assist them in making decisions. It should provide the capability to relate data on the availability of various energy resources to the technical requirements for delivering these resources, in order to meet the future needs of the nation. This study will assess the interdependence of differing energy-related factors with various social and economic development options, and will help select the most efficient and cost effective methods to meet the energy requirements of particular programs and projects.

Briefings by Egyptian Government officials during the recent discussions have emphasized the extensive range of planning activities which have been completed or are currently under way. In the energy supply sector, factors affecting decisions for providing electric power from a variety of sources (fossil, expanded hydro, nuclear and new energy) were explained, as well as how these power requirements relate to various economic sectors. In the energy demand sector, the discussions covered the importance of identifying specific energy requirements and their potential costs and sources, down to a project-specific level.

It has been made clear in these discussions that Egyptian decision makers are concerned with the interrelationship of energy with domestic expansion plans in a variety of sectors. Also involved is the allocation of financing from a large number of unilateral and multilateral sources to a variety of differing projects. Application of such an assessment methodology for these circumstances is especially appropriate.

The current energy assessment collaboration will produce both near- and longer-term results for Egypt.

Near-Term Results

Among the immediate results are the following:

1. Through direct participation, an increased familiarization on the part of Egyptian energy and planning experts with the most recently developed and recognized methodology and data;
2. A collaborative, objective, and comprehensive review and assessment of all available data on existing and potential resources, including oil and gas, geothermal, coal, nuclear raw materials, water resources and hydropower generation prospects, new energy prospects, and energy-related minerals;
3. The identification and examination of specific energy supply alternatives, based on identified and potential resources, and on both available energy technologies and those under development. Implementation factors, such as required lead times, costs, availability of financing (capital and foreign exchange), needs for manpower development, and key projects, will be identified;
4. A collaborative preliminary integrated analysis of the energy demand and supply options available to Egypt, taking into consideration:
   a. effective long-term use of the above assessed domestic energy and technology resources, as assessed in (2) above;

b. Arab Republic of Egypt plans and objectives for national economic growth and social development, including national financing, manpower, and other support requirements and capabilities;

c. The interrelationships of one energy demand or supply factor with other factors; and

d. Actions needed to begin implementation of identified options;

5. Identification of requirements for improved data or a more "in-depth" analysis;

6. Clarification of criteria for assignment of project priorities;

7. Opportunity for direct technical discussions and information exchange between Egyptian and U.S. experts from a wide-range of energy resource and technology specialties.

We feel that the specific results identified above will provide the basis on which to plan improved access to indigenous Egyptian energy resources.

Long-Term Benefits

Through support to the preparation of requests for outside assistance in meeting improved access to indigenous resources, these near term results will also support the Arab Republic of Egypt in attaining their long-term development goals.

Other Activities

During the cooperative effort this year, we anticipate that specific assistance can also be provided in other areas, such as:

1. establishing arrangements between US and Egyptian institutions to continue work on the assessment methodology, including providing training opportunities for Egyptian energy technologists and planners at US institutions;
2. providing technical and management support for energy-related activities under the Egypt-US Joint Commission on Science and Technology;
3. providing assistance in solving particular technical problems in such areas as high voltage transmission; and
4. providing information, materials, and technical exchanges on new energy sources.

VI. PRELIMINARY UNDERSTANDINGS:

The following preliminary understandings have been reached in the course of the discussions to date:

1. The A.R.E. ministries, authorities and institutions with whom discussions have been held support the concept of a systematic assessment of energy options, and will cooperate fully with the U.S. in the conduct of such an assessment.
2. The U.S. Department of Energy and the A.R.E. Ministry of Electricity and Energy will be the lead technical agencies for the cooperative assessment. In addition, the U.S. Embassy will initiate contacts in other appropriate A.R.E.

Ministries whose participation is needed in the analysis. The U.S. team will inform Deputy Minister Maher Abaza, Ministry of Electricity and Energy, of individuals from these other organizations with whom discussions have been held. Eng. Abaza will arrange for a ministerial decree to be issued on behalf of Deputy Prime Minister Sultan which will form an A.R.E. Committee, with membership from all the organizations involved. The committee will coordinate the work of the joint assessment.

3. The objective of the assessment is limited to:

   (1) identification of available energy demand and supply options;

   (2) assessment of the practicality of their application in Egypt;

   (3) identification of major cost, economic, environmental, and social implications associated with their use; and,

   (4) definition of key initial actions needed to begin to utilize selected energy demand or supply options.

Accordingly, the assessment is not intended to produce or modify a national energy plan for Egypt. It can serve as a basis for A.R.E. planning authorities to use in their planning activities.

4. To the extent possible, all energy demand and supply options which are viable for Egypt will be assessed. Alternative energy resources to be considered include: oil and natural gas, hydroelectic power, nuclear power, geothermal

energy, coal, and various new energy forms (solar heat, wind, solar electric, ocean thermal, biomass, and energy storage).

5. Schedule constraints and data availability will limit the comprehensiveness of the cooperative assessment. The assessment will identify areas where further data and analysis are needed.

6. Energy demand and supply projections will be formulated for the years 1985 and 2000. Treatment of energy demand or supply trends beyond 2000 will be made on a qualitative basis only.

7. The U.S. assessment team is currently reviewing available information on energy demands, resources, and technologies applicable to Egypt. From these reviews, information and data requirements will be provided by the U.S. team to their Egyptian counterparts, prior to the U.S. visits to Egypt in mid-March. The identification of these requirements will allow the Egyptians to assemble additional information necessary for the joint technical assessment.

8. The U.S. will provide Egypt with a listing of all materials which the Egyptian participants have provided to them during the first round of discussions. The U.S. will take the responsibility for assuring that U.S. team members have access to these materials prior to their arrival in Egypt

so that duplicate data collection efforts and redundant discussions are avoided.

9. In addition, the U.S. will provide Egypt with a listing of materials and data sources which it has used in the United States in preparing for the joint assessment.

10. Further detail on the discussions held to date is presented in:

Appendix A - Energy Resource Discussion

Appendix B - Planning Discussion

Appendix C - New Energy Discussions

11. A list of participants in the first round of discussions is included as Appendix E.

VI. LIAISON ARRANGEMENTS

Dr. Emad El-Sharkawi, Undersecretary of State and Managing Director, Studies Research and Development, Egyptian Electricity Authority, will be the chief liaison official for the A.R.E. He will be responsible for the planning and management of the Egyptian participation in the assessment. Dr. El-Sharkawi will receive two copies of all official communications between the U.S. and Egypt which deal with this activity. He will provide one copy to Eng. Maher Abaza, so that Eng. Abaza may keep the Deputy Prime Minister fully informed. Ms. Karla King of the U.S. Department of Energy, who serves as Executive Officer of the U.S. team, will be responsible for U.S. liaison.

APPENDIX A

ENERGY RESOURCE ASSESSMENT DISCUSSIONS

February 14-16, 1978

Cairo, Egypt

This report is based on discussions with (1) a panel of Egyptian resources specialists (an Energy Resource Work Group designated by Eng. M. Abaza, First Undersecretary, Minister of Electricity and Energy) and (2) other Egyptian officials concerned mainly with fossil energy resources.

Egypt - Participants

Resource Group

Eng. Mohamed Taha El Safty
Under Secretary of State, Qattara Project Authority
Ministry of Electricity and Energy

Dr. Hussein Abdel Mohsen Hussein
Deputy Chairman
Nuclear Material Corporation

Eng. Samir Habib
General Manager, Planning and Economics of Projects
Egyptian General Petroleum Corporation

Other Egyptian Officials

Dr. Mostafa K. El Ayouty
Deputy Chairman for Exploration and Production
Egyptian General Petroleum Corporation

Dr. Ahmed N. El-Barkouky
Chairman
General Petroleum Company

Dr. Mahmoud A. B. El-Koshairy
President
Solar Energy Commission

Dr. Galal Moustafa
Chairman
Egyptian Geological Survey and Mining Authority

Mr. Maurice Hermina
Coordinator, U.S.-Egyptian Geological Assistance Project
Egyptian Geological and Mining Authority

United States - Participants

Dr. John Reinemund
U.S. Geological Survey

Mr. Robert McFarren
Department of Energy

Scope of Discussions

The discussions concerned the scope and objectives of the proposed resource assessment studies, the methods and requirements of the studies, and the plan of action to be followed. The following is a summary of the views and information covered in each of these areas.

Resource Assessment Objectives

The resource studies will attempt to achieve the following:

1. To provide the best possible assessments, within the limits of available time and data, of known and potential resources available for the production of energy in Egypt. These assessments will form a basis for evaluating energy resource and technology options in supplying future energy demand. They will include assessments of petroleum and natural gas, coal and other solid hydrocarbons,

nuclear raw materials, hydropower, geothermal, ocean energy, solar, wind and biomass resources.

2. To identify methods and assessment factors that may be used by Egyptian energy planners to carry out more complete assessments of energy resources in the future, including guidelines for possible future exploration and development projects.
3. To develop and test an analytic process for national energy resource assessments that may be useful in other countries. Standards for resource classification and terminology are to be included, as are procedures for the use of data in the appraisal of multiple resources.

It is not expected that the planned survey assessments will result in a complete evaluation of all of Egypt's known and potential resources. However, it is expected to provide interim assessments, based on available data, which will be of use in the overall evaluation of energy options in Egypt.

It was explained that the resource assessments would be closely coordinated with analyses by other U.S. and Egyptian experts which will address: technology requirements, environmental effects, manpower requirements, costs, and the economic, social and infrastructure considerations which are related to the development and use of those energy resources. This coordination will allow inputs to the Reference

Energy System framework to be integrated, for comparative assessment of all available energy options. Because those analyses were topics of discussion for other working groups, this working group thereafter confined its discussions to resource assessment activities.

Methods and Requirements

The Egyptian and U.S. resource specialists will cooperate in the assembly and evaluation of resource data. A team of U.S. specialists will be assigned to Egypt for this purpose for not more than one month, beginning about the middle of March. It is the U.S. objective that the results of the joint assessments be incorporated in a draft report by June, 1978. The procedure for the resource assessment (which will be integrated with the corresponding steps of the overall assessment of energy options) will generally be as follows:

1) assembly and synthesis of information already available in reports, maps, or other documents (the U.S. specialists will study such information as they can obtain prior to departure from the U.S., and review previously assembled information during the first part of their visit in Egypt);
2) examination and interpretation of additional data, or collection of new data, if feasible, by U.S. specialists working with Egyptian counterparts during the last part of their visit in Egypt;

3) provision of needed input to Reference Energy System analysis framework;

4) preparation of a draft report by U.S. specialists after their return to the U.S., followed by transmittal of the draft to Egypt for review, and possible revisions or additions by Egyptian counterparts; and

5) joint consultations of Egyptian and U.S. specialists about the results of the study and the contents of the report after its review in Egypt;

To carry out the steps required for these resource assessments, information sources and requirements in each resource category were identified as follows:

Petroleum and natural gas

The available information resides with the Egyptian General Petroleum Corporation (EGPC) in the form of statistics on reserves, production, and distribution of the known resources, as well as geological, geophysical, and drill hole data pertinent to the assessment of undiscovered (potential) resources. The U.S. will provide a senior petroleum geologist and geophysicist from the U.S. Geological Survey to work with the EGPC specialists in the review, synthesis, and evaluation of this information.

EGPC also has much subsurface information that may be helpful in assessing other resources, such as gamma ray logs showing radioactive

zones, lithologic and electric logs showing possible sedimentary mineral deposits, and thermal information applicable to geothermal resource assessment. EGPC has agreed to make such information available to the extent feasible, considering the large volume of data involved.

Coal and other solid hydrocarbons

The existing information resides mostly with the Geological Survey of Egypt, but further indications of these resources may be identifiable in well-log information held by EGPC. The US (U.S. Geological Survey) will provide a specialist to work with these agencies in the review and evaluation of the data.

Nuclear raw materials

Ground and airborne surveys have been conducted over large areas by the Nuclear Materials Corporation (NMC). A considerable number of radioactive anomalies have been found and detailed exploration has been carried out at a number of sites. The most promising site is located along shear zones in granite in the southeastern part of Egypt. Available information has not been synthesized. The U.S. (U.S. Geological Survey) will send a nuclear resources specialist to work with the NMC to review and evaluate existing information, and also to examine field localities, to the extent feasible. Subsurface (gamma ray) information from EGPC will also be studied.

Hydropower

Egypt already has an excellent base of information on hydropower potential. However, the possible development of projects in agriculture, mining, and other sectors requiring water for irrigation, industrial use, or other activity may have an effect on river water available for hydropower. The U.S. (U.S. Geological Survey) will provide a water resource specialist to study water supply needs for energy development and also to consult with Egyptian specialists on the impact of development projects on hydropower resources.

Geothermal

Egypt is believed to have considerable geothermal potential, but little exploration has been carried out specifically to identify such resources. The Geological Survey of Egypt is undertaking a study, and the Egyptian National Committee for Geological Sciences has compiled geothermal anomaly maps. Dr. El-Koshairy gave two of these maps to Dr. Reinemund of the USGS. In addition, considerable information on thermal gradients and subsurface temperatures is available from EGPC. The U.S. (U.S. Geological Survey) will provide a specialist to work with these agencies in reviewing and evaluating the available data.

Seas and Lakes-Thermal Conditions

Thermal gradients in the seas bordering Egypt may constitute an energy resource. The assessment team specialist will study any relevant information available in the U.S. and any information Egypt may be able to provide to determine if conditions seem favorable for sea and lake thermal technology.

Solar

Solar energy is believed to have high potential for future use in Egypt. Since Egypt's solar energy resources are well known, the need now is for studies of applicable technology. Accordingly, this subject will be covered by a specialist in the assessment of applicable solar technologies, rather than the assessment of solar resources. (The Egyptian Solar Energy Commission has received proposals from American firms [Westinghouse, Metrics] for solar feasibility studies, for which the Egyptians are now seeking financial support.)

Wind

A small project involving U.S. assistance to the Ministry of Energy and Electric Power is already investigating the use of wind energy in Egypt. The wind resource information and specialist guidance from that project will be utilized in this study.

Biomass

Information on biomass resources will be supplied by the Ministry of

Energy and Electric Power. A U.S. biomass expert will participate in the assessment.

Energy Related Materials

Exploration and production of energy requires a wide range of mineral raw materials such as barite for drilling mud, iron for structural steel, and limestone for cement. Also, future energy demand will be affected by mining, mineral processing, and related industries based on the extraction of minerals. The U.S. (U.S. Geological Survey) will assign a specialist to work not only with the Geological Survey of Egypt in reviewing and evaluating the pertinent data, but also with the EGPC in identifying subsurface indications of such resources. This effort will be coordinated with the Survey's existing cooperative project with the U.S. Geological Survey to prepare metallogenic maps of Egypt.

SUMMARY OF REQUIRED ACTIONS

The preliminary discussions resulted in the formation of a plan of action. Through mid-April 1978, the plan is as follows:

UNITED STATES ACTIONS:

1. For each of the resources identified above, the U.S. will send a statement to the appropriate Egyptian agencies (at least one week before the visits) outlining the information needs and proposed plan of action for the study of that

resource. Questions concerning the available resource data will be included. The statement will be accompanied by a list of principal references to Egyptian resource data already available in the U.S. Reference documents describing methods and procedures of resource assessment in use in the U.S. will be included, at least for some of the more important resources.

2. The U.S. will provide biographical information for those resource specialists who will visit Egypt. At present, the following categories of resource specialists (as noted above) are expected to be on the U.S. Team.

    Petroleum Geologist
    Petroleum Geophysicist
    Geothermal Geophysicist
    Nuclear Materials Geologist
    Coal and Solid Hydrocarbon Geologist
    Water Resource Hydrologist
    Energy Related Materials Geologist
      (Team Leader)
    Biomass Specialist

3. The U.S. team will arrive during the last two weeks of March and remain in Egypt for periods of 2 to 4 weeks, depending on the amount of data available and the requirements of the individual resource assessments. The U.S. resource experts will provide a general briefing on resource assessment concepts and methods shortly after arriving in Egypt. They will be prepared to demonstrate and discuss procedures used in the U.S., as well as to review and evaluate the Egyptian resource data with their counterparts.

4. The resource and technology experts on the US team will provide input to the Reference Energy System as to the availability and practicality of use of a particular resource. The team will begin preparing a draft resource assessment report upon their return to the U.S. in April. This assessment will be included in the draft report to be jointly reviewed in Egypt in late June or July.

EGYPT ACTIONS

1. Prior to the arrival of the U.S. resource team, the Egyptian specialists will assemble as much of the needed information as feasible and schedule joint sessions for the analysis of data upon the arrival of the U.S. team. This task will be coordinated under the supervision of Dr. El-Sharkowi, the chief A.R.E. liaison official.

APPENDIX B

DISCUSSIONS ON PLANNING

February 15, 1978

Cairo, Egypt

Egyptian Participants:

Dr. Emad El Sharkawi
Egyptian Electricity Authority

Dr. Mustafa Swedan
Egyptian Electricity Authority

United States Participants:

Dr. Phillip F. Palmedo
Brookhaven National Laboratory

Mr. Robert McFarren
Department of Energy

SCOPE OF DISCUSSIONS

Two principal items were discussed:

(1) the analytical methodology to be used for the assessment; and

(2) the data needed for the assessment.

Methodology:

A discussion of methodology followed the presentation on "An Analytical Framework for the Assessment of LDC Energy Resource and Technology Alternatives" (see page 35). The group agreed that the approach described constitutes an appropriate framework for analysis of energy demand and supply alternatives. It was pointed out that the results

of more detailed modelling by the Government of Egypt, such as the electric sector analysis using the WASP model, can be used to provide aggregate data for the Reference Energy System framework.

In discussion of the objective functions of the analysis, it was stressed that the analytic structure did not involve an optimization of a selected objective function or functions, but rather, it was designed to identify the potential effect(s) of various energy supply or demand alternatives on several objective functions. It was agreed that no single or composite objective function would be applied in the planned assessment of Egyptian energy options. The following points were made with regard to the criteria (or objective functions) listed in the presentation:

- o Total Fuel Demand and Fuel Mix: an important policy option to be addressed is the optimum use of natural gas, particularly gas now being flared, and also that associated with future oil production.
- o Basic Human Needs: it is important to include a consideration of the energy requirements to meet national social goals. This is the basis, for example, of the rural electrification program. An analysis of the social benefits of this program is contained in a report by the World Bank on their rural electrification project.

- o Oil Import Requirements: for Egypt, this should read "Maximum revenue over time from oil exports and minimum petroleum product imports".
- o Consumer's Energy Bill: should be expressed as "total cost of energy to all sectors and users".
- o Employment in Energy Sector: this is directed toward the maximum use of local labor, particularly where there is current or anticipated unemployment (or underemployment), and where such labor can substitute for foreign labor or capital.
- o Capital Requirements: capital requirements, and particularly imported capital, are to be minimized.

Data Needs:

The basic data needed to perform the analysis are indicated on page 43 of the attached briefing document. These elements must be specified for each activity in the Reference Energy System (page 41). Much of the data for the electric sector will be available from the current work of the Ministry of Electricity and Energy. In other energy demand sectors the following ministries may be able to provide useful information:

(This list does not include the requirements of other parts of the study, e.g. resources and new energy, which are being handled by other discussion groups)

Ministry of Industry - future industrial demand for energy (heat and electrical) and major industrial generation of electricity;

Ministry of Petroleum - future demand for petroleum products by end-use sector, anticipated refinery capacity and product mix, and plans for the petroleum transport system;

Ministry of Irrigation - future irrigation needs and related energy requirements;

Ministry of Agriculture - future levels of agricultural production, fertilizer needs, and the use of crop residues as fuel;

Ministry of Planning - anticipated total gross domestic product (GDP) growth and sectoral economic growth; current status of energy system modelling in the National Planning Institute;

Ministry of the Economy - economic growth assumptions and projected balance of trade;

Ministry of Transportation - future transportation plans and projections for fuel use; and

Ministry of Housing - statistics on current housing and housing plans, including new towns.

In all cases it will be of interest to establish or verify current figures for total energy demand for conventional fuel (oil, gas, electricity) and non-commercial fuels. Projections of future industry activity levels (e.g. amount of irrigation pumping, tons of aluminum production, etc.) and the

anticipated use of fuels for each activity taking into account end-use device efficiencies are also to be established.

SUMMARY OF REQUIRED ACTIONS

In preparation for the next meeting in late March, the following "action items" were agreed upon:

United States Actions:

1. Assemble a current (1975) Reference Energy System for Egypt. This will be used as the basis for verification of included data and projections of future energy demand and supply patterns.
2. Prepare a questionnaire identifying information which Egypt should attempt to provide on energy demand, fuels supply, and conversion processes.
3. Prepare a concise description of the methodology to be used for the assessment and provide it to Egypt prior to the planned U.S. team visit in March.

Egypt Actions:

1. Summarize existing generation plant and transmission line capacities and the planned or projected expansion of generation (by plant size and fuel type) and transmission system capacities, to the year 2000.
2. Assemble information on projected costs (capital, fuel, operating and maintenance) of electric generation by major types (oil-fired, gas-fired, steam, gas turbine, hydro, and nuclear), for the current system and for planned additions to the system to the year 2000.

APPENDIX C

DISCUSSIONS ON NEW ENERGY

February 15, 1978

Egypt

Participants

Dr. Mahmoud A. N. El-Koshairy
President, Solar Energy Commission,
Ministry of Electricity & Energy

Dr. Mahmoud Higazy
Egyptian Electricity Authority

Dr. Ali Seif Allah Derwish
Solar Energy Commission Member
Ministry of Electricity & Energy

United States

Participants

Mr. William Porter
Department of Energy

Ms. Karla King
Department of Energy

SCOPE OF DISCUSSIONS:

This subgroup was primarily concerned with technologies for the development and use of solar, wind, biomass, geothermal, ocean thermal, and other possible resources that do not constitute major sources of energy in Egypt at present.

Dr. El-Koshairy provided an overview of Egyptian Government plans to establish a Supreme Council for New Energy. He explained that six

commissions, each specializing in a new energy area, would be formed. Dr. El-Koshairy also discussed the work which will be done by the Solar Energy Laboratory, the bilateral cooperation currently under way with France, and Egypt's intention to issue a tender for 1000 solar heating units. Dr. El-Koshairy also indicated his interest in exchanging ideas with American experts in the areas of wind, geothermal, and ocean energies and in energy storage, conservation, and the evaluation of environmental impacts.

The Egyptian representatives provided copies of several planning documents and studies. Several additional documents will be translated into English, and copies will be made available to the U.S. team.

Mr. Porter discussed the approach the U.S. Department of Energy is using to analyze energy resources, technology options, and end-use sector demands. He pointed out that the methodology being employed has been developed utilizing an integrated systems approach. Dr. El-Koshairy expressed interest in providing the Egyptian delegation and other interested Egyptian experts with a substantive briefing on the analytical system being used. Mr. Porter also described various types of information and reports which the U.S. would transmit to the Egyptian side.

Discussions were held on ways that new energy sources could be used to supply special needs, particularly for rural development, and for new

towns and industries. It was agreed that careful planning is necessary so that these new technologies will fit Egypt's overall economic and social development plans. To do this, it was suggested that the Ministries of Planning, Agriculture, Industry, Housing, Finance and others also be consulted for contributions to the cooperative investigation. It was also agreed that consulting with other Egyptian organizations such as universities, the Arab League Culture, Education and Scientific Organization, and the Egyptian Society of Engineers would be of value.

Dr. El-Koshairy expressed a desire to have more books and other reference materials on new energy technologies. Mr. Porter agreed to provide to Dr. El-Koshairy a bibliography of principal references on new technologies which are being used by U.S. scientists. Mr. Porter will also investigate means to provide the books and materials to Dr. El-Koshairy.

Discussions continued on the most effective ways for U.S. team technologists to interact with their Egyptian counterparts. It was agreed that the more extensive the advance preparation, the more meaningful the meetings in Egypt would be. Dr. El-Koshairy requested that the U.S. provide specific guidance on topics for discussion and information which is needed from Egyptian energy technologists. Mr. Porter indicated that a questionnaire and information request package was in preparation in Washington and that it would be transmitted as soon as

possible. (This will occur immediately after the U.S. team predeparture briefings to be held in Washington February 28-March 3.) Mr. Porter emphasized the need for each U.S. technical specialist to contribute to this information request package.

Arrangements for the joint technical interactions were discussed. It was agreed to emphasize having small groups of experts on particular technical subjects meet to concentrate on an in-depth information exchange and assessment. Because the time of the U.S. visit to Egypt is limited to approximately one month, and Egyptian experts are already heavily burdened by the volume of their on-going work, advance notice of meeting arrangements and the topics to be discussed is particularly important. It was agreed that the number of large, generalized meetings should be kept to a minimum, so that the available time could best be utilized for in-depth technical exchanges.

It was also agreed that after the U.S. team has completed its visit and its findings have been integrated into the overall analysis (in the U.S.), the draft report will be circulated for comment by the Egyptian participants. A proposal to hold a joint seminar in Cairo to discuss the report was suggested--this could probably occur in late June or July.

SUMMARY OF REQUIRED ACTIONS

United States Actions:

1. The U.S. will provide additional materials on data sources and methodologies to Egypt. These will be transmitted no later than the first week of March.
2. The U.S. will provide a bibliography on new energy technologies and will make suggestions on procedures for Egyptian experts to obtain U.S. energy reference materials on a continuing basis.
3. To allow the Egyptian counterparts to make advance preparations for the technical meetings, the U.S. will transmit a description of the information it seeks on possible new energy technology applications in Egypt. This will be done no later than the first week of March.
4. The U.S. will be prepared to give Egyptian participants a substantive briefing on the analytical system which is being used. This can be held at the beginning of the U.S. team visit.
5. The U.S. will remain in close contact with the Ministry of Electricity and Energy, to exchange information and to provide advice and assistance in the scheduling of technical meetings and other arrangements during the U.S. team visit.
6. The U.S. will provide information on the professional backgrounds of U.S. team members and the expected dates of their stays in Egypt.

7. The U.S. will provide copies of the draft report of the assessment for Egyptian comments and will be prepared to participate in a joint Egypt-U.S. review seminar.

Egypt Actions:

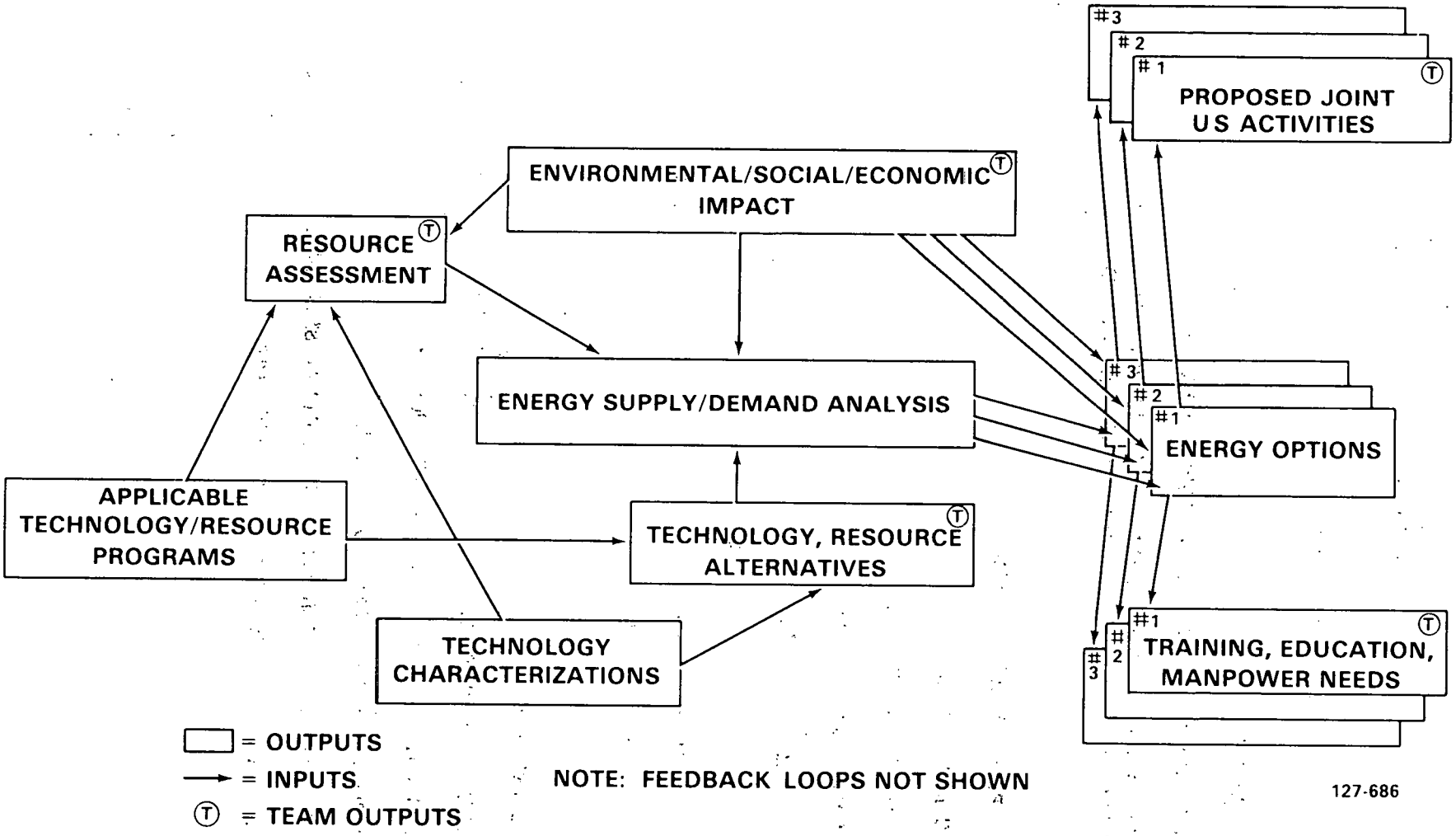
1. Egypt will provide translated copies of the reports discussed above, as well as assistance in obtaining other reference material on new energy technology applications in Egypt. (Completed 2/22/78)
2. The Ministry of Electricity and Energy (EEA) will coordinate the formation of a formal A.R.E. committee to facilitate cooperation between Egyptian Ministry representatives (and representatives of other institutions and organizations in Egypt) and the U.S. assessment team. EEA will also assist in making the necessary contacts and meeting arrangements between U.S. technologists and representatives of these organizations.
3. The A.R.E. Ministry of Electricity and Energy will assure that the U.S. package of information requests and topics for investigation is distributed appropriately.
4. The A.R.E. Ministry of Electricity and Energy will make arrangements for inviting Egyptian experts to participate in briefings and seminars which may take place.

APPENDIX D

AN ANALYTICAL FRAMEWORK FOR THE ASSESSMENT OF LDC ENERGY RESOURCE AND TECHNOLOGY ALTERNATIVES

This appendix contains the Reference Energy System briefing presented by Brookhaven National Laboratory's Policy Analysis Division to the Department of Energy's Egypt Assessment Team during the predeparture briefings, February 28 through March 3, 1978. This presentation explains the analytical framework to be used in the Egypt-U.S. Cooperative Assessment. The briefing was also given to Egyptian government officials during the preliminary discussions in Cairo.

COUNTRY ENERGY ASSESSMENT



PURPOSES OF ANALYSIS

ASSESS THE EFFECTS OF

- DEVELOPMENT OF CONVENTIONAL ENERGY SOURCES
- INTRODUCTION OF ALTERNATIVE ENERGY SUPPLY AND END USE TECHNOLOGIES (INCLUDING NON-COMMERCIAL SECTOR)

ON:

- TOTAL FUEL DEMAND AND FUEL MIX
- BASIC HUMAN NEEDS
- OIL IMPORT REQUIREMENTS
- CONSUMERS ENERGY BILL
- BALANCE OF PAYMENTS
- EMPLOYMENT IN ENERGY SECTOR
- CAPITAL REQUIREMENTS
- ENVIRONMENTAL QUALITY

CONSIDERING:

- BASIC UNCERTAINTIES
- AVAILABILITY OF DATA
- GOVERNMENT ALLOCATION AND PRICING POLICY
- ALTERNATIVE FUTURE WORLD OIL PRICE
- ALTERNATIVE RURAL AND URBAN DEVELOPMENT STRATEGIES
- ALTERNATIVE GDP AND SECTORAL GROWTH RATES

ANALYTICAL APPROACH

1. ESTABLISH CURRENT SUPPLY/DEMAND POSTURE
   - ALL ENERGY USES AND SUPPLIES
   - HISTORICAL ECONOMIC AND ENERGY CONTEXT
   - PROCESS DETAIL
2. PROJECT FUTURE REFERENCE DEMAND
   - 1985, 2000, 2020
   - BASED ON ENERGY SERVICES TO BE PROVIDED
   - USE NATIONAL ECONOMIC DEVELOPMENT PLAN
3. CONSTRUCT FUTURE REFERENCE ENERGY SYSTEM
   - TECHNOLOGICAL DETAIL
4. DERIVE SYSTEM REQUIREMENTS
   - RESOURCES
   - ECONOMIC
5. ASSESS RESOURCE AVAILABILITY
6. ANALYZE ALTERNATIVE RESOURCE, TECHNOLOGY SUBSTITUTIONS
   - EFFECTS ON RESOURCES, ECONOMICS, ETC.

CHARACTERISTICS OF REFERENCE ENERGY SYSTEM APPROACH

- NORMATIVE/INTEGRATIVE
- END USE DETAIL AT FUNCTIONAL LEVEL
  - -KEY TO FUEL SUBSTITUTION AND CONSERVATION ANALYSIS
  - -REFLECTS IMPORTANT SOCIAL AND ECONOMIC DEVELOPMENT PARAMETERS
  - -CAN REPRESENT COMMERCIAL OR NON-COMMERCIAL DEMANDS
- TECHNOLOGICAL PROCESS DETAIL
  - -KEY TO TECHNOLOGY AND FUEL SUBSTITUTION ANALYSIS
- FLEXIBILITY IN TECHNOLOGY ASSESSMENT
  - -EXPLICIT ASSUMPTIONS
  - -READILY EXTENDED TO OPTIMIZATION FORMAT
  - -COMPATIBLE WITH ECONOMETRIC APPROACH

Unit: 10^{15} Btu

REFERENCE ENERGY SYSTEM - COMMERCIAL AND NON-COMMERCIAL ENERGY - INDIA 1972

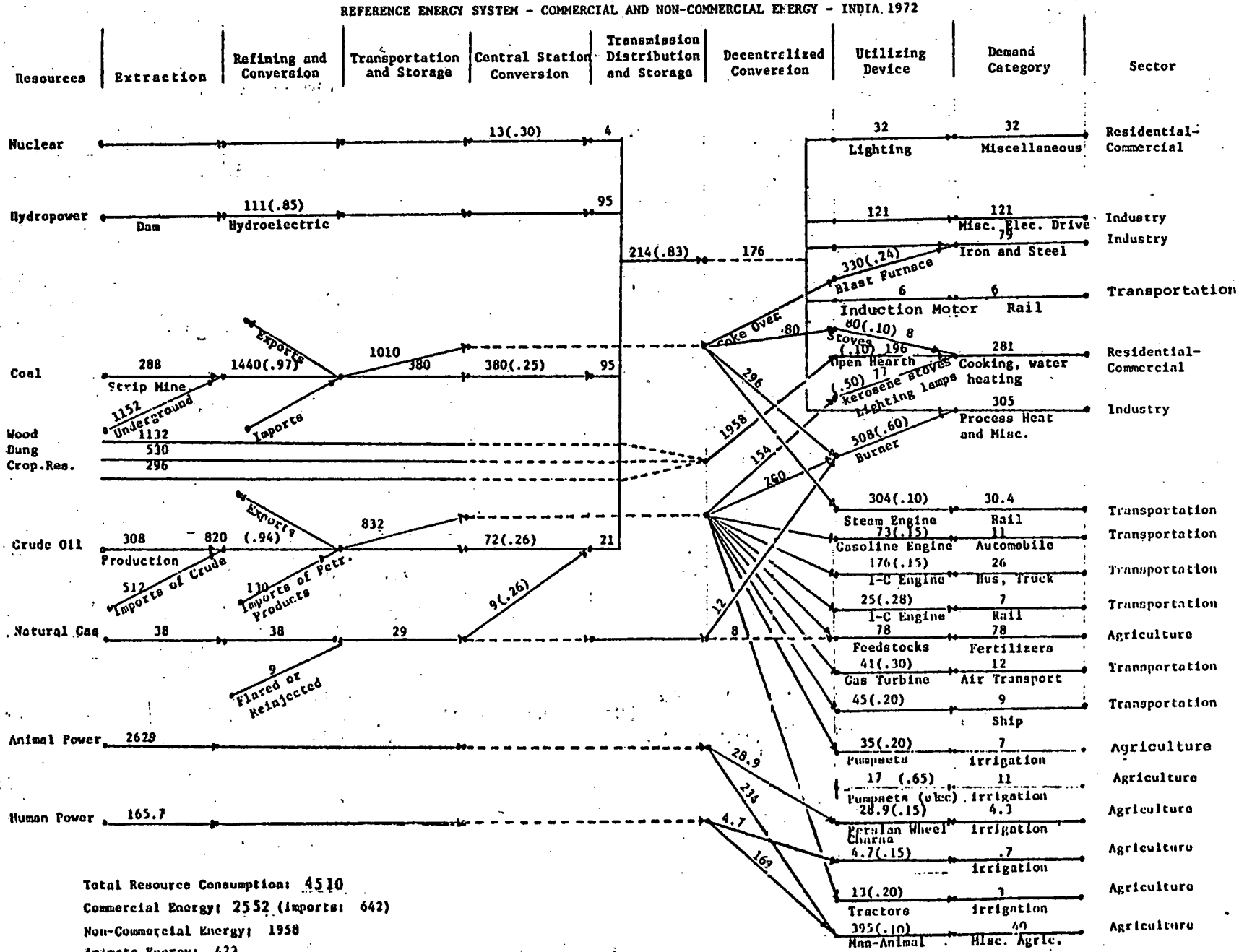
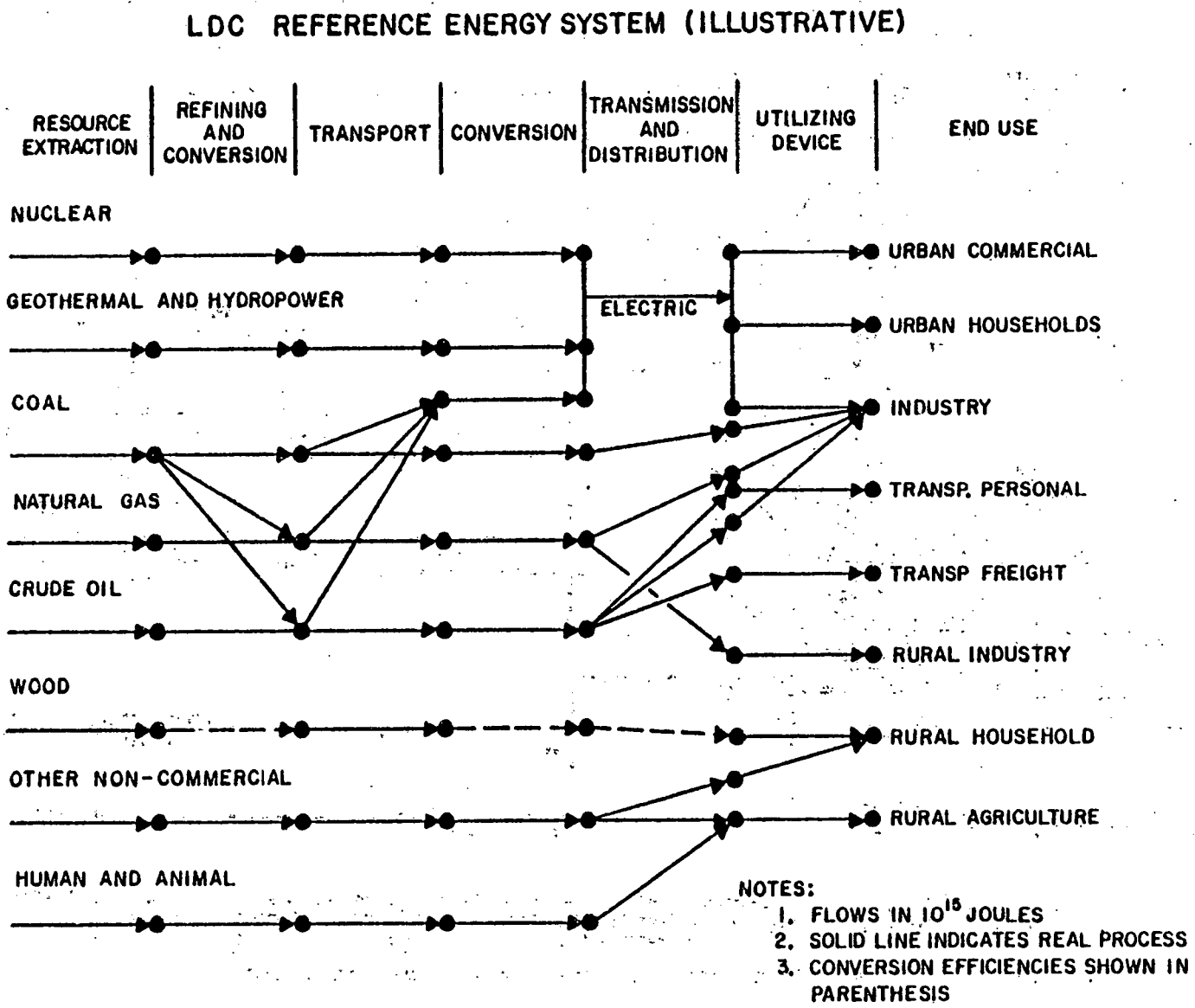


Figure 1


LDC REFERENCE ENERGY SYSTEM (ILLUSTRATIVE)
RESOURCE EXTRACTION
REFINING AND CONVERSION
TRANSPORT
CONVERSION
TRANSMISSION AND DISTRIBUTION
UTILIZING DEVICE
END USE
NUCLEAR
GEOTHERMAL AND HYDROPOWER
COAL
NATURAL GAS
CRUDE OIL
WOOD
OTHER NON-COMMERCIAL
HUMAN AND ANIMAL
ELECTRIC
URBAN COMMERCIAL
URBAN HOUSEHOLDS
INDUSTRY
TRANSP. PERSONAL
TRANSP FREIGHT
RURAL INDUSTRY
RURAL HOUSEHOLD
RURAL AGRICULTURE
NOTES:
1. FLOWS IN 10^{15} JOULES
2. SOLID LINE INDICATES REAL PROCESS
3. CONVERSION EFFICIENCIES SHOWN IN PARENTHESIS

EXAMPLES OF TECHNOLOGIES FOR REFERENCE ENERGY SYSTEM

- EXISTING TECHNOLOGIES

  EXTRACTION

    EG: ONSHORE OIL
        OFFSHORE OIL
        SURFACE MINED COAL

  CONVERSION

    EG: REFINING
        OIL STEAM ELECTRIC
        GAS TURBINE

  UTILIZATION

    EG: COOKING STOVE
        OPEN HEARTH FURNACE
        GASOLINE AUTOMOBILE
        WOOD STOVE

- NEW TECHNOLOGIES

  EXTRACTION

    EG: TERTIARY OIL RECOVERY
        SMALL SCALE OIL SHALE

  CONVERSION

    EG: FLUIDIZED BED
        COAL LIQUEFACTION

  UTILIZATION

    EG: WOOD STOVES
        SOLAR WATER HEAT
        INDUSTRIAL COGENERATION

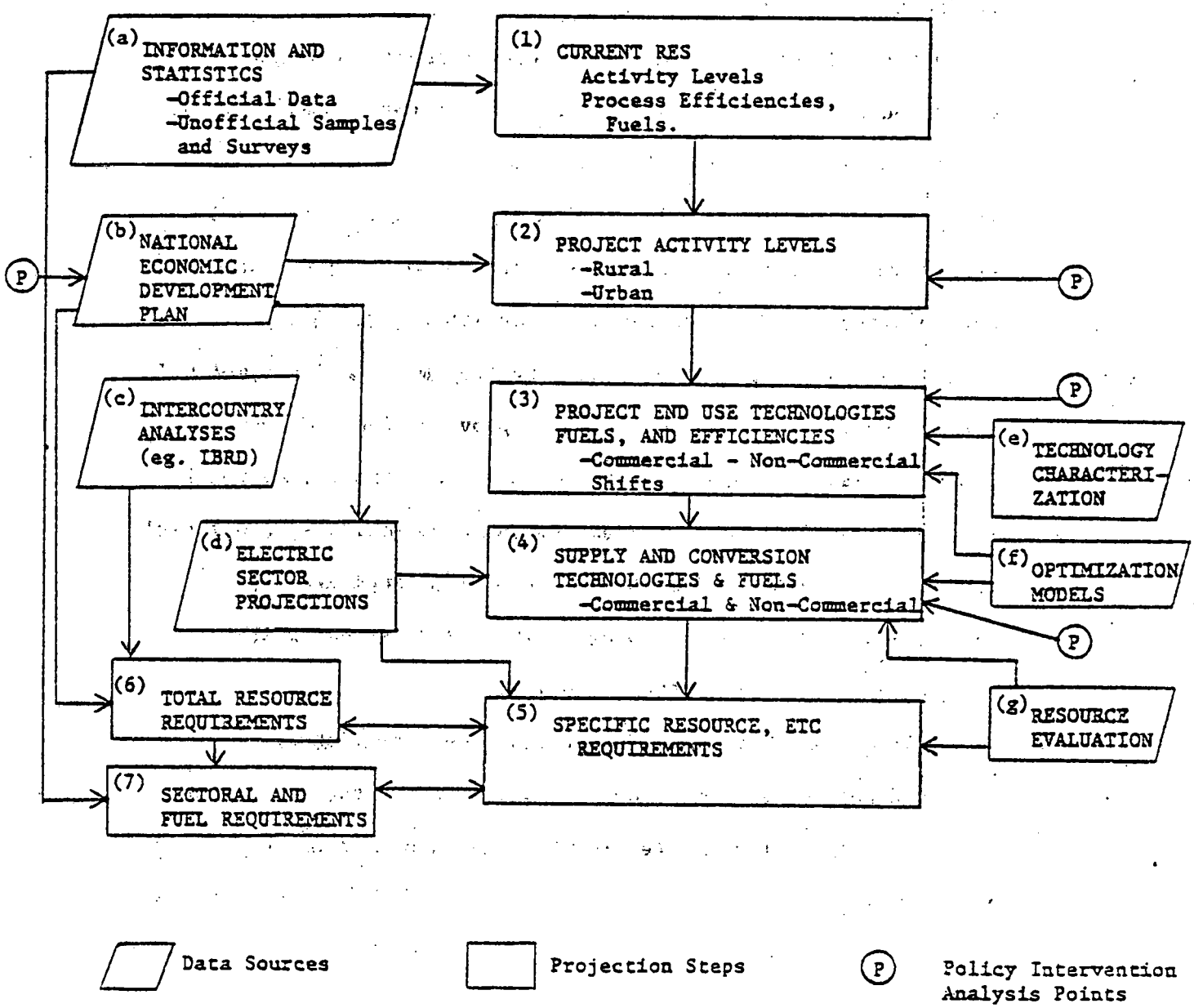
LDC-ESNS PROCESS ELEMENTS

(PER 10^{15} JOULES)

o DEMAND FACTORS	DEMAND BASIS
	BASIC ENERGY DEMAND
o ALLOCATION/EFFICIENCY FACTORS	MARKET ALLOCATIONS
	PROCESS EFFICIENCIES
	ANCILLARY ENERGY USE
o COST FACTORS	CAPITAL
	OPERATING
	ENVIRONMENTAL CONTROL
o MANPOWER	CONSTRUCTION
	OPERATING
o ENVIRONMENTAL "IMPACTS"	AIR/WATER EMISSIONS
	SOLID WASTE
	ECOSYSTEM IMPACTS
	OCCUPATIONAL HAZARDS

Figure 4

LDC COUNTRY TECHNOLOGY ASSESSMENT
REFERENCE CASE PROJECTION METHODOLOGY



Note: Feedback Loops Not Shown.

Assumes no existing National Energy Plan.

Notes to Flowchart on Reference Case

Projection Methodology

1. These are to be Reference Projections for policy analysis, predictions or forecasts.
2. Current RES designed in terms of activity levels, process efficiencies and fuels. Rural and urban sectors; commercial and non-commercial fuels are distinguished.
3. Projected activity levels are independent of fuels and based on economic development plan or social/economic goals. Reference Energy Systems will be established for 1985, 2000, 2020.
4. Rural and urban populations and activities will be distinguished.
5. The "technologies" and fuels used to provide energy to end use activities will be projected based on current trends, national plans, economic competitiveness, resource constraints, and social preferences. Human and animal power will be included.
6. Supply and conversion technologies will be selected on the same bases as end use technologies.
7. If available in Egypt, or if data and time permit their construction, optimization models of individual sectors in the entire energy system can be used to guide the choices of technologies and fuels.

8. The methodology provides an independent projection of electricity demand which can be compared with in-country electric sector projections. Comparison may lead to adjustment of electric shares in certain end uses.

9. Expected GDP growth rates from National Economic Development Plans or other sources will be used, along with the income elasticities of demand (e.g. from intra-country analyses) to project total energy resource requirements. These will be used as a check, and possibly for adjustment, of total resource requirements implied by the projected RES.

10. Historical trends of sectoral growth and fuel use may be used to independently project future fuel-specific sectoral energy use for guidance in constructing the projected RES.

11. Implications of the reference projection to be calculated include:

    a) total energy resource requirements

    b) import and/or export requirements

    c) energy costs to consumers

    d) capital requirements

    e) balance of trade effects

    f) labor requirements

    g) environmental implications

12. The level of detail and reliability will depend on the availability of data. Detail can be built up in those sectors which pertain to potential collaborative activities.

APPENDIX E

CONTACT LIST

PRELIMINARY DISCUSSIONS WITH EGYPTIAN OFFICIALS

February 14 - 21, 1978

	NAME	TITLE
Ministry of Electricity and Energy		
1.	Eng. Maher Abaza	First Undersecretary of State
2.	Mohamed Kemei Mamed	Chairman, Egyptian Electricity Authority
3.	Adly Kamel Yakan	Executive Chairman, Qattara Authority
4.	Dr. Mahmoud Abdei Baki El-Koshairy	President, Solar Energy Commission
5.	Dr. Emad El-Sharkawi	Undersecretary of State and Managing Director of R&D Studies, Egyptian Electricity Authority
6.	Dr. Hussein Abdel Mohsen Hussein	
7.	Hussein Sirry	Nuclear Power Authority
8.	Mohamed Kamal Nabin	
9.	Mohamed Taha El Safty	Qattara Depression Authority
10.	Dr. Mahmoud Hegazi	Director General Research & Testing Egyptian Electricity Authority
11.	Dr. Salah E. Subky	
12.	Dr. Mustafa A. Swidan	Director Power System Planning Egyptian Electricity Authority

NAME	TITLE
Egyptian General Petroleum Authority	
1. Mustafa K. El Ayouty	Dep. Chrmn. for Exploration & Production
2. Eng. Samir Habib	Gen. Mgr., Planning & Economics of Projects
3. Dr. Ahmed N. E.-Barkouky	Chrmn., General Petroleum Co.
Egyptian Geological Survey and Mining Authority	
1. Dr. Galal Moustafa	Chairman
2. Maurice Hermina	Coordinator, US/Egypt Geologic Assistance Project
Ministry of Finance	
1. Fouad Hussein	Undersecretary
Ministry of Industry	
1. Eng. Kamel Maksoud	Director of Central Admin. for Industrial Planning and Technical Research
Ministry of Planning	
1. Dr. Mahmoud A. Saleh	First Undersecretary of State
2. Dr. Ibrahim A. El-Rahman	National Planning Institute
3. Dr. El-Walid El-Shafie	National Planning Institute

United States Participants

Department of State

Mr. Martin Prochnik
Deputy Director
Office of Energy and
Safeguard Technology

Dr. Addison Richmond
Science Attache
U.S. Embassy, Cairo

Department of Energy

Mr. A. Nelson Tardiff
Director, Program Office

Mr. William Porter
Deputy Director

Mr. Robert McFarren
Team Leader

Ms. Karla King
Executive Officer

Dr. Phillip Palmedo
Brookhaven National Laboratory

Geological Survey

Dr. John Reinemund
Director International
Geological Affairs Office

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