PD-AAN-861

INTERNATIONAL DEVELOPMENT COOPERATION AGENCY

AGENCY FOR INTERNATIONAL DEVELOPMENT

Washington, D.C. 20523

EGYPT: PROJECT 263-0123

ENERGY POLICY PLANNING,

RENEWABLE ENERGY FIELD TESTING,

AND UTILITY MANAGEMENT

GRANT

RENEWABLE ENERGY FIELD TESTING

SUBPROJECT

263-0123.2

1983

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

1. TRANSACTION CODE: A (Add / Change / Delete) — Amendment Number: — DOCUMENT CODE: 3

2. COUNTRY/ENTITY: Arab Republic of Egypt

3. PROJECT NUMBER: 263-0123.2

4. BUREAU/OFFICE: HRDC/ST — 263

PROJECT TITLE (maximum 40 characters): Energy Pol., Renewable Field Test., Util. Mgmt.

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 12 DD 31 YY 86

ESTIMATED FY OF OBLIGATION (Enter 1, 2, 3, or 4): PDAAN861

A. Initial FY 82 B. Quarter 3 C. Final FY 86

8. COSTS ($000 OR EQUIVALENT $1 = 83.168)

A. FUNDING SOURCE	FIRST FY 82 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total						
(Grant)	(3,000)	(1,000)	(4,000)	(19,300)	(4,800)	(24,100)
(Loan)	( )	( )	( )	( )	( )	( )
Other U.S. 1.						
Other U.S. 2.						
Host Country		500	500		4,400	4,400
Other Donor(s)						
TOTALS	3,000	1,500	4,500	19,300	9,200	28,500

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1) 740B	740	878		0		24,100		24,100	
(2)									
(3)									
(4)									
TOTALS				0		24,100		24,100	

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each): 872, 874

11. SECONDARY PURPOSE CODE: 790B

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)

a. Code	TNG	PVOU					
b. Amount							

13. PROJECT PURPOSE (maximum 480 characters)

Collect data and conduct field tests on selected renewable energy technologies which will permit a judgment as to the technical, economic and social feasibility of these systems in a variety of Egyptian industrial, agricultural and remote settings.

14. SCHEDULED EVALUATIONS

Interim MM 12 YY 83 — MM 06 YY 85 — Final MM 12 YY 86

15. SOURCE/ORIGIN OF GOODS AND SERVICES: [X] 000 [ ] 941 [X] Local [ ] Other (Specify)

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of ___ pages PP Amendment)

Best Available Document

17. APPROVED BY

Signature: [signature]

Title: Donald S. Brown, Mission Director

Date Signed: MM 03 DD 18 YY 82

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM 03 DD 23 YY 82

RENEWABLE ENERGY FIELD TESTING PROJECT PAPER

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RENEWABLE ENERGY FIELD TESTING

PROJECT PAPER

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ABBREVIATIONS

AID/W-U.S. Agency for International Development, Washington
BUCEN - U.S. Bureau of the Census
CDC - U.S. Center for Disease Control
DOE - U.S. Department of Energy
EEA - Egyptian Electrification Authority
EREDO - Egyptian Renewable Energy Development Organization
GOE - Government of Egypt
HCC - Host Country Contract
Kwp/wp - Kilowatt peak/watt peak
Kwr - Kilowatt rated
MOE - Ministry of Electricity and Energy
NASA LERC - U.S. National Aeronautics and Space Agency-Lewis Research Center
NPT - Non-Proliferation Treaty
NPV - Net present value
O&M - operation and maintenance
PASA - Participating Agency Service Agreement
PID - Project Identification Document
PP - Project paper
PPM - parts per million
PV - photovoltaic
QHREA - Qattara Hydro Renewable Energy Authority
REA - Egyptian Rural Electrification Authority
RFP - Request for Proposal
SCE - Supreme Council on Energy
USAID/C - U.S. Agency for International Development Mission to Egypt - Cairo
WHO - World Health Organization

PROJECT OVERVIEW

Having almost a half billion dollars of USAID funds invested in the electric power sector, the Mission collaborates very closely with the GOE agencies involved in all aspects of the Egyptian energy situation, ranging from policy planning and technical training to power generation and distribution. The Mission's work in the sector, as well as the 1978 U.S. Department of Energy-sponsored Joint Egypt-U.S. Cooperative Energy Assessment (hereafter referred to as the Assessment) have provided us with a great deal of information on Egypt's energy resources as well as on the government's ability to put these resources to use.

The energy project herein described is composed of three sub-projects: Energy Policy and Planning; Renewable Energy Resources Field Testing; Utility Management. These sub-projects have as their common goal the efficient utilization of Egypt's extensive and increasingly complex range of energy resource options. They are designed to deal with three of the major problems which the Egyptians have identified as needing urgent attention for their impact upon the economic and social development of the country and, as such, are intimately related to each other.

Strengthening Egypt's overall national energy, economic and technical planning, as well as management capability, will enable the GOE to analyze various energy supply options, develop a sound program to identify energy demand and the capability to implement it in a more efficient manner. It is expected that these analyses will also result in a better understanding of the technical/economic characteristics of renewable energy resource systems and, thereby, help to convince decision makers within the GOE and donor organizations to consider renewables as having important potential in Egypt's future energy mix.

It is recognized that renewables are not yet economically attractive to the end-user in Egypt because of heavy subsidies on fossil fuel based energy. It is felt, however, that Egypt is beginning to move, albeit very cautiously, in the direction of adjusting selected energy prices upward. In the meantime, field tests of proven renewable technologies in the Egyptian scene in order to evaluate their appropriateness from a technical, cultural and economic (based on world energy prices) point of view is timely. Then, as Egypt moves toward world energy prices, the GOE will be in a position to move confidently in the renewable area.

The Energy Policy Planning sub-project has been authorized and will begin implementation shortly. The Renewable Energy Field Testing subproject has been developed through the PP stage. The third, Utility Management, will be developed in the near future, following an assessment of those critical areas of utility mangement which should be addressed. It is envisioned that this component will be an important part of the project and, though its development will not take place concurrently with the other two, it will be closely coordinated. Funding for the Renewable Energy Field Testing subproject should not be held up for the development of the third sub-project as, although they are interrelated, they have not been designed so as to be dependent upon one

another.

The following sections briefly describe the energy situation in Egypt today and the sub-projects which USAID/Cairo has developed to improve that situation.

Energy Situation - Present Levels of Use

Egyptian oil production in 1980 is estimated at 29.6 million MT/year. Of this, 5.8 million MT is taken as the share of the foreign companies, while 23.8 million MT is the Egyptian share.

Total domestic consumption of petroleum products in 1980 is estimated at 14.8 million MT/year. Domestic energy use has increased rapidly over the past three years, at an average rate of 12.5%. During this period butagas usage increased 18% and kerosene by 5%. This compares with an annual average GDP increase of 9% over the same years.

This rapid increase in energy use is, in part, due to the very heavy subsidies on both fossil fuels and electricity. These energy subsidies are part of an overall policy of providing subsidies for the Egyptian population in selected commodities (primarily energy and food). The effect of this policy is to distort capital investment decisions, discourage energy convervation and encourage energy intensive technologies in the productive and residential sectors.

Industry consumes about 40% of all energy in Egypt and this percentage is expected to increase over the coming years. Over 70% of this energy consumption is by public sector companies. Due to past and present subsidized energy costs, public sector industry has had minimal incentive to reduce fuel consumption by utilizing both well established and new energy conservation techniques. This situation is similar to that in the U.S. before 1974, which resulted in U.S. industry being significantly more energy intensive than its Japanese and European counterparts. Post-1974 experience in the U.S. suggests that realistic pricing can reduce industrial energy consumption by 10-30%, depending on the industrial sector. In fact, consumption in all sectors of the U.S. has been reduced significantly. Similar reductions might be expected in Egypt with significant beneficial effects on oil exports and energy, production/distribution capital needs. Energy planning in Egypt should stress the effect of energy conservation policy options on such crucial issues as oil exports, capital spending, energy production and energy saving equipment, alternative industrial development options and process choices. Most importantly, it must address pricing as the most effective mode of generating energy efficiency and conservation.

Since the Assessment, global energy developments have combined with energy factors in Egypt to produce a number of new energy planning priorities. In order to address these issues, Egyptian energy and economic planners have identified the need to enhance their capabilities for integrated energy analysis based upon both energy resource and production factors on the supply side, and energy consumption, pricing conservation and economic planning factors on the demand side.

The GOE has requested technical assistance in strengthening its energy data collection, analysis and decision making capabilities that will build upon the Assessment and upon other Egyptian experience in supply and demand sectoral analysis and planning.

There are several parallel strategies now being pursued by Egypt in its energy development program:

- Encouraging oil exploration to increase sustained production levels from the present 650,000 barrels per day to 1,000,000 barrels per day. The increased production levels will be used to satisfy internal needs and to increase export earnings.

- Increasing utilization of natural gas in industry, power generation and residential use. This is a relatively new trend[1/] and reflects the rapidly increasing reserves of natural gas expected from recently enacted regulations to encourage exploration of nonassociated natural gas for domestic consumption.

- Planning for utilization of both domestic and imported coal for power generation, thereby freeing up oil for export. Domestic coal reserves (about 65 million tons) can probably support only about 120 MW of power generation, any increases above this requiring imports.

- Planning for utilization of nuclear energy. The commitment of the GOE to nuclear power was confirmed by its ratification of the Non-Proliferation Treaty (NPT) and its agreement, recently signed with the U.S. and French Governments. Nuclear power plants with a total capacity of about 8,000 MW are planned by the year 2000. The GOE is planning to set aside approximately $500 million each year from oil revenues to finance this nuclear power program.

It appears that with some reasonable degree of success in the oil and gas exploration programs, Egypt will have sufficient fossil fuels for domestic consumption and for some level of oil export through at least the late 1980's. In the post-2000 time frame, the GOE has assumed that nuclear plants will result in nuclear energy replacing oil for electricity generation. The necessary policy analysis and management capabilities essential to deal with issues of pricing and alternative energy options are among those which this project seeks to transfer to the GOE.

Summary Descriptions of Sub-projects

1. Energy Policy and Planning

In recognition of the importance of energy planning to national development and international stability over the past several years, AID, the

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1/As compared, for example, to the assumed role of natural gas in the 1978 Joint Egypt-US Cooperative Energy Assessment.

U.S. Department of Energy (DOE), the International Financial Institutions and other donor organizations and countries have spent considerable effort to develop approaches and methodologies for energy analysis, pricing policies and data collection activities to support national energy planning in developing and industrializing countries. Without exception, Egypt's principal bilateral and multilateral donors have stressed the critical importance of pricing policy to achieve a proper allocation of resources, both in the Energy sector and in the sectors which use energy as intermediate inputs. The approach being suggested for Egypt draws upon experience from other countries and may similarly be applied to additional countries (with, of course, appropriate modifications to each country's needs). For example, the analytical methodologies proposed have already been employed by DOE in five countries. AID and other donors are undertaking similar work in a number of other countries. The need for improved demand energy data is a common requirement in most countries. Efforts to improve data collection methods and analyses in Egypt under this sub-project.

The Energy Policy and Planning sub-project will be directed toward institutionalizing the capacity within the Egyptian government to collect and analyze data necessary for national energy planning. This will be accomplished by providing technical assistance, on-the-job training and selected long-term training and appropriate hardware in order to upgrade Egyptian capabilities in energy economics, analysis, technology, conservation, information systems management and systems analysis.

Professional development in energy planning is an essential component for energy planning. A number of training programs are available through various institutions and private sector organizations to meet these needs in other developing countries. To mention a few, training in energy management is available at SUNY/Brookhaven National Laboratory, in renewable energy at Florida State University and in conventional energy and energy system analysis at Argonne National Laboratory. Detailed training needs are identified in the PP.

2. Utility Management

In order to respond to the GOE request for assistance in the utility management area, it is initially necessary to define the management issues to be addressed. A joint detailed review and assessment of the current and planned management development program efforts of both the Egyptian Electrification Authority (EEA) and the Rural Electrification Authority (REA), will be undertaken. Recommendations would then be translated into an appropriate sub-project. An understanding of the current organizational structure, adminstrative practices and procedures and managerial roles, is essential for the technical assistance required for expanding the power sector.

Utility management capabilities must be strengthened while assistance in policy planning and analysis is underway so that policy decisions which must be translated by management into implementable programs will be carried out by a cadre of well-trained persons.

Activities in renewable energy must also be closely field tested in Egypt and coordinated with all other power sector activities. The policy and

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planning sub-project will seek to encourage such coordination by enhancing the Egyptian capacity to plan renewable energy development as part of its overall energy development plan.

3. Renewable Energy Field Testing

Egypt has excellent potential for using solar, wind and other renewable energy resources. If the renewable energy goals of programs in the industrialized countries could be approached, these resources could be a major (20% +) contributor in the post 2,000 time frame. However, the use of these resources is presently minimal, particularly when compared to other countries in the Mediterranean area, such as Cyprus and Israel. One major reason for the lack of movement to introduce renewable energy technologies is the heavy subsidies on conventional fuels that artifically make renewable alternatives economicaly non-competitive to the end-user in Egypt. In contrast, by world standards, the economics of selected solar/wind systems are already very good if the economic analysis utilizes world energy prices for comparison purposes. Systems that are now competitive include solar water heaters, low temperature industrial process heat and wind power.

There are presently a number of demonstration projects of solar/wind systems in place or planned for Egypt. Funded by donor countries and international organizations, they include solar water heaters, an air conditioning system, a desalinization system and a cold storage facility. However, there appears to be very little strategy or continuity associated with the mix of demonstration systems. Some appear to be aimed primarily at serving the donor's commercial interests in introducing solar equipment to Egypt, as much as they are concerned with providing Egypt with technologies and know-how that can have significant near and long term impacts.

Egypt does not yet have a comprehensive plan in the field of renewable energy resources for development although one is currently under development. Very little analysis has been done to quantify such factors as the price elasticity of the demand for energy or the potential of renewable energy resources or on such issues as offset of conventional energy consumption, conventional energy reliability, foreign exchange transactions, employment and local industrial development. The Egyptian government is aware that solar/wind systems cannot compete with subsidized conventional energy systems and is beginning to consider how, given the price of conventionals worldwide, to provide selected solar applications (e.g. hot water heaters) with some sort of subsidy to counteract the financial advantage of conventionally fueled systems.

In view of the potentially important role of renewables in Egypt and the likelihood that the GOE will move forward on the issue of adjusting energy pricing in the not too distant future, USAID/Cairo has developed jointly with GOE a renewable energy field testing sub-project. This sub-project will field test at selected sites, proven, off-the-shelf, renewable energy technologies. The GOE, since the Assessment, has been discussing a project in renewables with the Mission, and, following a USAID study by the MITRE Corporation and visits by the NASA Lewis Research Center, collaborated on the development of the sub-project.

The renewables sub-project will field test the feasibility of a variety of applications ranging from wind energy for electricity generation to solar energy for water pumping. An important part of the renewables sub-project will be to select those types of renewables not already field tested in Egypt which appear to have the best chance of being competitive at world energy prices. Testing will require monitoring and follow-up of actual maintenance and operating expenditures associated with the renewables being tested in order to determine their costs as compared to competing energy sources. Social benefits of renewable energy use will be computed separately. The field test will be coupled with an education, training and promotion activity which will seek to enhance the awareness of Egyptians, from decision-makers to villagers, of the potential of renewables in Egypt. However, the main purpose of these activities is the test of the viability of renewable energy technologies in Egypt so that as the energy pricing structure changes, those technologies which have already proven successful will be ready to come into widespread use. An examination of Egyptian capabilities has shown that the expertise to produce renewable technologies already exists and, indeed, a small amount of manufacturing is taking place; however, technical assistance and training may be necessary to bring the Egyptians up to an internationally competitive standard. Such an activity might be considered as an appropriate follow-on to this sub-project.

The energy planning assistance program will help GOE energy analysts quantify the potential benefits of solar/wind energy utilization, and encourage its development by highlighting its effect in reducing consumption of conventional fuels, reducing capital expenditures in grid extensions to remote areas, avoiding conventional generation equipment costs supplying reliable energy supplies, creating solar industrial development and employment opportunities, and projecting savings in oil consumption and increases in oil export potential.

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RENEWABLE ENERGY FIELD TESTING SUB-PROJECT DESCRIPTION

I. SUMMARY AND RECOMMENDATIONS

A. Goal and Purpose

Described herein is the second sub-project of an energy project having three sub-projects: Energy Policy and Planning, Renewable Energy Resources Field Testing, Utility Management. These sub-projects have as their common goal the efficient utilization of Egypt's extensive and increasingly complex range of energy resource options. They are designed to deal with three of the major problems which the Egyptians have identified as needing urgent attention for their impact upon the economic and social development of the country and, as such, are intimately related to each other.

The purpose of this sub-project is to collect and analyze information on the technical, economic and cultural feasibility of utilizing selected renewable energy technologies through field tests in Egypt which might permit widescale replication by both the public and private sector in the five to ten year timeframe.

B. Sub-Project Summary

This sub-project has four major elements: 1) Field Tests; 2) Supporting Analyses; 3) Training; and 4) New Initiatives (Figure I-1). These activities are described in detail in Section III - Sub-Project Description.

Primarily, this sub-project will do the following:

- Collect data and conduct field tests on selected renewable energy technologies which will permit a judgment as to the technical, economic and social feasibility of these systems in a variety of Egyptian industrial, agricultural and remote settings;

- Establish an information system to collect and disseminate data on the field tests and on those of other renewables systems in Egypt on a continuing basis to support policy and investment decisions and system replication of those applications which are most promising in a five-ten year timeframe;

- Provide training, education and operational experience to potential users of renewable energy systems and decision-makers, especially training on system maintenance and repair, to enhance and accelerate the building of the required technical infrastructure;

- Provide the means to evaluate and support new initiatives in the form of studies and field tests which may evolve as the solar energy technologies are proven and accepted in the Egyptian environment.[1]

The scope of this sub-project involves all renewable energy technology and related applications with the exception of biomass and mini-hydro which are subjects of other specific USAID/GOE projects, the Applied Science and Technology Research Project and an activity under discussion, respectively.

C. Summary Financial Requirements

A summary of the estimated resources required for this sub-project is presented in Table I-1. The total cost of the sub-project is approximately $28.5 million. The AID share amounts to approximately $24.1 million and the Government of Egypt (GOE) share is $4.4 million in local currency equivalent. This represents a cost share ratio between AID and the GOE of 85%-15% including the value of services and goods in kind which will be supplied by the GOE. A detailed cost breakdown is presented in Section VII - Financial Plan.

D. Recommendations

It is recommended that the sub-project as described herein be approved and grant funding of $24.1 million be authorized. It is further recommended that the activities under the sub-project be implemented over a 60-month period from date of signing of the grant agreement.

E. Sub-Project Design Team

The design team which supplied technical support to USAID/Cairo for development of this Project Paper consisted of economists and engineers with expertise in solar energy technologies from the following organizations: Aerospace Corporation, Development Sciences, Inc., AID/W's Office of Energy, Georgia Institute of Technology and the National Aeronautics and Space Administration. Egyptian authorities and organizations participating in the preparation of the Project Paper include the Qattara Hydro Renewable Energy Authority (QHREA), the Egyptian Electricity Authority (EEA), both Authorities under the Ministry of Electricity and Energy, various governorate ministries and other participating entities cited in Annex A.

[1] Energy Project for Egypt, AID Project Identification Document, 1981.

RENEWABLE ENERGY FIELD TESTING PROJECT

PROJECT ELEMENTS

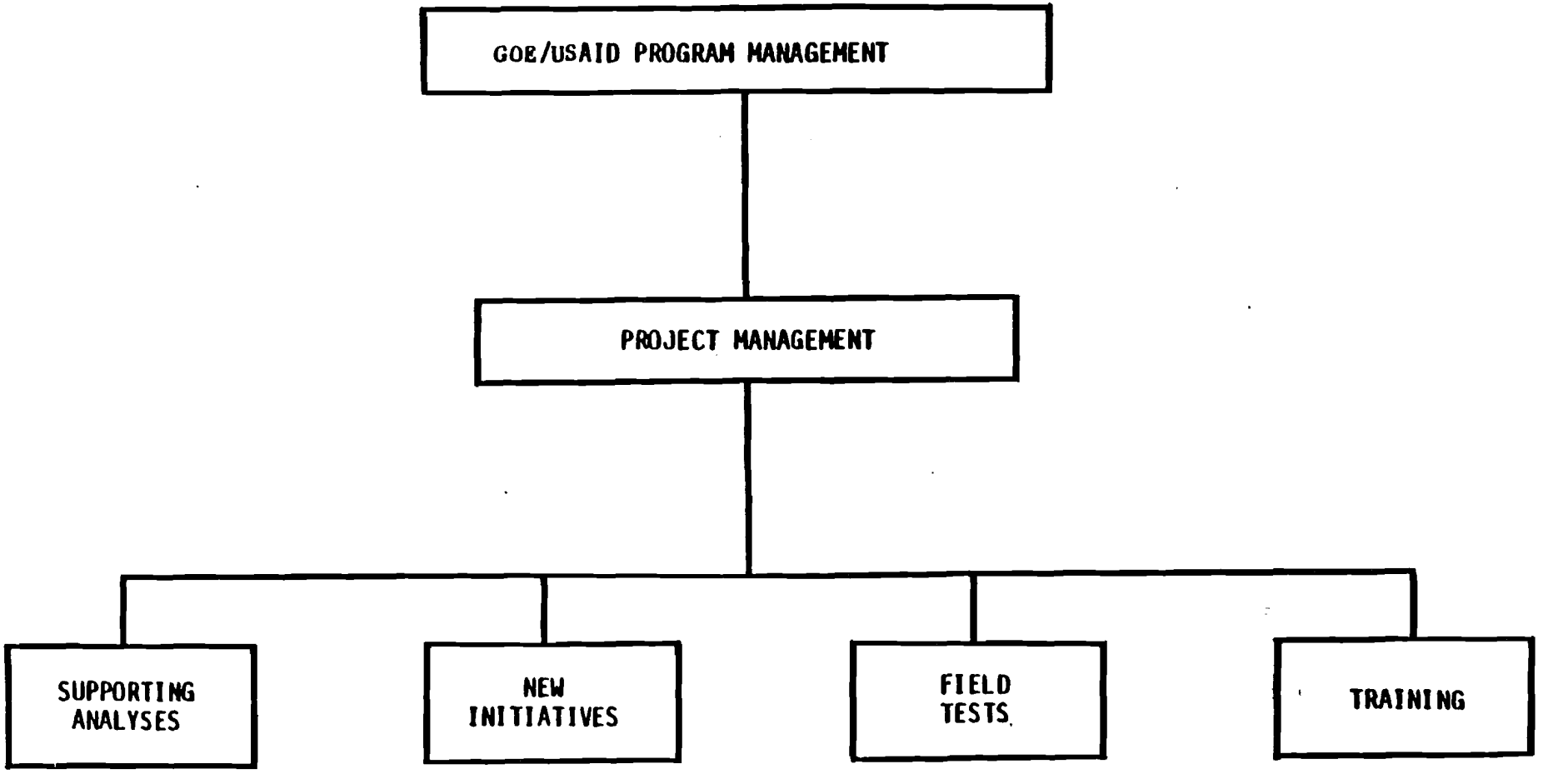

Figure I-1

II. BACKGROUND

A. The Problem

Energy became an increasingly abdundant resource in Egypt during the 1970's. The addition of major new increments of electric power generation, combined with growth in petroleum production, have insured that Egyptian enterprises have not had to face basic physical constraints on energy use (although supply problems have created some local periodic fuel shortages or electrical outages). The GOE has provided heavy subsidies in most categories of energy: electricity, butane gas, heating oil, diesel, kerosene and gasoline. In addition, the GOE has made the decision to forego revenue from export sales of petroleum at world market prices in favor of selling petroleum on the domestic market at subsidized rates. With production from existing oil fields projected to begin declining by the mid-1980's, unless new fields are discovered, the urgency for energy policy reform, especially in appropriate pricing, is manifestly critical. Furthermore, the GOE has come to recognize the need to maximize oil exports in order to secure foreign exchange requirements for development plans, including those in the power sector. Hence, the need to explore alternatives to fossil fuels for future energy requirements.

B. Renewable Energy Activities in Egypt

The GOE does not yet have a comprehensive plan for the development and introduction of renewable energy resources. However, there are a number of renewable energy activities in place or planned for Egypt. They range from research programs in universities to demonstration projects established by the GOE's Ministry of Electricity (MOE). Many of the activities are funded under bilateral agreements and cooperative programs with the developed countries that are leading in the field. Examples include:

- Deployment of small (0.1 to 2 kw) photovoltaic power systems for potable water, agricultural, and remote system applications and the testing of solar water heaters and collectors (with the German Federal Ministry of Scientific Cooperation);

- Installation of insolation measurement stations and a solar collector laboratory and the demonstration of solar water heaters, a desalination unit, and a solar refrigerator (with the Commissariat A L'Energie Atomique and Societe Francaise D'Etudes Thermiques et D'Energie Solaire);

- Survey, collection, and analysis of wind energy data (funded by AID)and the development of strategies and policies for the utilization of wind energy resources;

- Identification and definition of small-scale solar pumping systems (with the United Nations Development Program); and

TABLE I-1 SUMMARY COST ESTIMATES AND FINANCIAL PLAN

In US $ 000's

	AID			GOE	TOTAL		
PROJECT ELEMENT	FX	LC	Total	LC	FX	LC	Total
FIELD TESTS	9,067	1,985	11,052	1,418	9,067	3,403	12,470
SUPPORTING ANALYSES	1,580	315	1,895	205	1,580	520	2,100
TRAINING	650	185	835	75	650	260	910
NEW INITIATIVES	1,665	335	2,000	550	1,665	885	2,550
PROJECT MANAGEMENT	1,760	659	2,419	840	1,760	1,499	3,259
OTHER (Evaluation Inflation, Contingency)	4,600	1,317	5,917	1,273	4,600	2,590	7,190
TOTAL	19,322	4,796	24,118	4,361	19,322	9,157	28,479

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- o Pre-feasibility study for the establishment of the Egyptian Renewable Energy Development Organization (EREDO) for promotion, evaluation, and implementation of renewable energy resources (with the European Economic Community).

QHREA has responsibility for implementation of most of the bilateral projects, working with other MOE agencies as well as the Egyptian universities. However, these activities have had varying degrees of success. Some have been transfers of equipment, with little transfer of operation and maintenance skills, rendering them inoperable. Others are still in the talking stage, such as the UNDP pumping project.

USAID held discussions with other donors as well as other recipients of renewable energy technologies. USAID and the project design team visited the sites of other projects wherever feasible. Application and site selection of this sub-project was accomplished with as much information as was available on these other projects so as to avoid duplication and foster collaboration among all donors.

EREDO, once established, and the implementation of this USAID/Cairo Renewable Energy Field Testing sub-project will represent significant contributions in advancing renewable energy technologies in Egypt. Even though EREDO will be a few years in development (currently in the feasibility study phase), this USAID Renewable Energy Field Testing sub-project was developed in coordination with the EREDO concept. As a result of the assessment of needs in the renewables area, an excellent opportunity exists for a linkage with the EREDO structure as well as the other donor activities. As the EREDO structure is still developing, USAID is not concerned with duplicating efforts; rather, USAID looks forward to full cooperation with EREDO in implementing the GOE strategy for renewable energy development. This cooperation is assured as QHREA will be the primary implementing agency in both cases.

See Annex L for details on other donor activity in renewables in Egypt, including a summary of EREDO and its objectives.

C. Sub-Project Relationship to Host Country Strategy and Other USAID Projects

Following the U.S. Department of Energy (DOE) sponsored Egypt-U.S. Cooperative Energy Assessment in 1978, the Mission began discussing with the QHREA the possibility of cooperation in the area of renewable energy. USAID followed up those discussions in 1979 by contracting with the MITRE Corporation to do an analysis of options on "Renewable Energy in Egypt."

As a result of discussions with the GOE's Ministry of Electricity, it was clear that the systematic development of an energy policy was urgently needed and a project which would give technical assistance and training to policy-makers could lay ground for the GOE to form a rational, overall energy policy, taking into consideration renewable energy technologies. In addition, the EEA requested assistance in utility management, which will be the third sub-project to the one proposed herein.

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The GOE has shown a strong interest in research in non-conventional sources of energy over the last decade. It has given to the QHREA the authority to carry out studies beyond basic research in technical and economic field testing, as well as the implementation of renewable energy projects. The Supreme Council for Renewable Energy Technologies provides guidance to the QHREA for its activities. This Council has three major functions:

- planning for the use of new and renewable sources of energy on the national level;
- coordination between different concerned organizations in the country;
- determination of the priorities of projects.

It is chaired by the Minister of Electricity and has a technical secretariat head. Its members are:

First Under Secretaries of State of
    Ministry of Industry
    Ministry of Agriculture
    Ministry of Military Production
    Ministry of Education
President of the Academy of Scientific Research and Technology (ASRT)
Director of the National Research Center (NRC)
Chairman of the Board of
    Qattara Hydro and Renewable Energy Authority
    Egyptian Electricity Authority (EEA)

Proceedings of this Council are reported to the Supreme Council on Energy for consideration and potential for integration into the global energy plan. The QHREA as the primary authority for renewables (See Annex P) collaborates with all members of the Supreme Council on Renewable Energy and with universities.

The current stated goal of the GOE is to utilize renewable energy technologies for 5% of the total energy needs by the year 2000 and USAID has, since 1979, been developing with them an approach which we believe will examine options which will asssist them in meeting that goal.

"...Hydropower potential in Egypt has already been utilized up to two-thirds, with an energy output of nearly 10 billion Kwh per year. The remainder is to be fully utilized by the year 2000, with an anticipated energy output of 15 billion Kwh per year. However, total hydropower is expected to cover only 15% of total electricity demand by 2000 or nearly 7% of total energy demand."[2]

This realization that traditional fuel sources are dwindling but demand is continuing to rise at an alarming rate has caused Egyptian policy-makers to be anxious to move forward to demonstrate the effectiveness of renewables and introduce them on a wide scale.

In the Ministry of Electricity and Energy's (MOE) Sector Strategy it is specifically stated as an objective that there will be:

"...Optimum use of energy sources in Egypt in generating electrical energy and to keep up with scientific and technological development in the transmission and distribution of electrical energy resulting from utilization of hydro and natural gas, petroleum, nuclear, wind and solar energy with concentration on immediate initiation of implementation of the Egyptian plan for the setting up of nuclear stations."[3]

Annex O includes two tables from the strategy which demonstrate the magnitude of the annual cost of fuel and government subsidies in industrial heating, showing the potential for fuel savings and revenue savings as viewed by the GOE and the reason for their emphasis on those areas in which field tests have been chosen.

The MOE has been working with the United Nations Development Program (UNDP) on a strategy for renewables in Egypt. A draft working paper for that effort produced some very interesting conclusions which parallel the design of USAID's sub-project. The draft strategy found:

"...In the case of solar energy, which is available everywhere, zoning will be based on the following thinking:

a) In the present inhabited regions along the Nile, in the Delta, and within 15 km (tentatively chosen) of the electricity grid, projects can be implemented to replace some existing applications which are heavily dependent on the use of conventional energy sources such as oil and gas as well as on human and draught animal power;

b) In the case of Satellite Villages which are not included in the short-term national plan for rural electrification, small photovoltaic systems (together with biogas applications) may be suitable for lighting, at least in the streets, mosques, clinics and schools;

c) Within 15 km of the grid, projects whose end-product is electricity generation may be considered with a view to connecting them with the grid;

d) In the remote areas (practically defined as 15 km or more from the electricity grid) sites may be considered where there is either underground water (solar pumping), remote locale like the 21 Islands in Lake Nasser, sea or brackish water (desalination), or having a strategic value (mine, airport or camp)."[4]

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2 Excerpted from Statement by Deputy Prime Minister A.E. Hilal at the U.N. Conference on New and Renewable Energy, Nairobi, Kenya, 13 August 1981.

3 "Strategy for the Ministry of Electricity for 1980 - 2000," p. 6, Ministry of Electricity and Energy, Egypt, July 1980.

The draft strategy also presents criteria for assigning priorities to projects:

"...i. High Priority Projects:

These are the projects which depend on a mature technology, i.e. are technically and economically feasible. These are especially ranked according to: social impact, adaptability to local conditions (social acceptability, etc.), potential for local manufacture, institutional and individual capabilities. The weight factors used are the same for all (3, 2, 1, 0).

ii. Intermediate Priority Projects

These are priority projects characterized by relating to costly technologies with no proven reliability in the field. They are similarly ranked among themselves as in (i) above plus a factor related to upgrading research and development capabilities.

iii. Low Priority Projects:

Those which do not meet the immediate needs of the country."[5]

In Annex O, a priority listing of on-going and proposed GOE projects from the draft strategy shows nine of the applications AID is proposing to be of high priority and two to be of intermediate priority.

III. SUB-PROJECT ELEMENTS

A. Introduction

Implementation of present Egyptian plans for agricultural and industrial expansion, together with expected population growth and increased urbanization, will require additional energy sources. Present plans indicate requirements for:

- Industrial process energy in the urban areas;
- New sources of fresh water including sea or brackish water desalination;
- Small capacity, low-head water pumping for desert reclamation projects along the Nile;
- Large capacity, high-head water pumping systems to obtain additional water for reclaimed regions;

[4] Draft of "Preliminary Outline of a National Strategy for the Utilization of new and Renewable Sources of Energy in Egypt," pp. 5-7, Ministry of Electricity and Energy and UNDP, Egypt, 20 December 1981.

- Cold storage in the remote regions to store perishable foods; and
- Electricity in isolated villages.[6]

The inability of conventional energy sources to satisfy the Egyptian growth requirements is, in part, due to the country's geography. Egypt is part of a broad desert that extends from the Atlantic Coast of Africa into the Middle East. The geology of Egypt has produced four geographically diverse regions with different resources, needs and energy sources: (1) the Nile Valley and Delta; (2) the Western Desert; (3) the Eastern Desert and Red Sea highlands; and (4) the Sinai Peninsula.

The Nile Valley and Delta region supports over 95 percent of the people, contains almost all of the country's fresh water supply, cultivated land, good roads and conventional energy sources. By contrast, the Western Desert, which accounts for about three-quarters of Egypt's land area, has very limited agriculture and permanent habitation due to sparse fresh water supplies. Isolated communities in desert regions are situated at six oases and in a narrow coastal strip along the Mediterranean. Development of the Western Desert region has been further hampered by poor roads and the lack of conventional grid-connected power.

The Eastern Desert and Red Sea highlands region, comprising almost 20 percent of Egypt, in general, does not have a natural fresh water supply; therefore, growth of this region has been limited to very few permanent settlements devoted to development of oil, gas and mineral deposits. Access by road is circuitous and power, in most instances, is provided by diesel engines. The Sinai Peninsula, located east of the Gulf of Suez, also has few inhabitants, but is graced with some fresh water along with coal and minerals. The fresh water supplies are confined to aquifers in the Maghara area of the north and a few shallow wells along the Sinai Coast. The limited availability of fresh water from the developed Nile region, along with the isolation of the Western Desert, Eastern Desert and Sinai communities, have resulted in the extremely slow and sharply constrained development of these remote settlements. The lack of conventional energy resources, oil or electricity, in some of the outlying areas will make some applications of renewable energy technologies potentially economically attractive. Ultimately, as renewable energy system performance improves, as mass production reduces their cost, and as conventional energy costs escalate, renewable energy systems will be competitive in additional regions. Figure III-1, from Reference 1, characterizes the existing road and powerline network and depicts the location of potential applications for renewable energy in Egypt.

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5 Ibid.

6 "The Role of Renewable Energy Resources in Egypt's Development Plans" by A. El Tablawi, Ministry of Electricity and Energy and Mohamed K. Nadar, Ministry of Irrigation, GOE, June 1981.

B. Approach

The Renewable Energy Field Testing sub-project has four major elements: Field Tests, Supporting Analyses, Training and New Initiatives. Through these four interrelated and complementary elements, the sub-project is designed to:

- Collect and analyze information on selected renewable energy technologies which will permit a judgment as to their technical, economic and social feasibility;

- Provide on-going technical support to the sub-project through establishment of a broader data base, social, economic and market analyses, and supporting studies to evaluate existing field tests, identify new opportunities for renewable technologies and energy conservation, and determine where maximum impact from system replication is possible, as well as, provide planning support for interfacing with other Egyptian programs and follow-on activities;

- Provide training in system operation and maintenance to support and accelerate the building of the requisite technical infrastructure; also, provide information dissemination and technology transfer through training activities and operational experience to encourage acceptance and growth of renewable energy technologies; and

- Review, evaluate and support appropriate new initiatives in renewable energy to promote acceptance and replication in related industrial, agricultural and remote applications.

These four elements, depicted in Figure III-2, are described in the following sections. Project Management, which is very important to the successful completion of this type of project, is discussed in Section F - Sub-Project Administration and Implementation Plan. The scope of this sub-project involves all renewable energy technologies and related applications with the exception of biomass and mini-hydro which are subjects of other specific USAID/GOE Projects.

C. Field Tests

Emphasis in the Renewable Energy Field Testing sub-project is on field testing of various technologies for GOE-identified, high priority needs and applications. Based on Egypt's general energy needs and growth requirements discussed in the Introduction and on potential field tests of renewable energy resources and applications identified in the PID, QHREA and EEA arranged visits with appropriate local agencies to review the previously identified applications and sites and to visit additional sites. Several sites were proposed and visited for each renewable energy system application.

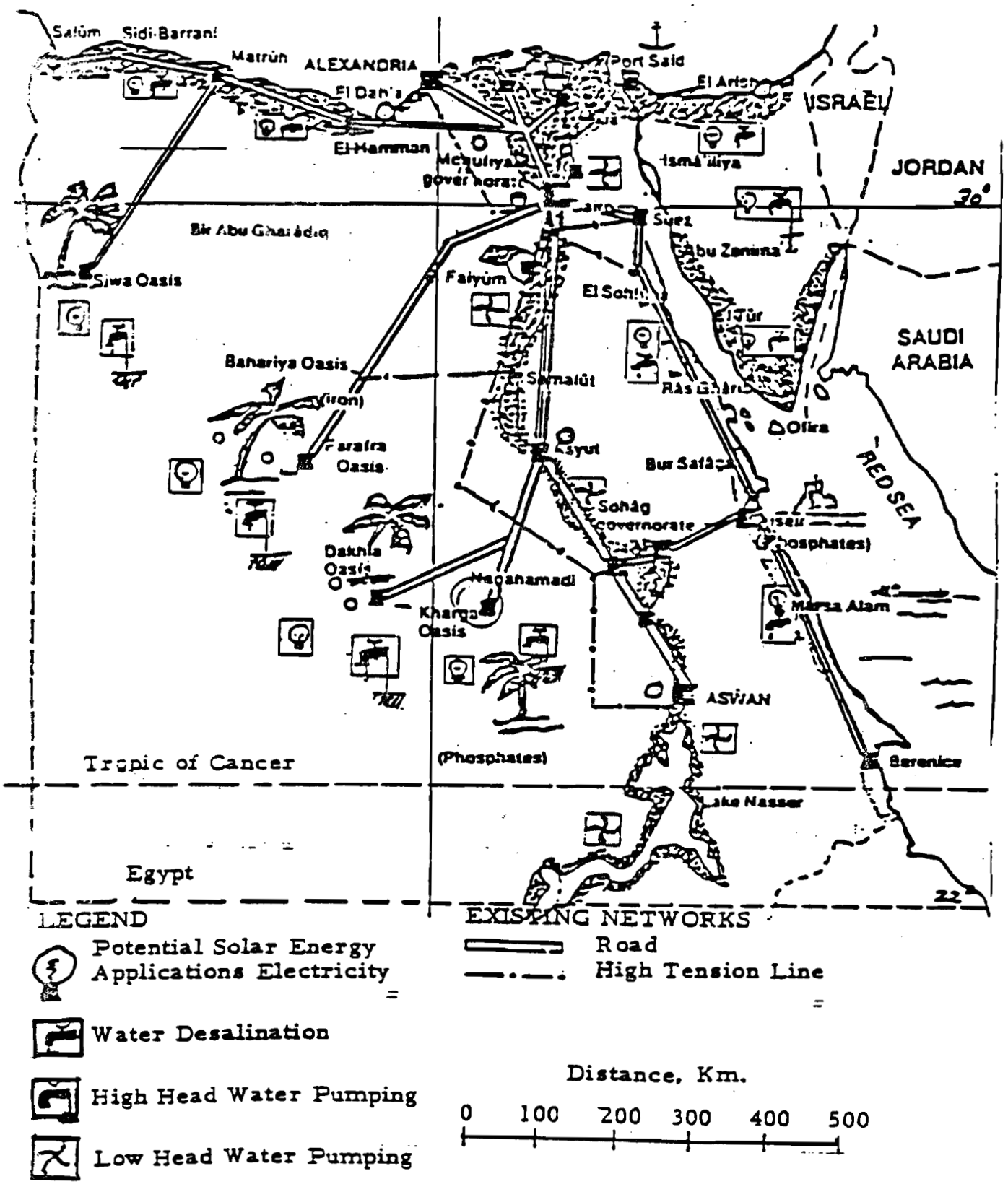

Figure III - 1. Potential Application for Solar Energy in Egypt

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All of the field tests chosen involve public sector institutions for a variety of reasons. As a field testing project, USAID is seeking to collect data on the feasibility of these systems first in the public sector where there is the greatest potential for energy savings and which plays a key role in the development of popularization of renewables.

In the industrial process heat applications, for example, which were identified as having great priority, the private sector has a small share of investment relative to the public sector: spinning and weaving (18%), basic metals (8%), other manufacturing (11%). This general pattern of private sector or public sector concentration in particular industries is likely to change only gradually.[7]

It is felt that QHREA, which has prime responsibility in the GOE for renewables, will provide a sound institutional base for the project, from which controlled field tests, including extensive data collection can be done. Data collection requirements in technical, economic and social fields will be onerous, so that it was felt that QHREA could better assure cooperation from public than from private organizations. However, USAID will involve the private sector in the original field tests, remaining open to utilizing a private firm in any of the field tests, but requiring that the New Initiatives be carried out by private firms. Training through seminars and field test visits will be available to private as well as public sector personnel.

Ultimately, we see the function of renewables development and local manufacture lying with the private sector; however, field experience will be necessary before that is possible. Technologies such as those involved in domestic hot water heating which have widespread use elsewhere have not been included in this project as it is expected that their development will come about naturally through the private sector when energy pricing signals are right. Although such systems are in widespread use throughout the region, the subsidization of energy prices has not made them attractive in Egypt. Be that as it may, there are still about five nascent Egyptian solar flat plate collector manufacturing companies, some of them joint ventures with developed countries such as the U.S. and Israel, which are anxious to see these field tests go forward. If the data generated by the field tests show the feasibility for widescale replication if these technologies and market studies demonstrate the potential for them then decision-makers and the private sector will be encouraged to increase investment in these technologies. We believe that the value of information gathered through the proposed field tests will significantly shorten the gestation period for the use of those renewables. In order to select the more viable field test candidates, an assessment was made utilizing factors based on the following criteria:

[7] "Private Sector Industrial Development Strategy," by Paul G. Clark, p. 3, Boston University, draft, August 1981.

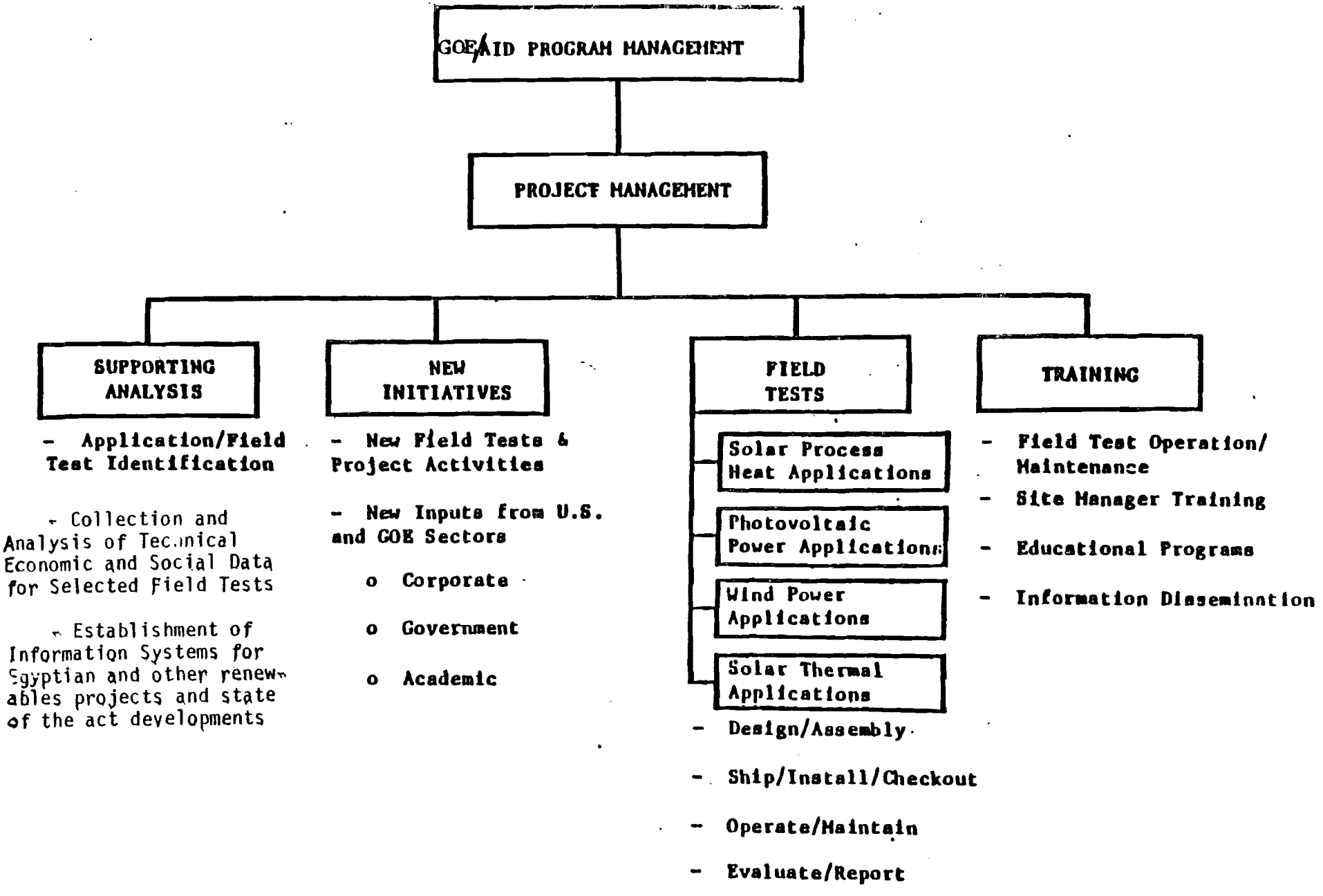

FIGURE III-2. RENEWABLE ENERGY FIELD TESTING PROJECT

- The country's regional and overall growth and development requirements, emphasizing improvements in industrial and agricultural productivity and the potential for these technologies to contribute to that development in the long run;

- The technical feasibility of renewable energy technology to reliably meet GOE-identified needs and applications;

- The general applicability and replication potential associated with the selected application and technology;

- Local ability and willingness to utilize, maintain and contribute to the installation of the technologies selected and data collection requirements for the field test and the perceived chance for a successful field test;

- The visibility of the field test and the potential opportunity to meet a need and to stimulate the introduction of the technology through a successful prototype or pilot plant field test;

- The economic and social feasibility of renewable energy technology compared with alternative conventional energy sources; and

- The inability or inappropriateness of conventional energy sources to meet current and/or future GOE-identified needs.

Economic feasibility has actually been categorized in the following manner:

1. Technologies, matched to identified needs, which have proven nearly economic, compared to conventional systems, under certain conditions in the United States and elsewhere and are worth testing out in Egypt in order to obtain actual data on installation, operation and maintenance costs;

2. Remote applications, though not economic, where alternatives may not exist or where providing conventional fuel may be prohibitive in cost and unreasonable in terms of personnel requirements for operation and maintenance; and

3. Applications such as in the agriculture sector where the Government of Egypt plans extensive development and, though perhaps not currently economic, so little information exists as to merit investigation.

Eleven applications involving four basic solar technologies have been selected and are recommended for field testing. The solar technologies, the field tests, location, number of sites and a brief description of the technology at these sites are summarized in Figure III-3. The selection of field tests was based upon the minimum system to meet the identified need for energy. Proven technology and perceived low-risk tests were selected after numerous discussions with QHREA, EEA and local officials as to their needs and the potential sites. Needs were ranked according to Egyptian priorities then technologies were examined for their suitability to meet those needs at suggested sites. The applications were selected based on the perceived potential for replication. A typical schedule of the nine major activities required for each of the field tests is presented in Figure III-4. Field tests include an extensive period of evaluation and monitoring of technical performance and actual maintenance and operating expenses in order to determine the costs of the solar technological applications compared to competing energy sources.

Summary descriptions of each of the field tests are presented in the text that follows. A complete description of each field test, including preliminary conceptual designs, specifications, costs and schedules are included in Annex B.

1. Solar Process Heat Applications

Solar heat, captured by a solar collector, is one means of using the sun's energy. The solar process heat applications are among those which have proved economic in the U.S. and have tremendous potential for energy savings through widespread application in the public and private sectors in Egypt. In order to standardize the solar collector types used in these field tests, glazed flat-plate collectors will be used in applications requiring temperatures under 80°C. Another way of saving conventional fuel is to recover waste heat. This is accomplished by using a heat exchanger to lower the temperature of the exhaust energy to preheat a working fluid. Both solar thermal heating and waste heat recovery are proposed for two of the five field tests summarized below while solar heating only is proposed for the remaining four sites.

a. Solar Water Heating for Milk Products Plant - This field test will use 15,000 ft^2 of flat-plate collectors which will deliver approximately 7.3×10^6 BTU/day for solar water heating and provide heat for yogurt incubation and hot water for cleaning the plant and equipment. The yogurt incubation heat requirement is relatively low temperature (60-80°C) and a recirculating hot water system will be used in conjunction with a fan coil for heating the air in the incubator room to maintain the desired temperatures. The system will be used to displace electricity, a high grade energy source, which is currently being used to heat the room. The plant cleaning heat requirement is also relatively low temperature (70-80°C) and use of solar heated water for cleaning will displace essentially all of the No. 2 fuel oil required at the plant.

TECHNOLOGY	FIELD TEST	LOCATION	NO. OF SITES	TECHNOLOGY DESCRIPTION
Solar Process Heat	Solar Water Heating for Milk Products Plant	Cairo	1	Flat Plate Solar Collectors 15,000 ft^2
	Solar-Assisted Fruit Dehydration	Cairo	1	Flat Plate Solar Collectors 1,500 ft^2
	Solar Energy and Heat Recovery for Poultry Processing	Cairo	1	Flat Plate Solar Collectors 16,000 ft^2; Waste Heat Recovery
	Solar Energy and Heat Recovery for Textile Dyeing	Sharqiya	1	Flat Plate Solar Collectors 14,000 ft^2; Waste Heat Recovery
	Solar Water Heating for Metal Processing	Cairo	1	Flat Plate Solar Collectors 50,000 ft^2
Photovoltaic Power	Photovoltaic-Powered Fisherman Shelter Systems	Aswan	3	Flat Plate Photovoltaic Array 600Wp per Site
	Photovoltaic-Powered Irrigation Systems	Asyut; Qena	3	Flat Plate Photovoltaic Array 250Wp per site
	Photovoltaic-Powered Reverse Osmosis Desalination System	Marsa Matruh	1	Flat Plate Photovoltaic Array 24kWp
Wind Power	Village Wind Power System	Marsa Matruh; Red Sea	1	Wind Turbine Generator(1) 20kWp
	Wind-Powered Reverse Osmosis Desalination System	Red Sea	1	Wind Turbine Generator(1) 200kWp
Solar Thermal Power	Solar Rankine Cycle Cold Storage System	Fayum	1	Solar Collectors, 3,000 to 6,000 ft^2; Rankine Cycle Chiller, 25 Ton

Figure III-3. Field Testing Technical Summary

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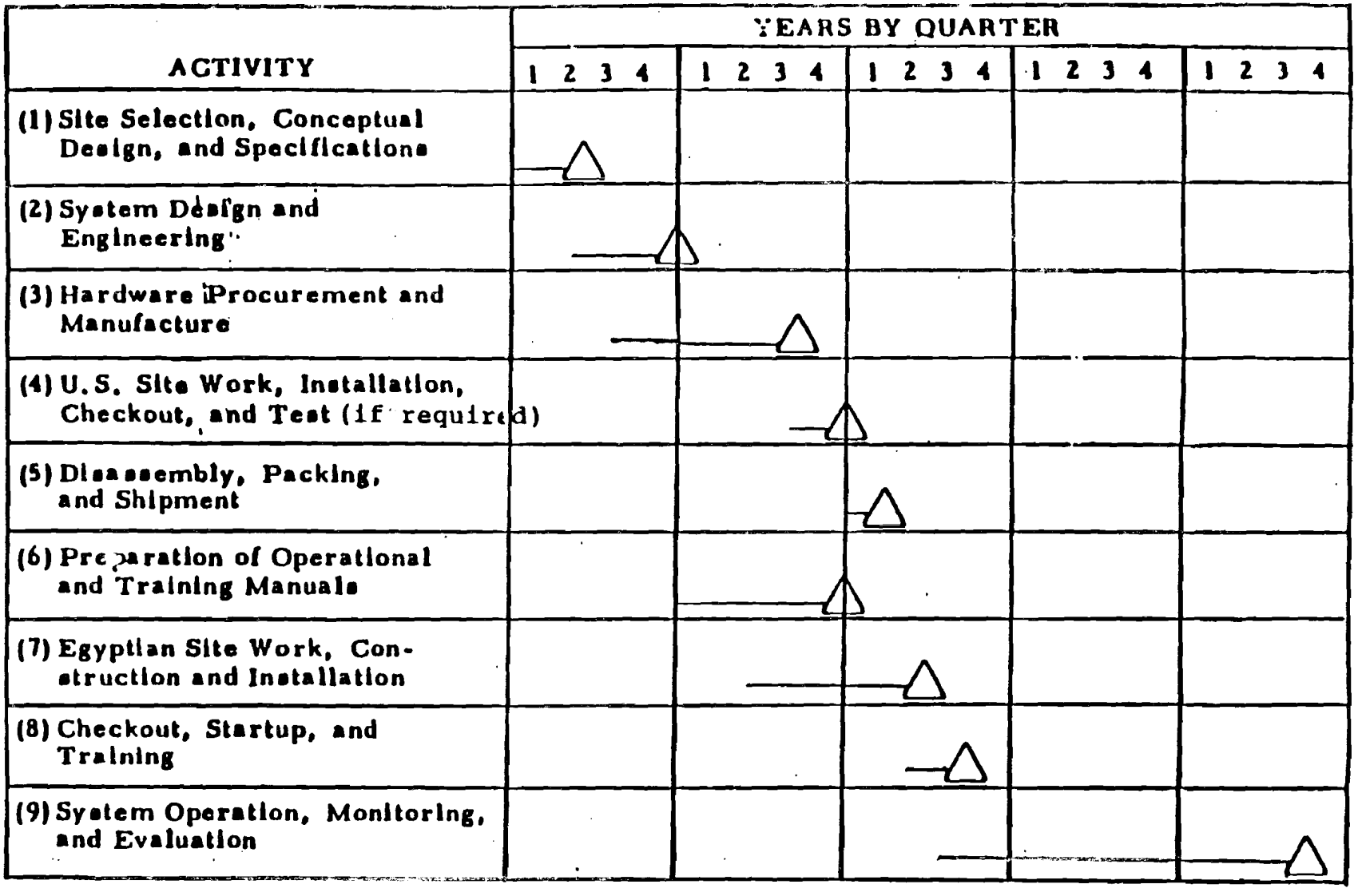

Figure III-4. Typical Schedule

b. Solar-Assisted Fruit Dehydration - The proposed field test will incorporate a dryer of conventional design capable of processing 10 tons/day of fruits into approximately 1.5 tons/day of dried product. The principal product will be dates; however, a variety of fruits and vegetables may be processed as seasonal harvesting dictates. The fruit is dried by hot air recirculated through the truck trays. In commercially available dryers, the air may be heated either with steam coils or clean flue gases. A portion of the air is replaced continuously in order to provide adequate moisture exhaust. Conventional design includes an exhaust fan so that the system operates at a negative pressure. Dampers are manually adjusted to control air exchanger rates. The proposed use of solar energy is to provide preheating of the makeup air to the system. This application contributes to a reduction in use of conventional fuel while minimizing the operating temperature of the solar collector array. It also assures that fluctuations in insolation will not have a major direct effect on curing temperatures. A 1500 ft^2 direct air heating collector array will be used with no energy storage system. This system offers lower capital cost than a water system, and the lower collector efficiency normally encountered with air systems will be compensated for by avoiding the use of a water-to-air heat exchanger. The collector array will be capable of providing peak preheat temperatures in the range of 15-27°C above the ambient temperature with an average energy contribution of about .70 to .75 MMBtu per day. For a projected utilization of 260 days/year, the annual energy contribution will be 190 MMBtu.

c. Solar Energy and Heat Recovery for Poultry Processing - This proposed field test will be located at the General Poultry Company broiler processing plant in Heliopolis, Egypt. The plant presently processes 40,000-50,000 chickens/day over an 8-9 hour period. This renewable energy application is to use a flat-plate solar array, in conjunction with a waste heat recovery system on the plant's refrigeration system, to heat water to 70-80°C, store it, and supply hot water needed by an expanded plant capacity. The expanded plant capacity will be approximately twice current production rates and is scheduled to be completed in two years. Reheated stored water will be used to satisfy scalder and plant clean-up requirements. It is expected that the solar flat-plate collector of 16,000 ft^2 will supply $8X10^6$ BTU/day while the waste heat recovery system will supply $4X10^6$ BTU/day. The resultant energy of $12X10^6$ BTU/day will be sufficient to process 100,000 birds/day.

d. Solar Energy and Heat Recovery for Textile Dyeing - The objective of the proposed system is to field test an improved method for heating of water for dyeing of textile fabrics. In current operations, cold water and chemicals are loaded into the dye beck. The fabric is introduced in a continuous loop which is draped over a horizontal drive roll that provides agitation. The dye bath is heated by direct sparging of low pressure steam at the bottom of the vessel.

The existing system will be augmented with waste heat recovery and flat-plate solar heating systems. The 14,000 ft^2 flat-plate solar collector will supply a major part of the heating requirements. The combined heat recovery/solar energy system will have the capability of

providing over 16,000 MMBtu/year assuming 24 hour operation six days a week. Waste heat recovery is expected to save $2X10^6$ BTU/day. Actual energy contributions will depend greatly on the plant's operation schedule and the utilization of the system.

e. Solar Water Heating for Metal Processing - The Koldair Company, located in Giza, manufactures water coolers, freezer units, commercial air conditioning equipment and window unit air conditioners. Metal parts for these products are chemically treated in dipping tanks prior to painting. Several of the treatment operations (degreasing, phosphatizing, chrome dip and one hot rinse) require water at 70-80°C. Two new automatic production machines are being installed which will provide continuous chemical treatment and subsequent painting of metal parts for window units and water coolers. The energy required to maintain the desired bath temperatures in the dip tanks and also provide a forced air drying prior to painting for these two machines is 4000 to 5000 lb steam/hr. This energy rate would be extremely high to utilize a solar system, and there is not enough area to mount collectors for such a capacity. However, a more reasonable use of solar would be to heat the water which is used to fill the tanks initially. The total daily water needs for this application are estimated to be about 30,000 gallons. This requires 50,000 ft^2 of flat-plate collectors producing $27X10^6$ BTU/day. In addition, a storage tank is required. This solar energy system would be displacing No. 2 fuel oil which is presently burned in the plant boiler.

2. Photovoltaic Power Applications

Another means of collecting and utilizing solar energy is through direct conversion to electricity by solar cells or photovoltaic (PV) devices. Solar cells were first developed for use in space, providing the electrical power used by space satellites. They are now routinely applied terrestrially to power a multitude of applications in remote locations, including communications equipment, cathodic protection for piping and structures, remote sensing, navigational aids, water pumping, etc. The proposed PV applications are to be field tested to collect data on their performance in remote areas not grid-connected, such as the fishermen shelters, so that actual cost and performance data can be collected. The pumping applications were chosen as a result of the GOE desire to acquire continuous data on those systems which have potential for widespread replication. The desalination systems, both PV and wind-powered, will provide much-needed comparative economic data with conventional systems.

Solar cells are manufactured from silicon using techniques and equipment basic to the solid state electronics industry. The individual cells are packaged in modules which are connected together into arrays to provide the desired power. Although the equipment, facilities, and techniques required to produce the basic device are not likely to be rapidly adopted by developing countries, the production of modules, arrays and supporting hardware could be easily diffused into the host country's manufacturing sector.

To complete the photovoltaic system, a power distribution and controls subsystem and optional battery storage are included. Both concentrators and flat-plate arrays have been developed; however, only the flat-plate arrays have a record of experience in long duration field tests. Therefore, for the applications proposed, only flat-plate units will be used. The array sizing in the following discussion is in terms of peak watts which refers to maximum electrical output of the array (essentially the output at noon on a clear day).

a. Photovoltaic-Powered Fishermen Shelter Systems - The proposed 680 Wp photovoltaic (PV) power system will supply 1.9 kw-hr/day of electrical power to each of three shelters for fishermen on Lake Nasser. Each PV system will have the potential to supply power to one shelter for electrical lights for the common areas, a small refrigerator/freezer for storage of medication and vaccines, a water pump and a water purifier for potable water. The water pumps will supply water for domestic use, irrigation and potable needs. The PV power system will be low-voltage to enhance personnel safety and will be designed for unattended operation. The final sizing of the PV array and battery as well as the final selection of uses for the power provided will most likely vary somewhat to meet the needs of each site. The loads will all be DC-powered to reduce system cost and increase system reliability through the use of fewer components.

b. Photovoltaic-Powered Irrigation Systems - Solar power for pumping irrigation water is idealy suited for small farms where low lift pumping is needed and the demand is regular over much of the year.[8] The need for irrigation and water pumping exists throughout Egypt. This application is designed to use solar energy to provide low head pumping for subsurface irrigation.

The PV-powered irrigation system will consist of a 250 Wp PV array, controls, and a low head water pump designed for 150 m^3/day at a 1.5 meter head or 75 m^3/day at a 3.0 meter head for operation from canals and shallow wells. To reduce maintenance and system cost, the system will be designed without storage and operate only when the sun is shining. The water would be discharged into a holding tank for subsurface irrigation.

8 UNDP Project Report, "Small-Scale Solar-Powered Irrigation Dumping Systems," July 1981.

A subsurface irrigation system consists of main distribution tubing from the holding tank and double wall tubing under the plant bed. The water is placed directly in the root zone for the plant's use. Since subsurface irrigation requires about one-third the water per crop as does flood type, three times as much land will be irrigated by subsurface as by flood methods. Thus the pumping systems will be capable of irrigating up to 15 feddans by subsurface. Since the pumping system is portable, these land areas would not need to be contiguous, but could represent various fields within a reasonable distance of each other.

c. Photovoltaic-Powered Reverse Osmosis Desalination System - The proposed field test is a reverse osmosis desalination pilot plant powered by a photovoltaic system. Water desalination by reverse osmosis is energy efficient and commercially available. Recent advances in membrane technology have lead to the design and construction of very large, conventionally-powered plants. In Egypt, solar-powered reverse osmosis systems appear to be attractive in the frontier governorates. The modularity of reverse osmosis and solar systems is an attractive characteristic lending itself to this sub-project's field test approach.

It is proposed that the field test be conducted near the center of the village of El Kasr at an existing brackish water site. The system proposed will produce 10-20 m^3/day of fresh water for the village. A 38 kWp PV array will supply sufficient electrical energy on an annual basis to power the system. Excess power during daylight hours could be fed into the local grid. When the output of the PV array is insufficient to power the unit (or for more efficient production of potable water), grid-supplied power will be used. However, a buffer storage system will be considered in the detailed design of the field test to provide a degree of autonomous operation.

3. Wind Power Applications

Where appropriate wind conditions prevail, power generated by wind machines is a very viable option for producing large amounts of energy. The better Egyptian locations appear to exist along the Red Sea coast, based on the data available to the project design team. Additional wind measurements will be required to select the specific sites for installation and to determine final detailed specifications of the wind machines. This is due to the limited period of time, four to eleven months, which the available wind data covered. The wind applications should offer a viable economic alternative to expensive traditional systems due to the remoteness of the applications chosen. Once installed, these systems will be carefully monitored and data collected.

Discussed below are two wind power applications designed to meet specific energy needs which typically exist in the Mediterranean coast and Red Sea regions.

a. Village Wind Power System - There are many out-reach villages in Egypt which the government wishes to electrify. Unfortunately, the existing grid will not be extended to most of these villages because of the distance involved and their relatively small size. Small wind energy conversion systems (WECS) may offer a viable alternative to grid interconnections for these remote villages. However, lacking adequate conclusive wind data, a specific village for setting the field test could not be identified. Therefore, two generic sites were used to size the field test based on assumed wind regimes.

A wind turbine capacity factor of 5.2% was chosen for the low wind regime site and a capacity factor of 13.0% for the high wind regime site. Though the chosen capacity factors are less than normally used in WECS sizing, they represent those considered attainable using the Egyptian wind data available. The village energy requirements considered are those representative of small Egyptian villages. One requires 50 kw-hr/day and the other requires substantially less, 10 kW-hr/day or 18.25 mw-hr/yr. and 3.65 mw-hr/yr respectively. Based on these considerations, a 4 kW_R and 20 kW_R wind turbine were used in the conceptual design analysis. The 20 kW_R system was used in determining the field test costs and in peforming the system economic analysis. The 20 kW_R machine, which is rated at 12.9 m/sec, would supply 18.25 Mw-hr/yr with three days battery storage. A 4 kW diesel back-up is recommended for the field test only. The concept being proposed for future replication is a stand-alone wind system with storage.

b. Wind-Powered Reverse Osmosis Desalination System - The entire Red Sea coast of Egypt lacks and urgently needs fresh water for present population and will require a tremendous increase in the fresh water supply to support the projected development of the region. Wind surveys indicate that the Red Sea region and Hurgada, in particular, have moderate velocity prevailing winds. The proposed field test is a reverse osmosis desalination pilot plant powered by a wind machine. As noted in the PV-powered reverse osmosis field test in 2.c., solar-powered reverse osmosis systems appear to be attractive options for applications in the frontier governorates and lend themselves to field tests of pilot plants.

A 24m diameter blade, 200kW rated wind machine or a suitable combination of other size machines will be installed along the coast in the Red Sea region. This size machine will generate a peak power of 76 kW and an average daily power delivery of 500 kW hr/day using available Hurghada wind data or 61 kW peak and 750 kW hr/day using available Ras Ghareb wind data. This is sufficient electrical energy for a reverse osmosis unit in the 40-75m^3/day capacity range using 43,000 PPM Red Sea water. Detailed conceptual design studies will be required before the final system configuration is selected. In a stand-alone system, the wind energy could generate power to charge a battery or pressure vessel storage system which would power the reverse osmosis unit. For this field test, the local grid will be used as a back-up power source. However, a buffer storage system will be considered in the design of the field test to provide a degree of autonomous operation.

4. Solar Thermal Power Applications

The requirement for refrigeration of cold storage for fish, meat and vegetables can be satisfied through the use of a solar-powered Rankine cycle refrigeration system developed in the U.S. for the DOE. The system has been field tested for several years in space cooling applications. This solar thermal application is not yet economic in the U.S.; however, the GOE has a great need for these systems in remote areas throughout the country and will need data on their economic and technical feasibility here in Egypt.

Solar Rankine Cycle Cold Storage System - This field test is for a solar-powered cold storage facility. It consists of flat-plate, double glazed collectors ground-mounted on a metal truss. The heated water vaporizes Freon which drives a high speed turbine. This turbine drives the compressor on a common shaft through an electric motor. The output of the compressor is a brine solution which is used to condition a conventional cold storage locker. Capacity may be augmented by multiple unit installation. Each unit is 7 ft X 7 ft X 12 ft, weighs 9000 pounds, and has a 25 ton capacity at 1.7 - 7.2°C. Some minor modifications will be needed to match the Egyptian grid power which is 220V 50 cycle versus the current design of 120V 60 cycle. Solid state controls are integral to the unit. The turbine will derive its heat for operation during the night hours from an above ground insulated water storage tank. It will include a solar thermal Rankine cycle powered refrigeration system to provide cold storage at 1.1° to 3.9°F for up to 100 tons of iced fish. A 6,000 ft^2 double glazed flat-plate collector with storage tanks will allow the system to operate on an 18 hour per day duty cycle. A terminal building will be constructed to house the 100 ton iced fish cold storage lockers, a conventional 20 ton ice machine, insulated storage for 40 tons of ice, service area, and receiving and loading docks. Water lines, pumps, and controls for supplying water from the lake for the ice machine and cooling tower will also be installed. Power controls for the ice machine, water cooling tower, water pumps, ice handling conveyors as well as back-up power for the solar-powered refrigeration unit will be provided by a dual diesel powered generator unit.

D. Supporting Analyses

The Supporting Analyses Task constitutes a key element of the Renewable Energy Field Testing sub-project. This element will provide both the USAID and the GOE with critical data and technical, economic, and social analyses needed for decision-making and project implementation. In addition, this element will also provide AID/W with a valuable source of information which will be part of a proposed evaluation network. AID/W has agreed to furnish technical assistance to the Mission to establish a standardized system for measurement of economic, technical, social and institutional factors relating to Egyptian renewable energy projects (task four). Four tasks will be conducted under this sub-project element: (1) The definition of additional candidate renewable energy technologies and applications and associated field tests; (2) the

acquisition and analyses of technical and social data and the development of design and performance specifications required for specific field tests; (3) continuing economic and environmental analyses covering both currently planned and future field tests of renewable energy applications; and (4) the establishment of an information system on this and other Egyptian renewable energy projects as well as state of the art developments which will permit a judgment as to the feasibility of their replication in the five-ten year timeframe.

A number of renewable energy applications have been identified by the GOE counterparts for potential field tests in Egypt on the basis of their utility to the Egyptian people. Some of these applications, although they may be desirable, are not now technically or economically competitive with conventional or other alternative energy systems and have been excluded from current consideration. Other applications and field tests may be practical but require further definition and additional data. Examples include:

- Industrial applications in chemical, petrochemical, paper and pulp and mining plants;
- Fuel oil preheating;
- Frozen storage, especially in the Governorates of Upper Egypt;
- Secondary and tertiary recovery in oil fields;
- Passive solar systems;
- Local electrical grid supplementation;
- Agricultural applications; and
- Numerous applications and field tests specific to the development needs of the Frontier Governorates, e.g., Siwa in Mersa Matruh, El Kharga in New Valley and Berenice on Red Sea.

Further analyses are required to ensure that applications are defined and optimized with respect to technical design parameters, size, and location of field tests. These analyses will require additional information on potential test sites to ensure that the inputs to the analyses are correct and as complete as possible. In some cases, field test sites need to be revisited, or visited for the first time, to acquire the necessary topographical, geological, application and/or solar data. Once all of the pertinent information has been acquired for a specific application, analyses will be carried out to select the preferred field test conditions and to define candidate field tests.

The second task in this sub-project element is the acquisition and analyses of technical and social data for specific field tests. In the majority of the field tests proposed for implementation in this sub-project, design and performance specifications can be developed by

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analyses of existing data and a limited survey of technical requirements for each site. However, it is expected that, in some cases, existing data will be inadequate and potential sites will have to be more thoroughly instrumented to obtain all the required technical data. Examples include the acquisition and analyses of wind data, environmental conditions (sand, salt spray, water quality, wind loadings, etc.), and plant operational and process heat requirements. Social data collection, described in more detail in the Social Soundness Analysis, Section IV.C will form part of task four, the information system.

The third task of the Supporting Analyses element is a continuation of economic analyses. This involves several different types of analyses to develop the decision-making data necessary for the design of current and selection of future field tests within the sub-project. One class of analysis involves a more intensive examination of the cost-effectiveness of the renewable energy technologies (those proposed herein, others, and hybrid combinations) relative to conventional energy sources then could be performed during the preparation of this plan. This type of analysis would consider the effect of reduced solar system costs as a result of improvements in technology or higher production rates for solar systems; or the increased cost of conventional energy due to higher fuel costs; and considerations of system reliability, operations and maintenance, and fuel availability and transport. New cost-effective solar applications may also be identified due to these same factors. A second area of analysis will examine the size of the potential Egyptian market for various solar applications as a function of the energy requirement of the application, i.e., the number of shallow well pumping installations as a function of the required pumping energy. This type of analysis will be used to identify specifications for the optimum size of solar energy sources for different applications within Egypt. The analysis may also determine that certain sources may meet a number of different applications cost-effectively if they are within a given size range. In addition, continuous environmental analyses will be conducted on the field tests so that information can be made available on their impact.

Task four, the establishment of an information system on Egyptian renewable energy projects will provide a mechanism for collection of social, environmental, institutional, economic, and technical data on a continuing basis. The information will be important not only for project monitoring and evaluation, but also for providing the basis for decision-making for future Egyptian activity in renewables. It is anticipated that the method of data collection on the AID-funded renewable energy project will be utilized for all other renewables projects so that a set of easily comparable, comprehensive data will be generated for analysis and dissemination.

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Project monitoring and evaluation should:

- track project activities, inputs and outputs, for level of achievement;
- identify present problems and future problems;
- provide mechanisms for analyzing problems and identifying possible solutions;
- measure project impacts;
- provide the correct information to the correct individuals, agencies, villages, etc, at the correct times to support good decision-making related to the above items;
- answer all key questions about technology performance and transferability.[9]

It will be the responsibility of the field test participants to collect data on a day-to-day basis. However, QHREA, NASA LERC and the various sub-contractors will give guidance to those participants. In order to have comparative data it will be necessary to collect, for example:

1. Data on system design, and on adaptations in system design.
2. Data on measurements which are mostly physical data; that is, measurements of energy availability in sun, water, biomass of energy inputs and outputs for a system; operating data and data on work actually accomplished by a system measured in other than direct energy output.
3. Impact and effectiveness data on both the technology and the project implementation strategies in terms of economic, social, and environmental criteria.[10]

A detailed system for data collection, analysis and dissemination will be required from the project management contractor in the initial stage of the project. As mentioned above, AID/W will be assisting in that effort. For an illustrative set of data categories, see Annex Q.

It is anticipated that once EREDO gets fully underway, perhaps in three-four years, the information system developed under this sub-project can be adapted for EREDO so that the analysis of data will be standardized and easily comparable.

The analyses of the data provided by the information system will be utilized by the Supreme Council on Renewable Energy which serves as an advisory body to QHREA. However, the information will be fed into the energy data bank of and be utilized by the Organization for Energy Policy and Analysis (OEPA) to be established as the implementing agency for the Energy Policy sub-project which will be seeking, in cooperation with this

sub-project, to provide information and analyses on the proper role of renewables in the overall energy sector strategy. The Supreme Council on Energy, (under which the Supreme Council on Renewable Energy is a sub-council), then, will have the proper information and analyses deemed necessary for informed decision-making on renewable energy applications and technologies.

E. Training

There is a growing interest in alternative renewable energy sources in Egypt. (See Section II. B.) It is recognized that there is a need for better understanding of the technologies involved, their economics and their practical applications. This understanding must be implanted on many levels within Egypt: the policy/decision-makers level; the engineers and technical managers; the users; the general public and public and private sector investors and manufacturers.

Training to be accomplished in this sub-project may be classified into three categories: general, field test-related and information dissemination:

1. General

In order to strengthen Egyptian capability to work in the area of renewable energy, a range of training activities will be conducted in areas such as project and contract management, energy management and economics and solar systems and engineering.

The policy/decision-makers, which include GOE Ministry and Governorate officials and industrial executives, will be provided with a broad exposure to renewable energy technology and its potential. Several seminars are planned which will address the economics and impact of solar technology and cost projections. Specific applications in the industrial, agricultural and domestic areas will be analyzed, showing trends in the energy field, potential for replication and technology transfer. Two seminars per year will be given by U.S. experts in Egypt for from 20-50 persons per session. There will also be technical seminars given by QHREA as well as other Egyptian experts in areas not covered by the U.S. experts or areas particularly relevant to Egyptian needs. These seminars will be held twice a year and, drawing from prior experience, the GOE expects at least 20-50 participants from both the private and public sectors.

[9] "Uniform Data Collection and Information Systems for Renewable Energy Projects," by George Burrill, a paper prepared for the SERI Workshop on Evaluation Systems for Renewable Energy Systems, Boulder, Colorado, Feb. 1980.

[10] op. cit.

Engineers and technical managers, those reponsible for implementing GOE energy policies, will receive in-depth technical training in theory and system design enabling them to design, install and maintain renewable energy systems.

Short-term training of 120 p.m.'s (4 persons/year to six-month courses) will be given over the five-year life of project at U.S. institutions in the fields cited above. In addition, the GOE will provide for five persons to attend at least two courses/year in Egypt over the five project years.

2. Field Test Training.

User training will greatly effect the successful operation of the field tests. Site managers assigned by the QHREA to each field test will be trained at a U.S and/or Egyptian institution in aspects of renewable energy technology. Specific, intensive, on-the-job training by the U.S. sub-contractors performing the detailed design and installation of the field tests will also be provided to the site manager and other site personnel and users. During installation of the field test, the site personnel will participate in all phases of activities. Manuals and instruction on operation and maintanance will be provided. The check-out phase of the field test will allow site personnel to gain supervised hands-on experience with the system. During the two year operation period, site personnel will be working with the U.S. sub-contractors should problems, malfunctions or questions arise.

3. Information Dissemination.

The general public, ultimately the consumer and private enterprise, will be informed of the Renewable Energy Field Testing sub-project through television and radio as well as printed reports which will be used to describe solar energy and how it is being used in Egypt. The GOE will utilize the above-mentioned seminars to disseminate information to the public concerning this activity. Visits to field tests and information brochures will popularize the utilization of solar energy and provide information on application specifics, available technical assistance and training and seminar opportunities. This information will be disseminated by QHREA, other MOE agencies as well as USAID/Cairo on a regular basis once the project has begun. The contractor will work with QHREA on the form and substance as well as best mechanism for dissemination of the information, which will form part of the information system to be developed during the first three months of the project.

All training tasks will be coordinated and integrated with activities being conducted in the Energy Policy and Planning sub-project.

F. New Initiatives

One of the elements proposed for the Renewable Energy Field Testing sub-project is the New Initiatives task. Concepts and proposals, both unsolicited and requested, can be expected to be received by AID and the Government of Egypt for new field tests during the lifetime of this sub-project. Additional field tests will also be identified as a result

of the application study being performed under Supporting Analyses. As the initial field tests are implemented, improved and/or new concepts probably will be formulated by the sub-project team as additional detailed experience in Egypt is gained. Criteria for selection and actual selection of New Initiatives will be determined by Qattara in collaboration with NASA LERC and USAID. It is expected that the criteria for the New Initiatives will be potential for economic, social and technical feasibility; priority of the application in the GOE renewable strategy; governorate and participating entity support (both technical and financial); opportunity for replicability.The New Initiatives element will provide the GOE with a resource for assessing the merits of any proposal or suggested concept for a renewable energy system field test as well as fund a limited number of new starts. It is anticipated that the New Initiatives will be undertaken with private sector companies.

Many of the new proposals may appear, initially, economically and socially attractive and technically feasible but will be of such a magnitude that the complete approval cycle (i.e. a Project Identification Document and Project Paper) will not be justified. Nevertheless, attractive proposals, both large and small, will be analyzed and evaluated. The technical soundness and feasibility, the projected cost effectiveness, if implemented on a major scale, and the relationship to the renewable energy field tests and GOE goals in the sector could be analyzed. The New Initiatives element will also support the initial selection functions required before the procurement of hardware. These functions include working with the QHREA and appropriate Egyptian organizations on selection of a specific site or sites for the proposed new field tests. The latter function will be performed in conjunction with the Supporting Analyses task, especially in those instances where obtaining detailed technical information for a site is required for a site selection decision. When the proposed field test has progressed to the procurement stage, the internal sub-project responsibilities and resources will transfer to the Field Testing element. Training for the new systems will be done by the Training Task in a fashion similar to the initial field tests.

A typical life cycle for a successful field test is presented in Figure III-5. There are many places in this cycle prior to the decision to implement the field test that a concept or proposal can be rejected and many of these are during the cycle proposed to be supported by this New Initiatives element. All contracting for field tests in the New Initiatives element will be done on a host country contract (HCC) basis. During the initial stages of the project, training in project, financial and contract management will be made available to the Egyptians so that HCC management should go smoothly. In addition, on-the-job training in the field tests will prove invaluable as QHREA moves into a HCC mode.

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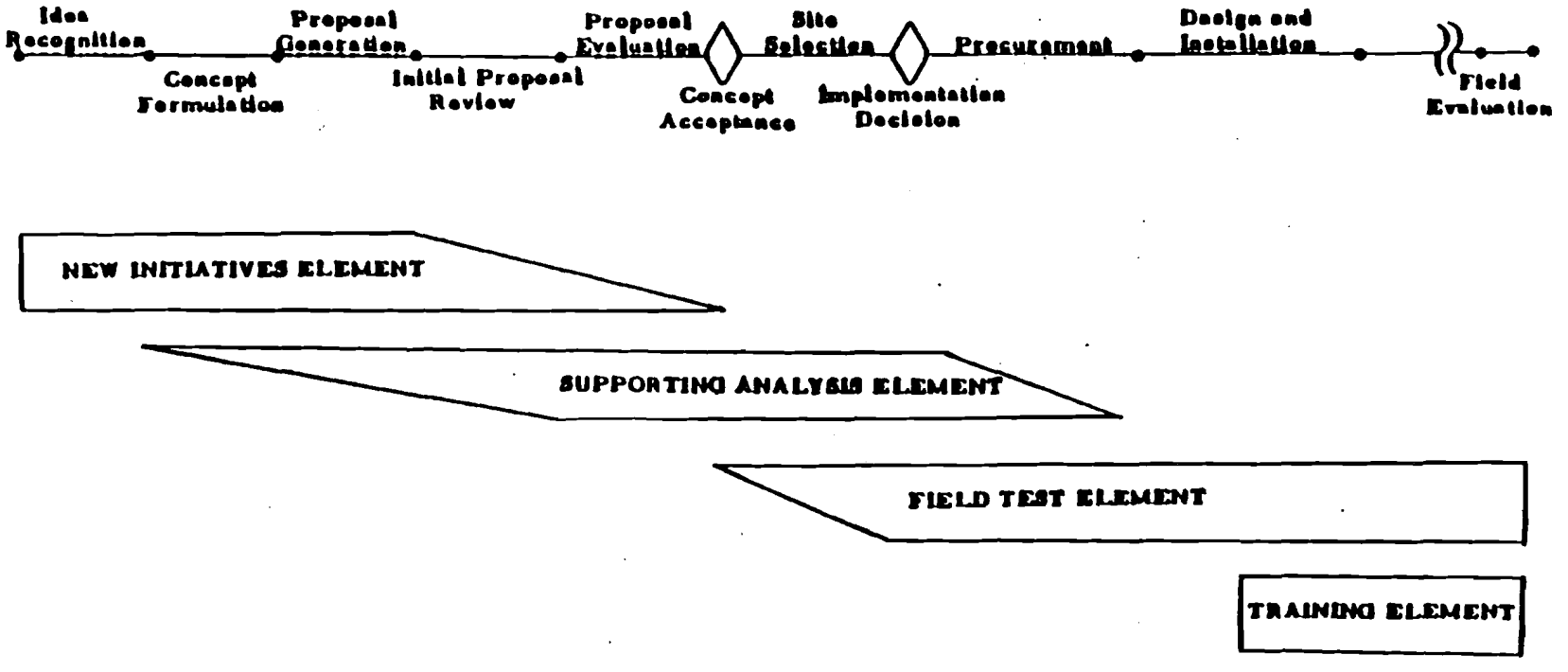

Figure III-5. Support During a Typical Field Test Life Cycle

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IV. SUB-PROJECT ANALYSES

A. Technical Feasibility

1. Appropriateness of the Technology

Each of the applications of renewable energy technology was selected for the sub-project based on worldwide experience in similar applications. Proven technology and perceived low-risk field tests were selected and matched to GOE-identified needs and priorities. The equipment components included in the preliminary conceptual designs described in this Project Paper are commercially available from U.S. manufacturers, as well as from manufacturers in other countries. Due to the fact that interest in the solar technologies has spawned U.S. industries which have manufactured and installed such equipment only in the last 5-10 years, long-term system performance has yet to be established for some applications. However, intensive efforts in U.S. research, development and demonstration, sponsored largely through past government programs, have resulted in accelerated commercialization of many renewable energy technologies. These efforts have also served to increase the awareness of both users and manufacturers of the potential benefits that renewable energy resources offer.

While the current U.S. Federal Government policy decisions on energy R and D and commercialization activities affect many renewable energy technologies, the types of technologies and application proposed here should not be significantly impacted. Solar heating technology, for example, is probably far enough along such that withdrawal of federal funds will not, itself, affect commercial status. Also, most of the technologies proposed here are inherently small and modular in nature, and economic and financial analyses of projects costs can be very attractive. Thus, the incentives for market development are still there.

Recently, as part of its preparation for the 1981 U.N. New and Renewable Energy Conference in Kenya, the United Nations Economic Commission for Western Asia identified their most promising renewable energy sources for applications in the Arab world. [11] These applications with estimated implementation time-tables are given in Table IV A-1. The U.N. Commission's recommendations relating to the renewable technologies and applications proposed in this Project Paper are shown in the Table.

2. State of the Proposed Renewable Energy Technological Applications

Each of the renewable energy technologies proposed for application in Egypt has been demonstrated in the U.S. and other foreign countries. A brief summary of the technological applications follows:

[11] U.N. Economic Commission for Western Asia, "New and Renewable Energy in the Arab World", Beirut, 1981

TABLE IV A-1

PROJECTED TIME-TABLE OF SOLAR APPLICATIONS

IN THE ARAB COUNTRIES*

Application	Product	Area of Implementation	Estimated Year	
solar dryers	preserved dried food	sea shores & rural areas	now	*
solar stills	fresh water	individual houses and sea shores	now	*
solar pumps	pumped water	remote rural areas	now	*
solar pumps	pumped water	all rural areas	1990	*
solar greenhouses	vegetables	all rural areas	now	
solar refrigeration	preserved food, ice	fishing villages and pastoral settlements	1985	*
solar air conditioning	conditioned space	cities	1990	
solar heating	comfort heat	cities	now	
water heaters	hot water	cities	now	
solar electricity	electricity	telecommunications	now	
solar electricity	electricity	remote areas	1985	*
solar electricity	electricity	general applications	2000	
solar furnaces	heat 1000°	mining	1985	
solar heat	heat 200°	industry	now	*

*U.N. Economic Commission for Western Asia: New and Renewable Energy in the Arab World, Beirut 1981.

*Areas related to Project Paper activities.

- Solar Industrial Process Heat - The application of solar thermal energy to supply industrial energy demands, especially low-grade heat, is one of the most appropriate uses of solar energy. One survey of "the most adaptable" applications for U.S. industries is shown in Table IV A-2.[12]

Some representative current U.S. demonstration projects of low-grade solar industrial process heat are:[13]

Location	Industrial firm	System Description	Collector Type	Temperature	Status
AL-Athens	Sweet Sue Kitchens	Process hot water and boiler feed-water.	Shallow ponds	55	Design only
CA-El Centro	American Linen Supply	Process hot water and boiler feed-water	Parabolic	93	Design only
CA-Fresno	Red Star Industrial Laundry	Preheat boiler feedwater	Flat plate (water)	66	Operational
CA-Sacramento	Campbell Soup Co.	Process hot water washing for cans	Parabolic trough & flat plate (water)	85	Operational
FL-Jackson	Anheuser-Busch, Inc.	Process hot water for pasteurizer	Evacuated tube	66	Operational
MS-Canton	LaCour Kiln Services, Inc.	Hot air for kiln drying via W/A exchanger	Flat plate (water)	82	Operational
NM-Grants	Sohio Petroleum Co.	Process hot water ore processing for uranium	Shallow ponds	55	Operational
PA-York	York Building Products	Hot water to cure concrete blocks	Linear array mirrors fixed	82	Operational

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12 Wilson and West, "Solar Industrial Process Heat - A Study of Applications and Attitudes," SERI/TR-98348-1, April 1981.

13 Kreith and West, "Economics of Solar Energy and Conservation Systems; Vol II Solar Applications and Cost," CRC Press, 1980.

TABLE IV A-2

U.S. Industrial Processes Nominated as "Most Adaptable" to Solar Energy[a]

Industrial Process Nominated	Temperature Range	Number Nominated (GRI Project)
Boiler feedwater or make-up	60°- 90°C	58
Clean-up water	60°- 80°C	8
Drying and curing ovens (e.g., paint, milk, print)	135°-200°C	30
Rinse/wash/plating/storage tanks	50°- 90°C	34
High-temperature furnaces, kilns	285°-815°C	10
Process mixing and steam generator (e.g., vats, cookers, chem milling)	50°-285°C	40
Low-temperature ovens (e.g., air preheat, space heat)	30°- 90°C	6
Oil field heater/treater	100°-175°C	2
Electric Processes (e.g., extrusions, arc welding, presses)	60°-815°C	0
No application for process heat	- - -	12
Total Interviews		200

[a] "Most Adaptable Process" means, a process which can use solar thermal heat with moderate physical change to existing equipment. Electronic manufacturers with electric bake ovens at 455°C (850°F) and above, and heat treating companies have little hope of adapting their equipment even for pre-heat.

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Foreign countries active in commercialization programs in this area include: Mexico, Spain, France and Australia. Australia, in particular, has ten operational solar industrial process heat installations-all supply low-grade heat for processed hot water, cleaning, and pasturizing applications.[14]

The technological applications proposed here for Egyptian dairy products, poultry, textiles and metal processing industries closely parallel current demonstration projects. Their technical viability has been clearly established. In addition, since these industries represent a majority component of the Egyptian industrial base, the potential for a significant renewable energy contribution exist.

- Solar Agricultural Applications - A common energy requirement for agriculture is for low-grade heat(40 to 90°C) in applications such as grain and crop drying. The U.S. Department of Agriculture has sponsored a number of demonstration projects for solar grain drying and livestock shelter heating through its Energy Research Program and the Cooperative Extension Service. U.S. operational demonstrations of solar hot air systems include:[15]

Location	Industrial Firm	Process	Collector Type	TemperatureoC
CA-Gilroy	Gilroy Foods Inc.	Onion Drying (Preheat)	Evacuated Tube	99
AL-Decatur	Gold Kist Inc.	Soybean Drying (Preheat)	Flat Plate	60
CA-Fresno	Lamanuzzi & Pantalco Foods	Fruit Dehydration	Flat Plate	63

[14] Saunders, "Status of Solar Energy Research and Development in Australia," Solar Energy Research Institute of Western Australia, Report Number 1007, May 1981.

[15] Wilson and West, loc. cit.

Worldwide experience in using solar energy for agricultural applications is extensive. Obviously, drying food, agricultural products and fish by solar energy is very old practice. Recent development center around improved system efficiency, time required to dry and protection of the products from dust and insects. In the Arab countries, Iraq, Lebanon, Sudan and Saudi Arabia are actively studying solar systems.[16]

The proposed fruit dehydration field test in Egypt is an extension of the U.S. demonstrations and is a simple concept to implement. The field test as configured is not intended to represent a prototype for future replication. (The utilization, efficiency, and economic of the field test system are marginal.) Rather, this field test is intended to introduce recently commercialized technology to the Egyptian agricultural community in a relatively simple, low cost and highly visible demonstration. Applications relevant to this field test technology appear to be numerous and will be investigated under the Supporting Analyses Element of the project.

- Photovoltaic (PV) Power Systems - Applications for photovoltaic systems in isolated rural areas of the world are numerous. Originally developed under the U.S. space program, PV cells and systems are now being manufactured by several major energy companies in the U.S., France, West Germany, U.S.S.R., U.K. and Japan. U.S. demonstrations of small PV-powered system applications, such as forest towers, highway warning signs, light houses, village systems, communication relay stations, etc, began in the mid 1970's and have established the technical feasibility of such concepts. The modularity of the systems, the fact that they can use both direct and diffuse solar radiation, the simplicity of installation, the low level of maintenance skills required for operation-all make this technology particularly appropriate for small electrical power systems in remote areas. A partial list of demonstrations and commercial installations of small PV power systems includes: [17]

System	Country	Company
Water Pumps	France	Pompe-Guernard Briau
Water Pumps	Tunisia	Leroy-Somer Elf-Aquitaine
Water Pumps	W. Germany	Telefunken
Water Pumps	U.S.A.	Solar Electric Int'l Arco Solar A.Y. McDonald Solarex
	Extensive demonstration program by UNDP [18]	

[16] U.N. Economic Commission for Western Asia, loc. cit.

[17] NASA Photovoltaic Marketing Studies.

[18] Halcrow and Partners, "Small-Scale Solar-Powered Irrigation Pumping Systems, Technical and Economic Review," UNDP Project GLO/78/004, September 1981

Communications	France	Thomson CSF
	Germany	Telefunken
	Australia	Telecom
	Gabon	Motorola
		Elf-Gabon
	U.S.A.	Arco Solar
		Motorola
	Jordan	JTC
	Holland	Phillips
Refrigerators	Belgium	IDE
	France	Photon
	UK	Lucas
	W. Germany	Electrolux
	Ireland	Champion
	U.S.A.	Arco Solar
		Solar Power
		Motorola
		Solarex

Related CDS/WHO/AID Project consists of deployment of systems by NASA in thirty countries

Village/Community/ Distributed Power	Holland	Various
	Tunisia (with NASA)	Solar Power
	Gabon (with NASA)	TBD*
	Italy	Various
	Marshall Islands (with NASA)	Hughes Corp
	Spain (with NASA)	TBD*
	Australia	Arco Solar
		Martin Marietta
		Solar Power
	Japan	Various
	Gabon	Elf-Gabon

The proposed field tests for PV-powered systems relate to two of the above system applications - water pumping and electrical power for remote fishermen shelters.

- o <u>Solar Refrigeration</u> - Refrigeration and frozen storage facilities represent a critical need in developing countries, especially in remote areas. In Egypt, the governors of those governorates visited by the Project Team members consistently stressed their needs in this area. One frozen meat storage facility in Qena of approximately 75 tons capacity, for example, serves the <u>entire</u> needs of the governorates of Upper Egypt.

Solar-powered refrigeration technologies are being actively investigated on many fronts. The U.S., CDC and AID, in cooperation with WHO and under the project management of NASA, are engaged in an extensive program to develop and field test 100 liter-size medical refrigerator/freezers powered by photovoltaics. These systems are currently operational in India, Indonesia and the Maldive Islands. Future installations in 30 additional countries are

* To Be Determined

scheduled in 1982. The Australians have 10 operational demonstrations of various solar cooling technologies.[19] Austria has developed a 10 kw solar power plant, employing concentrating collectors and an organic Rankine cycle turbine, for applications in developing countries.[20]B. This power plant could be used to drive a compressor in a refrigeration cycle. The Japanese with Sanyo Corporation are demonstrating a solar air conditioning unit incorporating an absorption chiller and evacuated tube collectors. Solar refrigeration projects are underway in Algeria, Bahrain, Kuwait and the Sudan.[21] One operational demonstration comparing a solar thermal absorption unit with an organic Rankine cycle unit (80 ton capacity) is underway at Los Alamos.[22]

The most extensive program in solar cooling is being conducted under a joint U.S.-Saudi Arabia cooperative agreement called SOLERAS. The program consists of engineering field tests of solar-powered conventional cooling technologies and the establishment of solar cooling laboratories at four Saudi Arabian universities. Four commercial-sized active solar thermal systems were installed in June 1981 in Phoenix, Arizona. The four systems vary in size from 10 to 18 tons cooling capacity. Two of the systems used organic Rankine engines to drive conventional compressor units. The others are absorption cooling systems. The purpose of the program is to evaluate conventional system modifications aimed at advancing overall system performance while lowering system design, installation and maintenance costs. The systems are designed for use in both hot-dry and hot-humid climates, conditions that exists both in the U.S. and Saudi Arabia as well as Egypt.

Solar refrigeration systems using concepts similar to the above are currently technically feasible. However, most systems display relatively low overall efficiencies and/or involve complex mechanisms. The current economics of these systems, are, though very dependent on the application, generally not attractive. Higher temperature systems will have to be developed for the solar thermal plants or significant price reductions will have to occur for the PV-powered plants to be economically viable.

The solar refrigeration field test proposed here was configured around the SOLERAS program field test units. The conceptual design meets a current critical need for cold storage in Fayoum. The purpose of the field test is to introduce current solar refrigeration technology to the Egyptians and to bring the commercialization of such systems in Egypt at cost competitive with conventional cooling systems.

As noted in the detailed field test descriptions, alternative concepts of solar refrigeration systems (i.e., in addition to Rankine units) will be defined meeting the Fayoum means and a comparative evaluation will be conducted. Technical and economic feasibility will be thoroughly assessed prior to initiating the field test.

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19 Saunders, loc. cit.

20 Federal Press, "Austrian 10 KW Solar Power Plant for Developing Countries," Final Report, Vienna, 1981.

21 U.N. Economic Commission for Western Asia, loc. cit.

22 Hedstrom, "Solar Heating and Cooling Results for the Los Alamos Study Center," Los Alamos Scientific Laboratory, Report Number LA-UR-79-2706.

- Solar Desalination - Developing energy-efficient and cost-effective technologies for producing potable water is a high priority objective for many countries throughout the world. An overview of solar desalination methods has been prepared by Kreith and Luft.[23] Electrodialysis, reverse osmosis, distillation, vapor compression, freezing and solar still desalination technologies can be matched to the various solar energy source technologies to produce technically viable systems. There are many active demonstrations of solar desalination concepts. Solar stills, in particular, have a long history. The U.N. Commission relating to Arab World applications contains a thorough discussion of current projects.[24] Of particular interest here are recently commercialized developments in membrane desalination technologies which are currently being used in large-scale operational desalination plans throughout the world. Membrane technologies have the least energy requirements, are modular, simple in concept, and require only an electrical source for operation. In remote areas where adequate insolation and wind energy are available and where the price of conventionally-produced water is high, wind-driven or PV-powered reverse osmosis systems appear to be very attractive.[25]

The proposed field tests in solar desalination will use commercially-available equipment configured around low-capacity and simple system designs. As presented in a detailed field test descriptions, system definitions of contending concepts, where actual application data such as input water quality and wind resource data, will be prepared and evaluated. Final field test engineering designed will be based on the best technical, social and economic options.

- Wind Power - Wind applications for rural development include three major categories: Electrical applications for small rural villages, dispensaries and education centers; direct heat applications for domestic hot water, home heating and crop processing; and water pumping applications. An excellent report on wind power for developing countries, including a listing of the numerous operational demonstration project in different parts of the world has been prepared by Mikhail. For example, Cape Verde, Kenya, South Africa and Tanzania have developed windmills for such purposes as water pumping, electricity generation and grinding. In Pakistan and Sri Lanka wind systems for irrigation have been successfully demonstrated. The Danish and New Zealand efforts in wind-powered electricity generation have been most successful.[26] Wind power is technically feasible for a multitude of applications. In most instances the decision criterion will be economic feasibility.

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[25] MIT Energy Lab, K.F.Dudley, "Solar-Powered Desalination in Egypt: A Design and Cost Analysis," MIT-EL 81-015WP, March 1981.

[26] Mikhail, Amir, "Wind Power for Developing Nations," SERI/TR-762-966, July 1981.

The proposed wind-powered field test is directed toward electrification of small rural villages in Egypt. As in the preceding field tests, an assessment of the application coupled with actual wind resource data will be performed before initiating the design and installation of the field test.

In applying the above technological applications in Egypt, the following considerations were made during project selection:

- For the solar thermal and PV systems applications, sites in Egypt should provide solar insolation which is comparable to the most favorable site in the U.S. (i.e., Southwest U.S.), due to the near absence of cloud cover which would attenuate direct solar radiation. In addition, the relatively high ambient air temperature which can be anticipated in Egypt will serve to minimize heat loss from solar thermal energy collection and storage systems, thereby increasing system efficiencies when compared to similar systems in the U.S. Thus, for a given capital investment in solar systems, an Egyptian site should provide more available energy than will a site in the U.S.

- The application of wind energy systems must be based on the speed and constancy of winds at the installation sites. It is imperative that reliable wind data for a given site be obtained before proceeding with construction of a wind energy system.

- Personnel must be available at each application site who will be capable of performing routine maintenance on the renewable energy systems. As with any other eguipment used for industry or agriculture, the efficiency and effectiveness of a renewable energy system will be reduced if it is not properly maintained. All of the systems proposed involve relatively simple and reliable components (e.g., water pumps, fans, etc.) which will require little more technical expertise than is already available at each of the selected sites.

Economic Analysis

1. Introduction

Nearly every form of energy in Egypt is currently subsidized by the GOE. Because of this large subsidy the market value of energy services in Egypt diverges dramatically from the true social value or shadow price of those services. Although Egypt is a net energy exporter, the vast majority of its oil production is employed in the country to produce thermal energy and electricity. It imports nearly all of its butagas which is widely used for domestic hot water, cooking and heating. All end-use forms of these fuels (butagas, oil, gasoline, diesel fuel and electricity) are heavily subsidized. The difference between the world market price and the domestic (subsidized) price of energy represents both a loss in the total social value of Egypt's resources and a source of resource misallocation in the economy.

If Egypt were to sell more of its production in the world market at world prices, as well as not import as much refined fuels, a large amount of capital would be available to the GOE either to invest in other projects of high social value or return the capital to the private market for investment and consumption. By directly underpinning a factor of production of a consumer item, more of that item will be used than if it were properly priced. In the case of subsidized energy prices, energy is used more intensively and/or less efficiently in commerce and domestically than if it were priced according to world market prices. Because of improper pricing, therefore, energy and other resources are misallocated within the economy.

In evaluating the cost competitiveness of renewable energy technologies with conventional energy technologies in Egypt, an economic analysis using full, non-subsidized market energy prices should be performed. The economic analysis performed in this section calculates and compares the delivered, end-use prices for energy sources purchased and distributed at competitive world market prices.

The approach used for this analysis employs standard economic principles and techniques, along with preliminary engineering cost data, to calculate the price which would be charged per unit of energy delivered at the application site for a stated rate of return. The estimated capital cost of the installed renewable energy systems, operating and maintenance costs, lifetime, and net energy output are used to calculate the levelized cost of delivered energy. Each renewable energy system is then compared to conventional energy delivery systems, such as a petroleum fuel boiler/steam generator or a diesel or gasoline engine/generator, to see the range of energy prices which theoretically would be necessary to achieve a given rate of return. The renewable and conventional system performances are compared for current installations in 1981 and projected installations in 1990.

2. Methodology

There are many methods for evaluating investment projects. In this paper the net present value (NPV) method was chosen for the economic analysis of the application of renewable energy technologies. The NPV can be expressed as:

$$NPV = -C_o + \sum_{i=1}^{n} \frac{(B_i - C_i)}{(1+r)^i}$$

where Co = initial cost of the investment
i = time period
n = number of time period
Bi,Ci = benefits and costs in time period i
r = rate of return; cost of capital

The NPV is value of the discounted flow of benefits and costs of an investment and the initial cost of the investment. The investment criterion is to accept all independent projects with positive NPV or in the case of mutually exclusive projects to accept the one with the greatest NPV.

A rigorous approach would quantify the benefits and the costs for the NPV calculation as accurately as possibly by preparing an engineering design of each renewable system application, optimally configured to meet a selected and accurately defined energy demand profile. A conventional energy source would then be designed to meet the same specifications at the given site. The technical performance, installed costs, operations and maintenance costs, etc., for the renewable and conventional systems at each site would be estimated for the current year. The economic feasibility would be determined by a comparison of the NPV's of the two systems. For installations projected in the future, market penetration curves for each solar technology and application would also be prepared. Forecasts of price charges due to technology improvements would be made. A cost curve for each solar technology and application would be constructed showing expected costs as a function of scale of production, learning, and experience. Using these data projected NPV's would be calculated.

Clearly the above approach is beyond the scope of this project paper. The diversity and number of applications, the lack of definitive design specifications and engineering designs, and the difficulties in developing market penetration curves and projected unit cost curves for Egyptian applications greatly complicate such an analysis.

The approach selected here was to use a modified form of the NPV criterion to calculate the levelized cost associated with the delivery of the energy services for the applications and renewable energy technologies represented by the project's eleven field tests. In this analysis we assume a particular rate of return which should be required in Egypt for a capital investment and, given the initial and O&M costs and the energy output of the energy system, solve for that energy price per unit which must be charged to earn the necessary rate of return. The technique employs the unit value of energy, i.e., the $/kwh and $MMBtu, calculates the annualized present value of cost of the energy per unit, and solves for the "annuity" price per unit of energy which must be charged to equal the cost, given the internal rate of return. This methodology of computing levelized cost of energy as an economic performance measure is commonly accepted and frequently used in the analysis of energy systems. Computational details are derived in Annex C.

The costs and technical performance data for the renewable energy applications were estimated from the conceptual design of the field tests. Input data for each of the eleven field tests were compiled for the economic analysis of each application. The form used for this data compilation is included in Annex C. The data for capital cost, operating and maintenance cost, construction period, and life of the system were generated only for the portion of each application which was associated with the collection, conversion, and storage of the solar energy. Projected data for the 1990 installations were estimated based on conservative expectations generated by the project team members and not on formal future market forecast analyses. Input data and assumptions are given in the following section.

In order to facilitate the comparison of the renewable energy technologies with conventional energy technologies, three "generic" conventional, petroleum fuel energy sources were defined:

- o A boiler supplying heat energy for comparison with solar heating systems;
- o A diesel engine/generator of order of magnitude of 10 kw rated output for comparison with similar size solar electric systems - for use in off-grid, decentralized elective utility or remote site applications;
- o And, a small gasoline engine/generator of order of magnitude of 1 kw rated output for comparison with similar size stand-alone solar electric systems deployed in remote areas.

In the absence of specific one-to-one comparisons of conventional versus renewable systems, it is believed that the use of these three systems represents an equitable compromise. For these conventional technologies, which are assured to use petroleum fuel at world prices, the cost of fuel is escalated at a real rate of 0, 5%, and 10% per year. (A 3% real fuel escalation rate is commonly used today in economic analyses. However, historically from 1975 to 1980, actual real escalation rates were 10% per year for diesel fuel and 16% per year for gasoline. A recent study documenting U.S. industrial response on their perception of future fuel escalation rates to 1990 indicates ranges varying from approximately 8% to greater than 20%.) [27] To account for fuel transportation and distribution costs for the diesel and gasoline engine/generator site, a fixed charge equal to 20% of the first annual year fuel cost was added to the annual O&M costs for system. As with the renewable energy applications, cost and performance data were only generated for the energy supply system and not for loads, distribution, equipment and facilities which are common to the system application.

The discount rate used in the analysis was regarded as a variable. The discount rate used in any NPV economic analysis of projects should match the unit of account in which costs and benefits are measured. The range of real discount rates used here was varied from 0.04 to 0.16 and is believed appropriate for a levelized economic cost analysis of energy systems.

Finally, information about displaced fuel is provided for each application. While not used in the levelized cost calculations, the amount of fuel displaced is, nonetheless, quite important in the planning stages of a project. Particularly important is the possibility of replication of the renewable energy field tests. If project A displaces less conventional energy than project B but can be replicated at many more sites, project A could be the better project in the long run.

[27] Wilson and West, loc.cit.

The economic analysis as defined above is intended to provide an input to the decision process in a consistent, straightforward approach. While somewhat simplified, the approval should yield valid results within the assumptions stated and the accuracies of the input data. It should be emphasized, however, that regardless of the economic feasibility indicated by this analysis, a continuing economic analysis should be performed throughout the early phases of this project. In particular, at the critical design reviews scheduled for each field test when more accurate cost data can be obtained from the preliminary and final engineering designs, the economic feasibility of the intended applications must be firmly established prior to proceeding with the fabrication and installation of the field test.

3. Results of Economic Analysis for 1981 Installations

The input data for the renewable energy technology applications assumed installed in 1981 are shown in Table IV B-1, Annex C. The costs are 1981 costs estimated from the conceptual designs of the field test representative of each application. The installed 1981 system costs used in the economic analysis are substantially different from the field test project costs. As noted previously, the initial capital cost data are only for the energy delivery portion of the system application. Loads, facilities, and auxiliary equipment are not included. (For example: In the case of the solar desalination systems, the costs of the reverse osmosis equipment is not input into the levelized cost of energy calculation because those costs are common to the system regardless of which energy source is used; also, in the case of the solar Rankine cycle cold storage system, the ice-making unit and refrigeration storage facilities are not included.) The initial costs were estimated by assuming that these systems are the next systems installed beyond the field tests and that certain non-recurring costs associated with the field tests would not be incurred. All field test specific costs were subtracted, such as engineering design, instrumentation, back-up systems, and operations support during the actual field testing. Design and engineering and management costs were assumed to be an indirect cost account included in the FOB price of the equipment. Since the equipment is commercially available, this assumption is considered reasonable. Further reductions were made for installation by assuming a greater contribution by the Egyptians.

The data shown in Table IV B-1 assumes neither system price reductions due to technology improvements nor significant local manufacturing. Most of the capital equipment is assumed to be manufactured and purchased in the U.S. In many applications shipping costs are large a fraction of the installed costs.

The "Annual Energy Output" data are based on the anticipated energy collection, conversion and storage efficiencies anticipated for each renewable energy system. It should be noted that the "Annual Energy Output" data are not necessarily equivalent to the "Fuel Displaced Annually." This is due to the fact that a conventional energy technology which could be replaced with the proposed renewable energy technology may have a different operational cycle or energy conversion efficiency than the renewable energy technology.

The levelized cost of energy estimates for renewable energy technologies in 1981 calculated by the methodology previously outlined are shown in Table IV B-2, Annex C, for real discount rates of 0.04, 0.10, and 0.16. Levelized energy cost estimates for the conventional technologies are given in Table IV B-3, Annex C. The results of the economic analyses as presented in these two Tables allow comparison of the proposed applications of renewable and conventional energy technology based on a unit energy price. This comparison is shown graphically in Figure IV B-1 where the renewable energy technologies are grouped with the appropriate 'competing' conventional technology. (Note that the scale on the ordinate of the graphs varies.)

Figure IV B-1a shows that, under the stated assumptions, and depending on the required rate of return, the solar industrial process heat applications are economic only if a fuel escalation rate of 10% is assumed. The systems incorporating heat recovery are attractive at lower fuel escalation rates. Figures IV B-1b,c indicate that the remaining renewable energy technologies are not currently economic.

The results for 1981 are not too surprising as the annual fuel savings afforded by the renewable energy systems are more than offset by their large current initial costs. What is encouraging, however, is how close they are to being economically viable. Most of the renewable energy system applications appear to be within range of economic feasibility if (1) projected installed costs of these systems fall within present-day scenarios for future fuel price increases and renewable energy technology price decreases, and (2) components of future initial costs, such as installation, can be transferred to Egyptian input factors.

4. Results of Economic Analysis for 1990 Installation

The 1981 installed system cost estimates (Table IV B-1) were used as the starting points for projecting costs of the renewable energy applications to 1990. The projected cost data for 1990 were generated by reducing the 1981 estimates assuming:

- Photovoltaic system prices (less installation) of $3.5/Wp for the PV powered desalination system and photovoltaic array prices (less installation) of $1.6/Wp for the PV powered irrigation and fisherman shelter system - These prices are consistent with present-day scenarios for future price reductions in PV systems technology.

- Construction and installation of all systems by Egyptian labor - The Egyptians are capable of installing the systems considering the commercial availability of components and the information and experience gained from the precursor field tests. This assumption of Egyptian labor substantially reduced the installation component of system capital cost which in 1981 was dominated by U.S. labor costs.

FIGURE IV B-1a

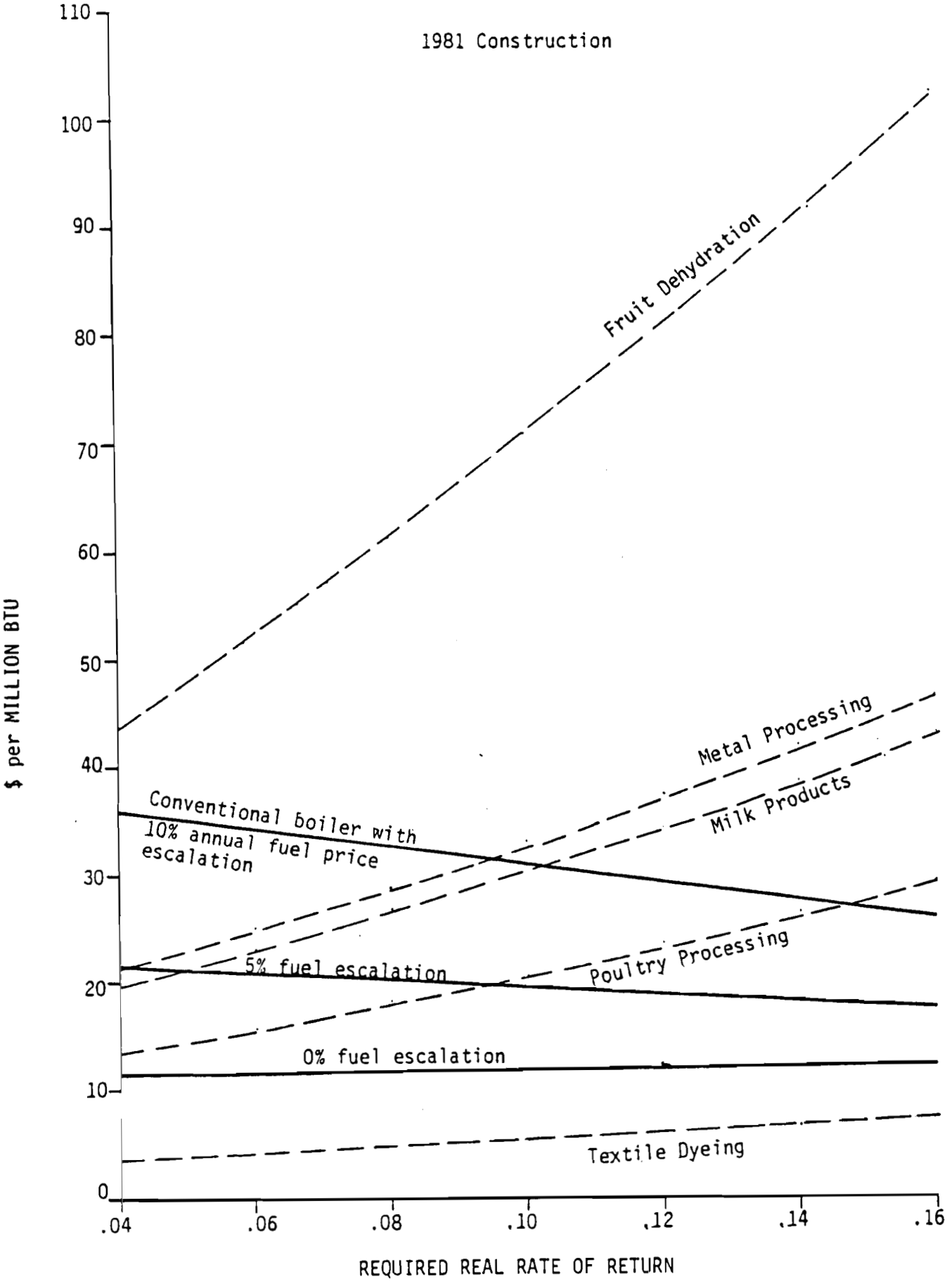


FIGURE IV B-1b

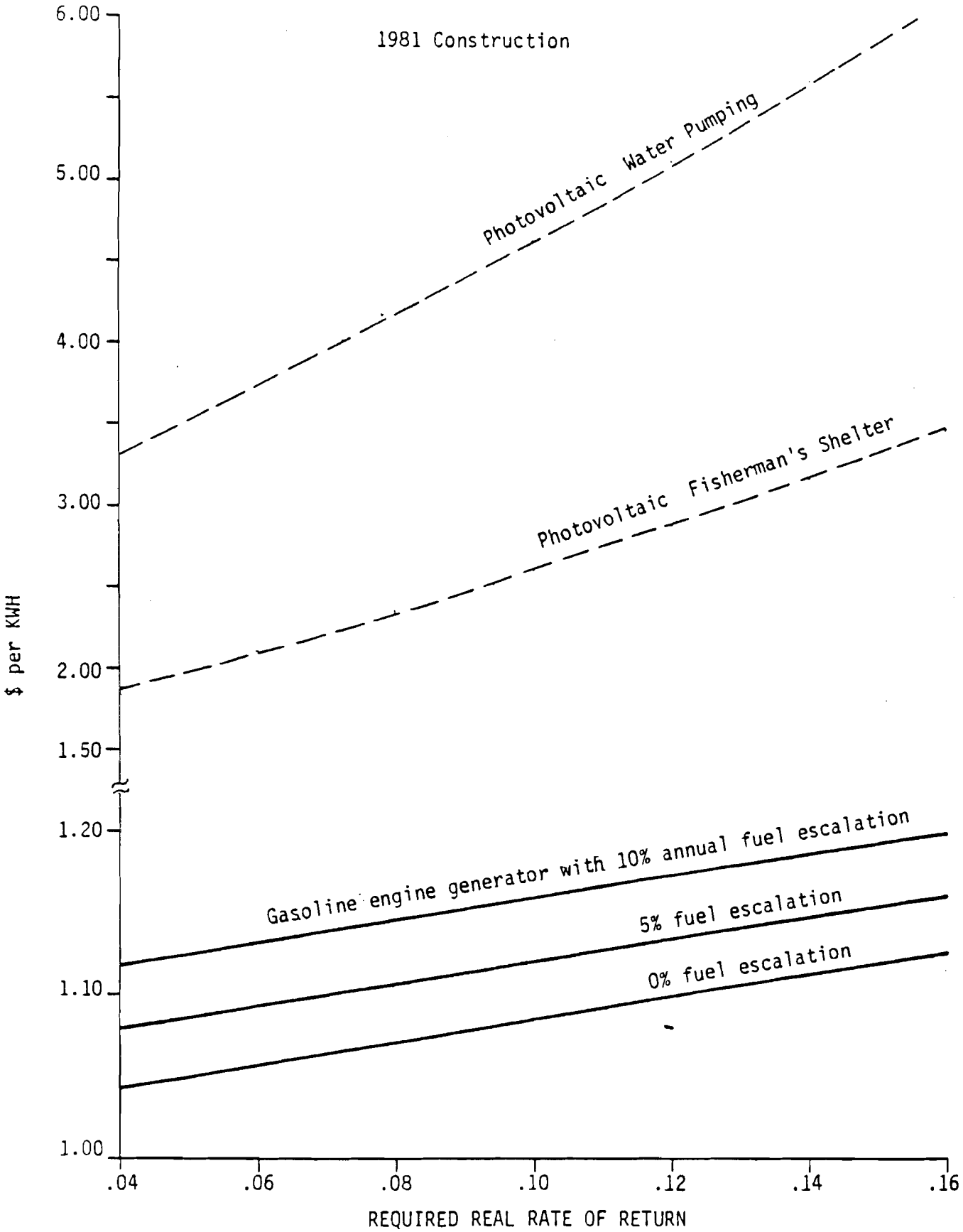
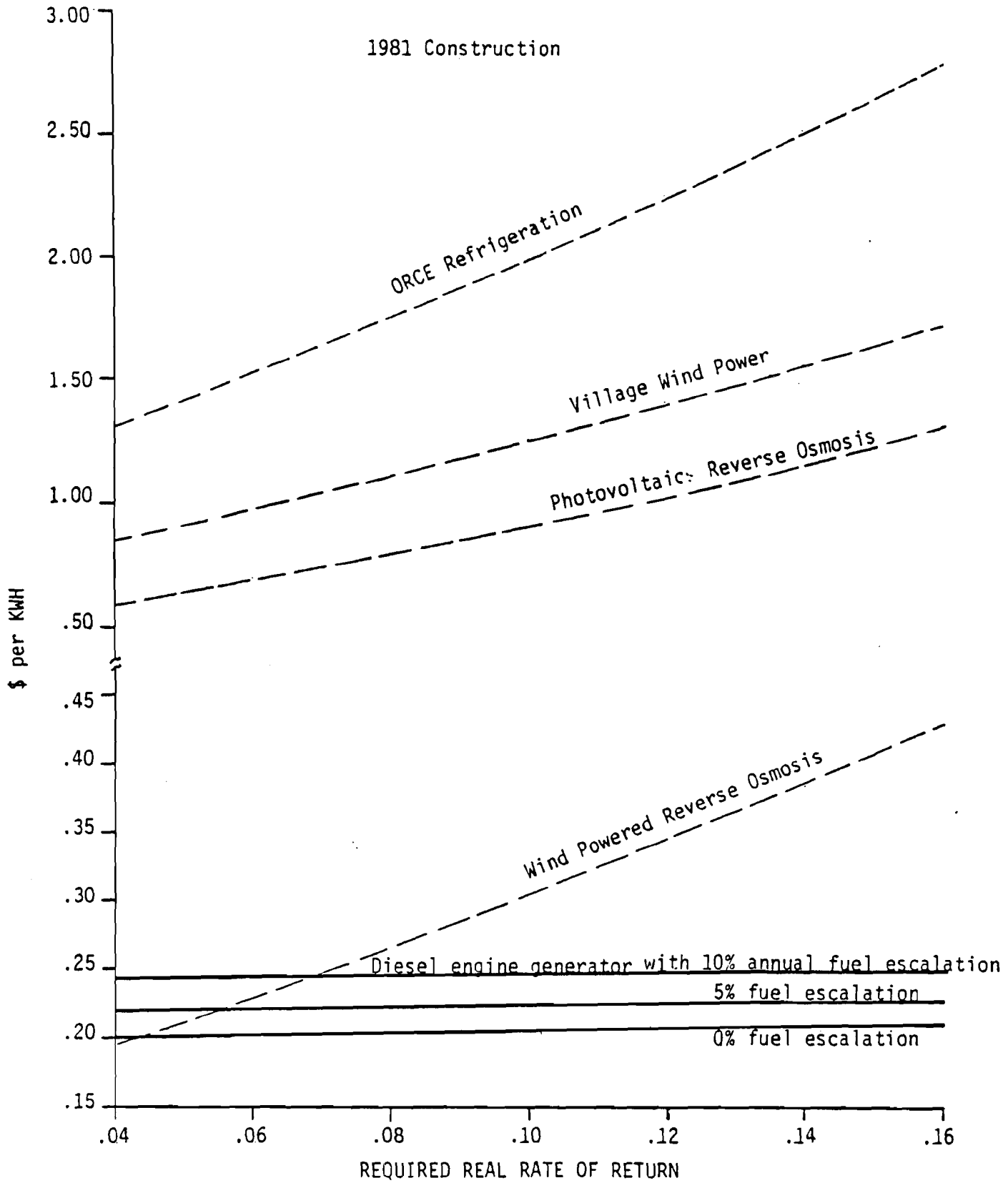


FIGURE IV B-1c



- Reduction of wind turbine generator systems (less installation) to approximately $2,500/kw.

- In the case of several systems, small reductions in annual O&M costs reflecting expected experience gained in field tests.

- The local manufacture and purchase of supporting hardware such as towers, storage vessels, piping, etc. - While this resulted in some changes in equipment costs, the major reductions were in shipping costs.

The cumulative effect of these assumptions are reflected in the 1990 input data for the renewable systems technology shown in Table IV B-4, Annex C. It is believed that the initial cost estimates shown represent conservative projections. Construction period, useful life, and annual energy output were not changed from the 1981 numbers. The levelized cost of energy calculations resulting from these input data are shown in Table IV B-5, Annex C.

The levelized cost of energy for the conventional technologies was calculated as before for the 1981 installations, except that the fuel costs were escalated in accord with a 1990 installation date. Results are detailed in Table IV B-6, Annex C.

The comparisons between the renewable and conventional energy system technologies are graphically plotted in Figure IV B-2. (Note that the scale of the ordinate of the graphs varies.) The results of the economic analysis for 1990 are:

- The projected 1990 unit energy costs for the solar industrial process heat applications shown in Figure IV B-2a decrease from the 1981 levels by about 18% in all cases except for the fruit dryer, where the costs decrease about 35% due to the greater proportion of installation and shipping costs to capital costs in the initial estimates. For 1990, all of the solar industrial process heat systems other than the fruit dryer are economically attractive for a rate of return of about 12% and a 5% fuel escalation rate. The fruit dryer is attractive for an assumed fuel escalation of 10%. The projected economic feasibility of these results are generally consistent with economic analyses projected for similar U.S. solar industrial process heat applications [28, 29, 30].

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[28] Ibid.

[29] SERI, "Cost of Energy from some Renewable and Conventional Technologies," FY 1980 Progress Report, SERI/SP-741-1022, N81-27662.

[30] Kreith & West, "Economics of Solar Energy and Conservation Systems; Vol. II Solar Applications and Cost," CRC Press, 1980.

- The projected 1990 unit energy costs for the small photovoltaic systems shown in Figure IV B-2b indicate that these applications are economically feasible. This is due to the significant cost reductions projected for photovoltaics technology and the high costs of comparable conventional energy systems at remote sites. These results are consistent with many other economic analyses of similar PV concepts [31, 32, 33, 34].

- In Figure IV B-2c, the solar prowered desalination systems are seen to be economically competitive with conventionally powered systems. These results are in agreement with the results of a study conducted on similar desalination concepts for Egypt [35].

- In Figure IV B-2c, the village wind power system is uneconomic when compared to a conventional diesel engine generator below fuel escalation rates of 10%. The principal reasons for this are the high installed cost of the 20kw rated wind turbine and the battery storage system and the system's assumed capacity factor. The results indicated here are not in general agreement with other studies conducted for small wind power systems, especially for developing

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[31] Development Sciences, Inc (DSI), "The Economic Costs of Renewable Energy," Final Report, April 2, 1981, For AID, Contract No. AID/SOD/PDC-C-0306.

[32] Cabraal, et al, "Market Assessment of Photovoltaic Power Systems for Agricultural Applications in the Philippines," NASA CR-165286, April 1981.

[33] Halcrow & Partners, "Small-Scale Solar-Powered Irrigation Pumping Systems; Technical and Economic Review," UNDP Project GLO/78/004, Sept. 1981.

[34] Aerospace Corporation, "Comparison of Photovoltaic & Diesel Engine Systems for Village Power Applications," for NASA-LeRC, May 1980.

[35] MIT Energy Lab/K.F. Dudley, "Solar Powered Desalination in Egypt: A Design & Cost Analysis," MIT-EL 81-015wP, March 1981.

FIGURE IV B-2a

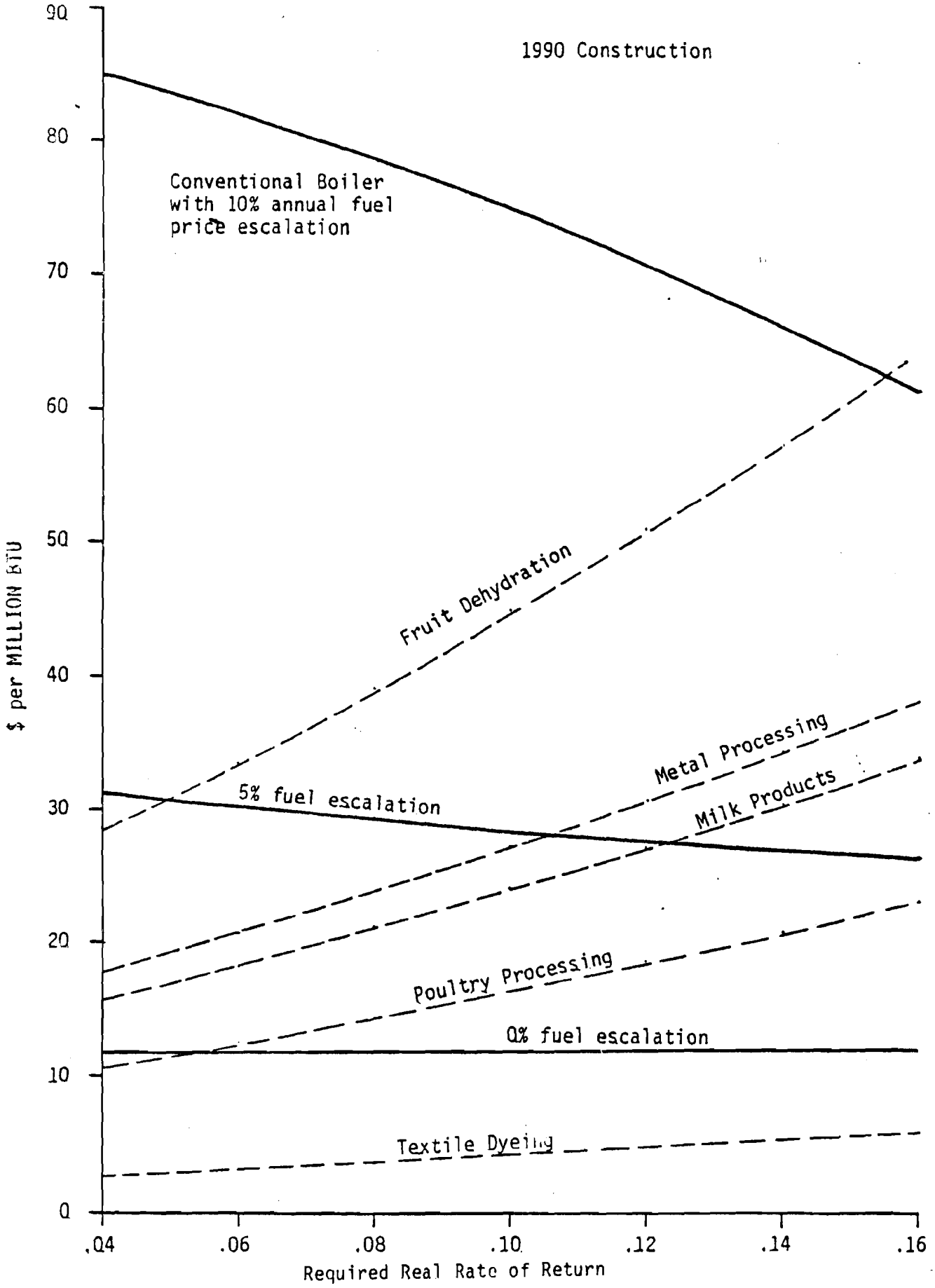

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FIGURE IV B-2b

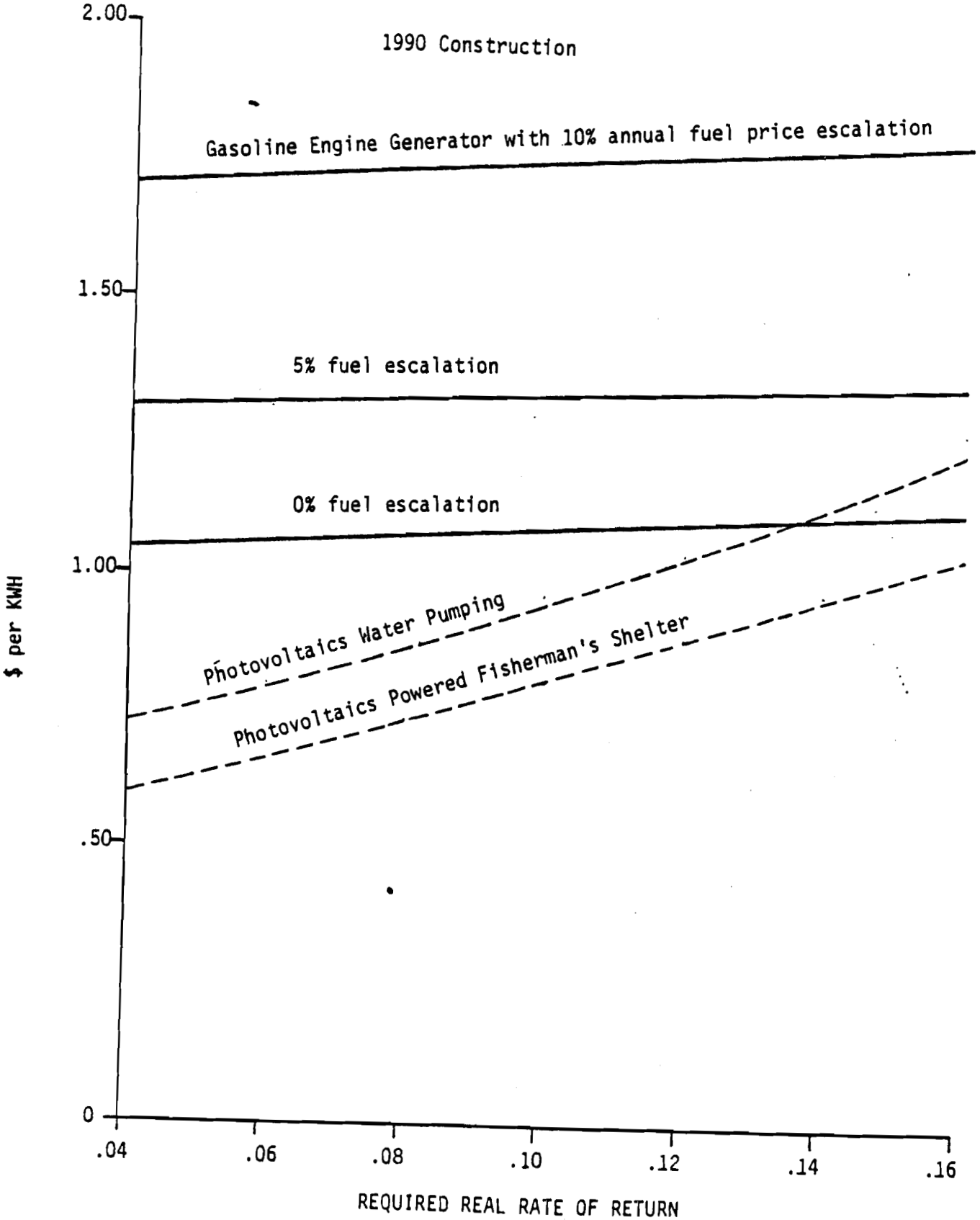
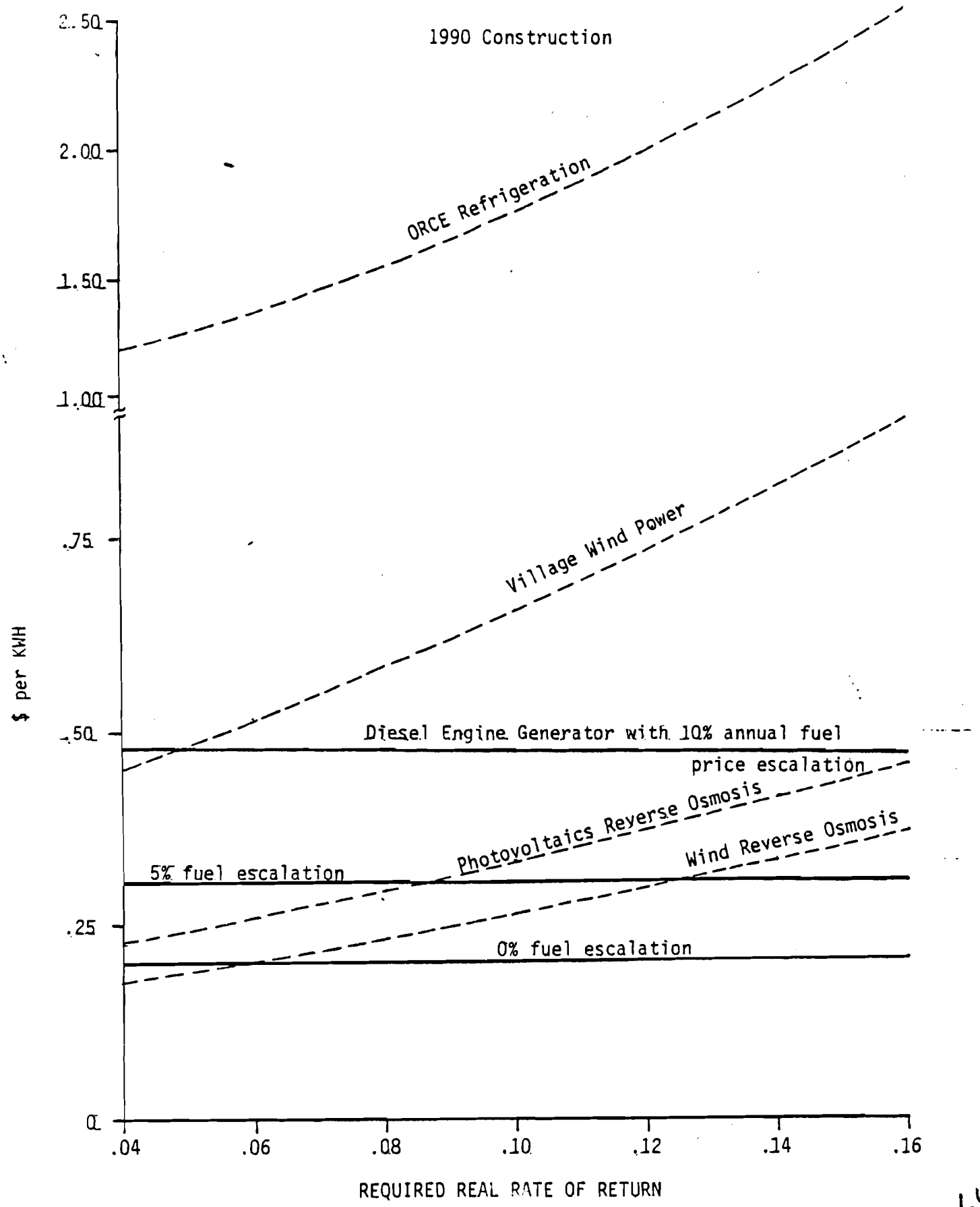


FIGURE IV B-2c



country applications [36, 37, 38, 39, 40]. If Egyptian rural village electrical needs can be met by smaller size wind systems and especially if favorable wind sites can be located, these systems may be economically feasible. Additional study for these applications are required.

- The projected 1990 unit energy costs for the solar Rankine cycle refrigeration system shown in Figure IV B-2c clearly indicate that this system concept is not economic. This is caused by the system's relatively high capital cost and very low overall system efficiency. However, the need for refrigeration and frozen storage is critical in Egypt, especially in remote areas. Solar powered systems should be thoroughly investigated for potential application in Egypt, well beyond the limited technical and economic analysis performed in this paper. As noted in the Technical Feasibility section of this paper, U.S. engineering field tests of solar-powered cooling technologies (including Rankine systems) are currently underway. The results of these U.S. field tests should be factored into preliminary engineering designs of solar refrigeration concepts using detailed Egyptian application specifications. The economic viability of the resulting concepts can then be assessed with certitude.

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[36] SERI, loc. cit.

[37] Mikhail, Amir, "Wind Power for Developing Nations," SERI/TR-762-966, July 1981.

[38] JBF SCI. Corporation, "Small Wind Systems Applications Analysis," Technical Report RFP-3147/2 UC-60, June 1981.

[39] Hegazy, M. "Wind Energy Utilization in Egypt," Egyptian Electrical Authority Report, July 1981.

[40] U.N. Econ. Commission for Western Asia, "New & Renewable Energy in the Arab World," Beirut, 1981.

5. Conclusions of Economic Analysis

The results of a projected economic analysis to 1990, using levelized cost of energy and conventional energy systems as comparators, indicate that eight of the eleven renewable energy applications proposed for field test are economically attractive. Of the remaining three, the solar agricultural fruit dryer agricultural application is economic if petroleum fuel escalates at 10% per year. The village wind power and the solar Rankine refrigeration system applications are not economic in their present design configuration. Implementing the field tests for these systems would, however, provide valuable information for related Egyptian applications. It is recommended that field tests for these latter two systems be implemented at least through a preliminary engineering design phase when the economics can be more thoroughly and accurately assessed.

C. Social Soundness Analysis

The Egyptian social structure does not present any major obstacle to introducing solar renewable energy technologies. However, the total potential impact of these new technologies may not be evident, especially to the farmers, fishermen and local villagers. During sub-project development Egyptian officials (see Annex A) on both the national and local levels were extremely receptive and highly supportive of this proposed sub-project and the Field Tests, Training, Supporting Analyses and New Initiative elements. Since this sub-project is aimed at collecting data in order to determine the viability of renewable energy technologies in the Egyptian context and is geared to developing Egyptian understanding of how the technologies function, an on-going socio-economic evaluation will be important. Inputs to assist in this evaluation are provided for under the Supporting Analyses and Training Project elements. Also, a measure of the social acceptance of solar technologies will be evidenced by their replication and spread effects after the field tests, providing energy pricing policies change. An indication of this will be the number of proposed applications which are received under the New Initiatives.

This sub-project will be supplying technology and training suitable and consistent with national and regional Egyptian development goals and plans. The following may be concluded regarding the social implications of this activity:

- The program is compatible with Egyptian efforts in the production of fresh water which would present opportunities for a population shift from the Nile region.

- If the field test systems prove viable, the benefits will be widespread and lasting due to opportunities for replication of these systems since they will have the potential to improve the welfare of people in the remote regions of Egypt, especially in the Frontier Governorates.

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- The field tests and training will produce better qualified technical personnel in the Egyptian government and other participating agencies . This will improve the quality of the Egyptian technical organizations responsible for planning for the future use of renewable energy technologies as a contributing energy source in Egypt.

- The introduction of solar energy for industrial process heat applications will not only provide a renewable substitute for the conventional fuels which can better be utilized for other purposes, but it will also demonstrate the need for energy conservation which is an integral part of solar energy technology. The project design team found little or no evidence of waste heat recovery or other energy conservation techniques associated with the industrial sites visited, so this activity will serve to initiate industrial awareness about the tremendous opportunities for energy savings by waste heat recovery.

The principal beneficiaries of this sub-project will be the general public since:

- major displacement of oil will allow for the export of domestic oil which will improve the Egyptian foreign exchange position and, thereby, improve the general economic status of the general populous, assuming the government of Egypt maintains its policy of equitable social development.

- more reliable power systems for critical uses in industry or communications or for potable water, now subject to power outage or fuel shortages, will improve quality of life through better services and more efficient production.

The technical infrastructure of Egypt will be benefited by the participation of Egyptian universities and by the training of engineers and technicians and others in this sub-project. The private sector will also benefit by these field tests as the awareness of renewable energy technologies will be created, information on field tests and technologies will be dissiminated, technical assistance and training opportunities will exist. When the market signals are right, the demand for a local manufacturing capability will, if the field tests prove successful, already exist.

D. Initial Environmental Analysis

Of the four major activities of this project, only the field testing would have direct environmental effects. The potential environmental effects of the field tests are judged to be wholly positive based on the non-polluting characteristics of solar technology compared to the conventional alternatives now employed. Therefore, a negative determination is recommended such that an environmental assessment and impact statement not be required. During the Supporting Analyses, technical assistance will be given to QHREA and participating entities in judging the environmental impacts of these and other renewable energy technologies.

V. EVALUATION PLAN

The Renewable Energy Field Testing sub-project will be evaluated from technical, economic and social viewpoints. The project will be reviewed and evaluated on an annual basis by USAID. We will also finance two external evaluations: one near the mid-point of the sub-project after installation of the initial field tests and all activities have begun; the other at the end of the sub-project. The specifics of the evaluations and the composition of the evaluation team will be detailed in the Project Management Implementation Plan to be supplied by the contractor within three months of being contracted. Evaluations will be conducted jointly by USAID and the GOE, the external ones with the assistance of technical experts outside AID. Funding for the external evaluations has been included in the budget.

The technical performance of the field test systems, including reliability maintenance, will be monitored and evaluated throughout the life of the sub-project. Attention will be given to the specification of data requirements, the design and installation of instrumentation, and data collection and analyses of results.

A continuing analysis of the economics and social acceptance factors of the systems and applications will be conducted under the Supporting Analyses element and used in the evaluations. Price per unit of delivered energy, actual operation and maintenance costs, product yield, system efficiencies and displaced fuel will be factors considered. The evaluations will also compare the economics of the solar systems with conventional systems.

An important criterion to be used in the final evaluation of the sub-project will be whether where initial data has shown that field tests are successful and reasible for replication, there has been some move toward adoption of similar systems and applications in other industrial and agricultural settings. Sociological aspects regarding the introduction, disposition, and long-range sustainability of the solar systems will also be considered in the evaluation. The involvement of communities and users will be of special interest. The ability of end-users to adapt to these new technologies and contribute to their installation, operation and maintenance costs will provide a measure as to whether or not these systems are appropriate for the Egyptian environment. Finally, the reactions of policy-makers within the GOE and the private sector will be sought as field test experience is gained.

Annex Q and Section III.D. Supporting Analyses supply further information on the information system which will be developed upon which detailed evaluations will be designed and carried out.

VI. SUB-PROJECT ADMINISTRATION AND IMPLEMENTATION PLAN

A. Master Schedule

The master schedule for major sub-project element tasks, activities and milestones is given in Figure VI-1. The time required to accomplish the sub-project's goals and complete the tasks, described in Section C - Sub-Project Elements, is estimated to be 60 months from the signing of the Grant Agreement and the award of a Participating Agency Services Agreement with NASA Lewis Research Center (NASA LERC) as the U.S. Project Management organization.

The Ministry of Electricity has specifically requested the participation of NASA LERC as the project management contractor for this project as the only entity, both within U.S. Government and in the private sector, which can bring objective, technical expertise to bear upon the project and, at the same time, provide project continuity. The GOE is keen to work with an agency of NASA's stature and expertise. It is our considered opinion that NASA Lewis Research Center has the qualified personnel who have shown themselves capable of working closely with the Egyptians and could serve to upgrade Egyptian capability in this field by transferring the NASA management style. NASA LERC has shown outstanding ability to assist in the implementation of other AID projects, especially in the area of project management in Tunisia and Upper Volta.

Because the Mission does not have a renewables expert resident in Cairo, (although a Mission engineer has been collaborating with the S&T office on this sub-project) it was determined that another U.S. Government agency could most appropriately provide a full time source of technical expertise to assist the Mission with the coordination and management of a large number of sub-contractors. As another federal agency, NASA is prepared to perform the tasks outlined in this Section and has the experience which the Mission and the GOE require. Although this coordination function could conceivably be carried out in the private sector, most perspective contractors have management experience, experience in renewables, or experience with large multi-faceted projects, but not all three. The coordination role assigned to NASA relative to the entire project is one which the GOE and the Mission believe should stay within the U.S. Government. In addition, AID/W's Office of Energy will continue to support the Mission during project implementation, providing technical assistance as necessary. NASA has experience and in-depth familiarity with national and international standards, developments, practices and procedures for the design, manufacture and testing of renewable energy technologies as well as a proven capability to act as contract administrator during implementation of the project while following U.S. Government procedures for contracting.

In particular, the Supporting Analyses and New Initiatives project elements are best entrusted to another U.S. Agency since no particular technology would be recommended by them with a profit motive in mind. The plethora of vendors of renewable energy technologies in Egypt has reached a level where it is deemed necessary that NASA, as the agency

that has had the primary role in developing and advancing R E technologies, be involved in evaluating the appropriateness of such technologies for application in Egypt.

NASA LERC will work very closely with the host country implementing agency QHREA to facilitate technology transfer and management training such that the New Initiatives may be implemented with maximum lead responsibility by the host country and minimum assistance from NASA.

QHREA has been given authority for implementation of all Egyptian renewable energy projects (See Annex P). Its current activity includes both study and site assessment, and the implementation, test and documentation of renewable energy projects with other Egyptian entities and foreign donors. The QHREA has supported study and analytical tasks such as the USAID Mitre study; the McDonnell Douglas Corporation site study for central power towers; and the pre-feasibility study with EEC for the establishment of EREDO. It is also lending technical assistance and other support to the American University in Cairo's desert development project in Sadat City.

Among their hardware activities is the procurement and test of 1000 solar hot water systems. Collector thermal testing to the ASHRAE Standard is accomplished on a routine basis. International cooperative programs involve a solar cold storage unit and solar desalinization plant with France, and a German cooperative project for 10 kw photovoltaics to be used in a variety of applications (see Annex L for detailed activities with other donors).

NASA will be responsible for coordinating all U.S. sub-project inputs, including furnishing all technical services required to successfully implement the Supporting Analyses, Field Tests and Training activities described in the Project Paper and further defined in the Project Implementation Plan. These functions shall include:

A. Assembly of the necessary work force and securing of the services of solar energy experts in the fields of photovoltaics, wind, solar industrial process heat, solar Rankine cycle, and solar desalination for determining and developing the detailed, site- specific technical specifications required for procurement for all approved field tests.

B. Development and submission to USAID and GOE for review and approval of a detailed Project Implementation Plan which will include updated technical schedular and resource requirements (based on the detailed technical specifications developed for the procurement documents) as well as detailed definition of the functional and specific roles and responsibilities of all participating parties, including interfacing, approval, and other procedures regarding the implementation activities for achieving the sub-project purpose.

C. Provision of the necessary solar technology oversight to ensure that correct design principles and engineering practices are followed in the implementation of all selected project field tests,

D. Responsiblity, in full collaboration with QHREA, for the procurement of all equipment and services from U.S. sources required for the approved field tests. Procurement functions for which NASA will be responsible will include:

1. Preparation of the technical package defining the system(s).

2. Issuance of requests for proposals.

3. Conducting bidders' conferences as necessary.

4. Performance of technical evaluation of proposals and award of contracts through competitive procurements, following USAID contracting guidelines.

5. Conducting debriefings of unsuccessful bidders as required.

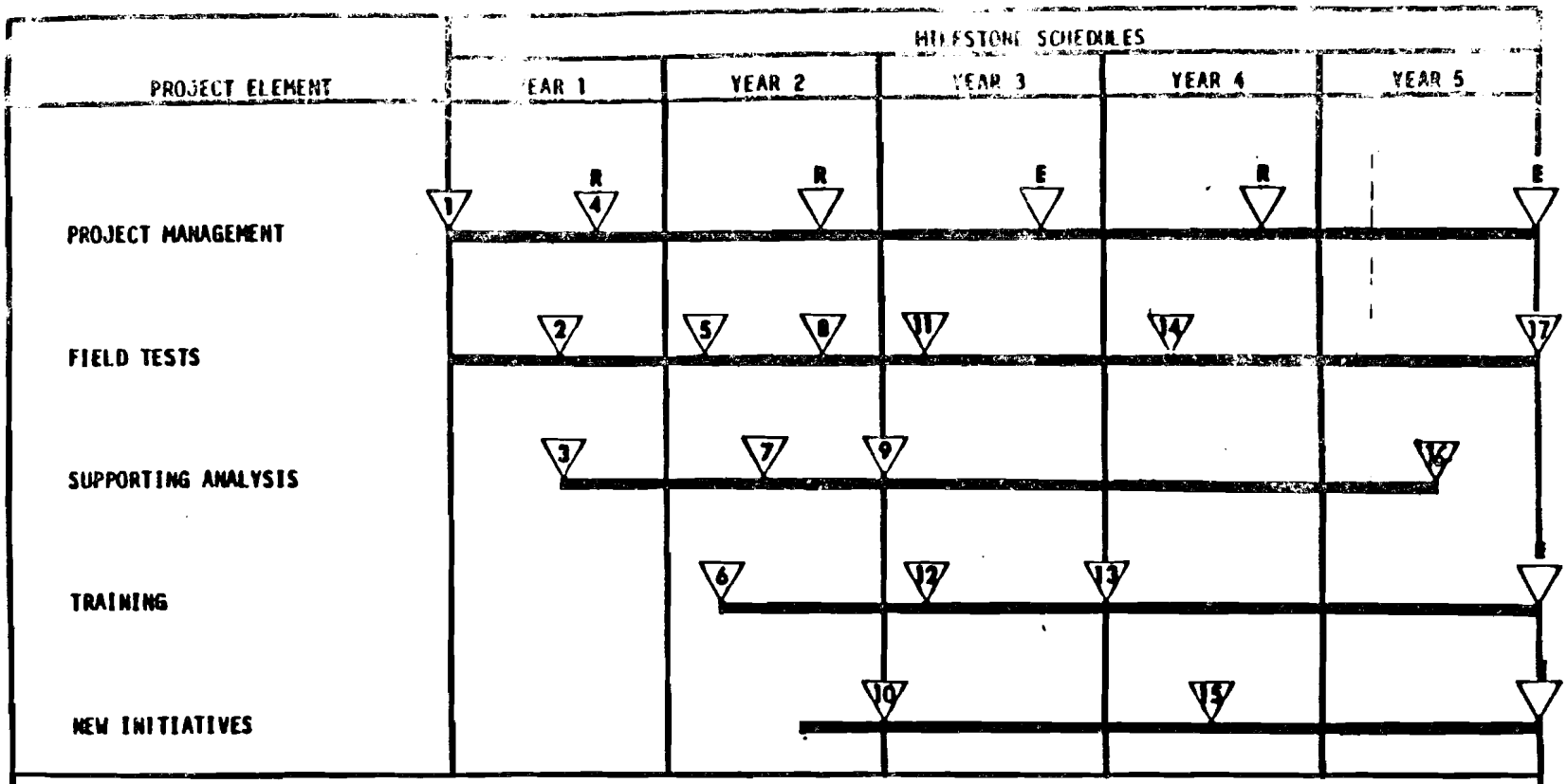
6. Monitoring sub-contractors' performance including system design reviews/approvals, technical direction of sub-contractors' work, and adherence to technical milestones and cost schedules.

E. Provision of general technical and management assistance to the host country for all sub-project activities (e.g., New Initiatives Task) for which the host country has lead responsibility as defined in the Implementation Plan.

F. Coordination and management of sub-project resources from the planning stage through project completion in accordance with USAID financial management requirements.

G. Provision for the training of host country personnel in contract and project management techniques, including technical assistance in the preparation of specifications and procurement documents for all host country contracting in accordance with AID regulations.

H. Preparation of monthly status reports which includes a brief description of the technical progress during the reporting period along with a schedular and financial summary. Provide Qattara and USAID with copies of all reports and studies conducted by sub-contractors funded under the project. Provide to Qattara and USAID timely trip reports covering NASA personnel and its sub-contractors.



1. Grant Agreement Signed; PASA/Contract for Project Management Awarded
2. Site Surveys Completed; Design Specifications Prepared; Procurements Initiated
3. Procurements Initiated
4. Detailed Plans Prepared
5. First Contracts Awarded
6. Training for Site Managers Initiated
7. Field Test Data Acquired and Analyzed
8. All Contracts Awarded
9. Applications Study Completed
10. New Initiatives Identified
11. Installation of First Tests Completed
12. Assistance for Local Manufacturing/Maintenance Task Defined
13. Academic Programs and Technology Dissemination Initiated
14. Installation of All Tests Completed
15. Contracts Awarded
16. Tech. and Econ. Analysis Completed
17. Operations, Monitoring, Evaluation Completed

R Review/Coordination Meeting

E Project Evaluation

Figure VI-1. Renewable Energy Field Testing Project Master Schedule

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Major milestones and activities include:

- Completing detailed site surveys and acquiring technical data and information required for the preparation of design specifications for the field tests and detailed Implementation Plans. The time required for these tasks depends on the specific field test, varying from approximately one month for the small field tests, e.g., photovoltaic-powered irrigation systems, to six months for the more complex field tests. (In some instances instrumentation systems will be installed and data collected and analyzed over longer periods. These tasks will be performed under the Supporting Analyses element.)

- Preparation of detailed Implementation Plans and Annual Operating Plans, the preparation of Requests for Proposals, the evaluation and selection of sub-contractors and the negotiation and award of sub-contracts for the field tests.

- Detailed field test design, assembly, testing of sub-systems and components (if required), shipping, installation, operations training, and check-out. Again, the time required for the tasks depends on each field test. Installation of the first systems is scheduled for the first quarter of year 2; all field tests should be installed by the first quarter of year 3.

- Supporting Analyses, Training and New Initiatives tasks phased to complement the Field Tests.

- Approximately two-year period of field testing operations.

- Completion of all sub-project tasks with final reporting and evaluation.

An order of priority of field test installation should not be necessary as installation will be determined by the varying lengths of time to manufacture the equipment for the field tests. The joint QHREA-NASA RFP development and bid reviews will, however, provide a forum for ordering installation activities should that become necessary. Moreover, due to the number of sub-contractors, field test entities and QHREA personnel to be involved in this sub-project, it is anticipated that installation activities will be proceding at various sites concurrently without confronting personnel constraints.

The Renewable Energy Field Testing sub-project is involved not only with a number of solar technologies and applications but also with a large set of diverse activities and tasks. The successful implementation of the sub-project will depend directly on the effectiveness of the management organization and participants. Training for the Egyptian counterparts as described in II.C.5, will serve to upgrade GOE personnel and field test participant management skills as well as provide technical on-the-job training.

3. Management Structure and Roles and Responsibilities of Participants

The management structure assumed for this sub-project is based on: 1) the creation of a NASA coordinator and GOE project manager and field test site managers who are the focal points of management responsibility for the conduct of their assigned tasks; 2) centralized planning and control which is exerted by the project manager and the other organizations; 3) decentralized project executive, i.e., much of the work will be performed outside each of the sub-project and site managers' organizations by others who are outside the direct administrative authority of the sub-project and site managers, but who take direction from the managers. The NASA coordination and technical assistance role is based on the philosophy of providing direct, but ordered, assistance to the GOE and private sector, while integrating the technical and managerial competence of U.S. and GOE agencies, industries and organizations.

The proposed project management structure is shown in Figure VI-2. USAID/Cairo's Science and Technology (S&T) Office will manage the project, providing policy and technical guidance and information concerning the other sub-projects and other relevant USAID activities. NASA LERC will be responsible to QHREA's project manager and, in a collaborative manner, provide the technical inputs to the sub-project. QHREA will be fully responsible for coordinating all field test entity activities, including site preparation for installation of equipment, human and financial resources for that installation, agreements with those entities for establishing a system for careful monitoring and data collection once the systems are installed. QHREA will be responsible for coordination with local participating ministries, governorate offices, companies, universities and CARE where applicable.

Technical assistance will be provided through a PASA with NASA LERC who will coordinate U.S. inputs including goods and technical services. QHREA will be responsible for implementing host country activities with technical assistance and support supplied by NASA and its sub-contractors. For sub-project tasks involving U.S. sub-contractors, NASA will have final responsibility, as the contracting agent, however, QHREA will assist and support these tasks in a fully collaborative mode.

There will be a QHREA project manager and assistant project manager as well as four site managers. These site managers will be responsible for logistic support, acquisition of site survey data, liaison and coordination, installation support, and the management of operations and maintenance for each field test. Technical assistance, equipment, and services supplied by NASA and its sub-contractors will be defined in the Project Implementation Plan. Once New Initiatives begin, additional site managers will be added: one the first year, an additional one the second year and three for years three through five.

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The design, assembly, sub-system and component testing, shipping, and installation for the majority of the field tests will be the final responsibility of U.S. sub-contractors selected and awarded through competitive procurements by NASA in collaboration with the GOE project manager. Once field test installation requirements have been established, it will be the responsibility of QHREA to mobilize their resources and those of the cooperating field test participants to work with the U.S. sub-contractors toward expeditious site preparation and installation of equipment. These same sub-contractors will also provide training and operations and maintenance support for the GOE site managers. In particular, the sub-contractors will work closely with field test participants on collecting and analyzing data so that the tasks described in Section III.D. Supporting Analyses can be carried out on a continuing basis. Indigenous goods and labor will be used wherever technically and financially feasible.

The GOE project managers and their supporting offices and organizations with NASA assistance will manage and conduct the Analyses, Training, and New Initiatives tasks as described in Section III - Sub-Project Elements.

A formal reporting and information and control system will be established in accordance with AID requirements, the evaluation plan, and NASA and QHREA needs. The system will summarize technical, managerial, and financial status, problems, and prospects compared to approved implementation and annual operating plans. In addition to the formal written system of reporting, a series of regular, formal meetings between USAID/Cairo, NASA and QHREA Project Managers will be scheduled. Finally, NASA and the GOE project managers will institute their own formal and informal means of maintaining a constant and open flow of communications once field site protocols have been finalized between QHREA and field site participants. (See Annex K for sample site protocol.).

C. Contracting Procedures

AID contracting procedures and regulations will be followed by NASA and the GOE when awarding contracts. Proper controls and assurance as required by the USAID Project Manager, GOE Project Manager and NASA will be implemented prior to issuance of contracts. These controls and assurances will be documented in the Implementation Plan.

Negotiated procurements will be conducted under competitive procedures to the extent practicable. Noncompetitive procurements will require formal and complete justification for selection. AID guidelines regarding contract preparation, the extent and clarity of request-for-proposal instructions, and source evaluations and selection processes will be followed with GOE collaboration throughout. When appropriate, the source evaluation and selection process will be conducted in accordance with

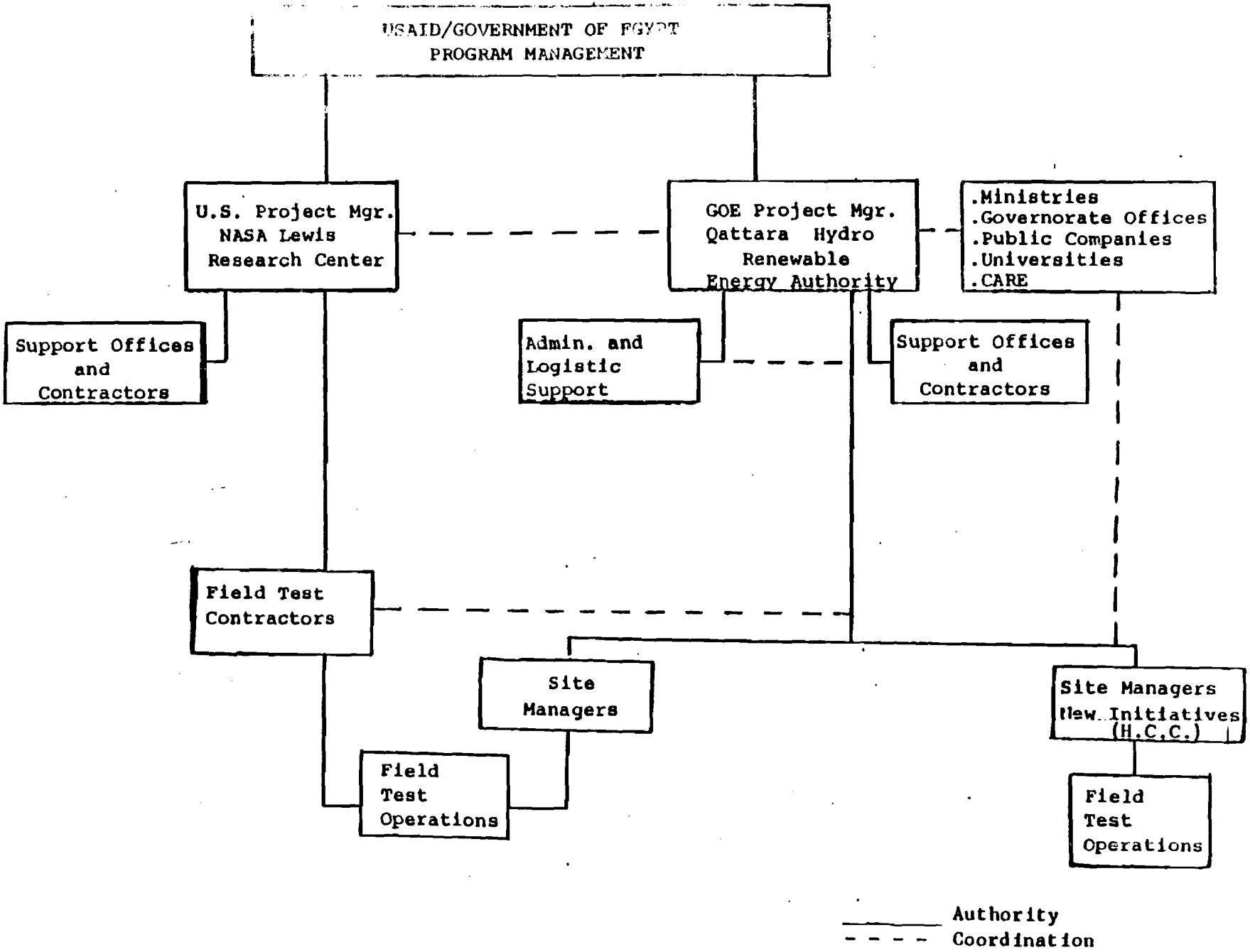

Figure VI-2 MANAGEMENT STRUCTURE

formal Source Evaluation Board (SEB) procedures. The New Initiatives will be host country contracts, which after QHREA participation in initial field tests, should require minimal U.S. technical assistance. After careful review by the Mission, in collaboration with QHREA, it was determined that an AID direct contract was preferable to a host country contract in the initial stages of project implementation. QHREA will receive on-the-job training as stated above, so that they will be prepared to take on the contracting role for the New Initiatives.

VII. FINANCIAL PLAN AND RESOURCE REQUIREMENTS

The total cost for the Renewable Energy Field Testing sub-project is estimated to be $28.5 million. The AID contribution totals $24.1 million, $4.8 of which will be in local currency. The GOE contribution is approximately $4.4 million Egyptian Pound equivalent. The sub-project will be incrementally funded; $4.0 million in FY 82 and $20.1 million in FY 83. It is anticipated that the sub-contracts for the field tests will be awarded during FY 83. Table VII-1 provides a summary of the cost estimates for each of the project's elements. An amount of $220,000 is set up as a special line item in the project budget to finance the external evaluations. Also shown is 10 percent contingency fund based on considerations of uncertainties and risks associated with a project of this type. Inflation is added at a nominal rate of 12% compounded for U.S. as well as Egyptian costs. The detail costing for the field test, supporting analyses, training, new initiatives and project management elements of the sub-project, are shown in Annex E of this paper.

A PASA will be negotiated with NASA, who will have project coordination responsibility including all sub-contracting for field tests, training and supporting analyses. In addition, NASA will supply technical assistance as necessary to QHREA for the design and development of the New Initiatives. However, the New Initiatives will be contracted by QHREA under host country contracts. A total of approximately $20 million will be put into the PASA to fund the above-mentioned activities, except New Initiatives. The overwhelming (92%) majority of those contracts will be sub-contracted to the U.S. private sector.

Field tests account for the major portion of the Project's cost - an estimated $12.47 million, based on preliminary conceptual designs of each field test. Field test cost estimates include engineering design, equipment, testing in the U.S. (if required), shipping, training, manual development, installation, check-out, and operations and maintenance support for approximately two years. (Costs for site surveys, preparation of specifications, preparation of technical packages for competitive requests for proposals, proposal evaluation, etc. are included in Project Management costs.) Costs for each field test (less the assumed inflation and contingency rate) are documented in Annex B.

GOE costs are based on estimates of work breakdown task requirements for project implementation. In the field tests, e.g., the GOE will share approximately 50 percent of the installation costs and assume primary

TABLE VII-1 SUMMARY COST ESTIMATE AND FINANCIAL PLAN
In US $ 000

PROJECT ELEMENTS	AID FX	AID LC	AID Total	GOE LC	TOTAL FX	TOTAL LC	TOTAL Total
I. FIELD TESTS							
a. Milk Plant	685	152	837	73	685	225	910
b. Fruit Dedydration	388	89	477	38	388	127	515
c. Poultry	635	195	830	110	635	305	940
d. Textile	672	128	800	90	672	218	890
e. Metal	1,585	257	1,842	193	1,585	450	2,035
f. Fishermen	209	38	247	28	209	66	275
g. Irrigation	80	35	115	17	80	52	132
h. PV-Desalination	1,362	338	1,700	270	1,362	608	1,970
i. Village Wind	285	70	355	52	285	122	407
j. Wind Desalination	1,533	333	1,866	265	1,533	598	2,131
k. Cold Storage	1,633	350	1,983	282	1,633	632	2,265
	9.067	1,985	11,052	1,418	9,067	3,403	12,470
II. SUPPORTING ANALYSES	1,580	315	1,895	205	1,580	520	2,100
III. TRAINING	650	185	835	75	650	260	910
IV. NEW INITIATIVES	1,665	335	2,000	550	1,665	885	2,550
V. PROJECT MANAGEMENT	1,760	659	2,419	840	1,760	1,499	3,259
VI. EVALUATION	200	-	200	20	200	20	220
Subtotal	14,922	3,479	18,401	3,108	14,922	6,587	21,509
VII. INFLATION	2,928	969	3,897	944	2,928	1,913	4,841
VIII. CONTINGENCY	1,472	348	1,820	309	1,472	657	2,129
Subtotal	4,400	1,317	5,717	1,253	4,400	2,570	6,970
PROJECT TOTAL	19,322	4,796	24,118	4,361	19,322	9,157	28,479

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responsibility for the field test participant contributions to installation, operation and maintenance of the systems. Field test management costs are included in GOE's contribution to Project Management. The GOE contributions will also cover in-kind support in the form of salaries, facilities, training and logistic support.

Field test participants have agreed to pay a portion of equipment improvement (other than the solar equipment), and building modification costs; however, as no resource commitment other than for installation and technical monitoring could be made by those entities before AID project approval, all funds necessary for these items have been included in the AID contribution should those contributions be delayed. The renewable energy technologies will be granted to the participating entities. QHREA, with NASA and sub-contractor assistance, will be responsible for the successful performance of these systems until the end of the project. Training will be provided, so that participants will take over the operation and maintenance of these systems after the project has ended. Back-up systems have been provided for where continuous system operation is essential. QHREA will be responsible for providing any additional assistance to the field tests after USAID participation has ended.

The estimated sub-project costs by year in thousands of U.S. dollars are supplied in Table VII-2.

AID costs are expected to be in U.S. dollars except for:

- International travel and per diem by consultants;
- Local installation, on-the-job training and other costs associated with the field tests;
- Training activities: local costs for consultants, mainly for seminars conducted in Egypt; and
- Supply of a locally-procured trailer-type facility for the Cold Storage field tests.

For GOE, all financing will be in local currency.

It should be noted that NASA Project Management cost estimates are based on the assumption of a U.S. federal agency accepting that role, where only costs for direct labor, travel, and NASA support charges are obligated. In accordance with FMM 9090, "Guidelines Applicable to Reimbursable Agreements," Agency overhead and depreciation are not included. If a private contractor were selected for U.S. Project Management functions, it is estimated that U.S. Project Management costs would increase from $2.4 million to about $3.8 million. In such case, the sub-project will be amended to provide additional Project Management funds.

Note: All figures provided in the narrative include contingency and inflation.

TABLE VII-2 SUMMARY DISBURSEMENT SCHEDULE BY FY

in US $ 000

	FY 82			FY 83			FY 84			FY 85			FY 86			ALL		
AID	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T
I. Field Tests	60	-	60	6,231	65	6,296	1,863	1,017	2,880	675	776	1,451	238	127	365	9,067	1,985	11,052
II. Supporting Analyses	935	198	1,133	284	51	335	181	33	214	155	30	185	25	3	28	1,580	315	1,895
III. Training	130	37	167	130	37	167	130	37	167	130	37	167	130	37	167	650	185	835
IV. New Initiatives	-	-	-	500	100	600	500	100	600	500	100	600	165	35	200	1,665	335	2,000
V. Project Management	491	188	679	466	168	634	376	119	495	214	86	300	213	98	311	1,760	659	2,419
VI. Evaluation	-	-	-	-	-	-	100	-	100	-	-	-	100	-	100	200	-	200
Subtotal	1,616	423	2,039	7,611	421	8,032	3,150	1,306	4,456	1,674	1,029	2,703	871	300	1,171	14,922	3,479	18,401
VII. Inflation	-	-	-	914	50	964	762	327	1,089	669	412	1,081	583	180	763	2,928	969	3,897
VIII. Contingency	162	42	204	761	42	803	305	131	436	167	103	270	77	30	107	1,472	348	1,820
Subtotal	162	42	204	1,675	92	1,767	1,067	458	1,525	836	515	1,351	660	210	870	4,400	1,317	5,717
TOTAL AID	1,778	465	2,243	9,286	513	9,799	4,217	1,764	5,981	2,510	1,544	4,054	1,531	510	2,041	19,322	4,796	24,118
GOE																		
I. Field Tests	-	-	-	-	15	15	-	970	970	-	222	222	-	211	211	-	1,418	1,418
II. Supporting Analyses	-	51	51	-	51	51	-	36	36	-	36	36	-	31	31	-	205	205
III. Training	-	15	15	-	15	15	-	15	15	-	15	15	-	15	15	-	75	75
IV. New Initiatives	-	-	-	-	100	100	-	200	200	-	150	150	-	100	100	-	550	550
V. Project Management	-	158	158	-	164	164	-	176	176	-	176	176	-	166	166	-	840	840
VI. Evaluation	-	-	-	-	-	-	-	10	10	-	-	-	-	10	10	-	20	20
Subtotal	-	224	224	-	345	345	-	1,407	1,407	-	599	599	-	533	533	-	3,108	3,108
VII. Inflation	-	-	-	-	41	41	-	349	349	-	240	240	-	314	314	-	944	944
VIII. Contingency	-	22	22	-	35	35	-	140	140	-	60	60	-	52	52	-	309	309
Subtotal	-	22	22	-	76	76	-	489	489	-	300	300	-	366	366	-	1,253	1,253
TOTAL GOE	-	246	246	-	421	421	-	1,896	1,896	-	899	899	-	899	899	-	4,361	4,361
TOTAL PROJECT	1,778	711	2,489	9,286	934	10,220	4,217	3,660	7,877	2,510	2,443	4,953	1,531	1,409	2,940	19,322	9,157	28,479

VIII. COVENANTS AND CONDITIONS

A. Conditions Precedent to Disbursement

1. First Disbursement

Prior to any disbursement or to the issuance of any commitment documents under the Grant, the Cooperating Country shall, except as the parties may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

a. A statement of the names and titles of the persons who will act as the representatives of the Cooperating Country, together with a specimen signature of each person specified in such statement.

b. Such other information and documentation as AID may reasonably request.

2. Additional Disbursement

Prior to any disbursement or to the issuance of any commitment documents under the Grant for the long-term technical assistance contractor, the Cooperating Country shall, except as the parties may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID, the names of those persons who will be serving as Project and Assistant Project Managers for project implementation.

B. Covenants

1. The Cooperating Country shall establish the organizational and communication links necessary to coordinate project activities and to exchange information among the participating companies, universities, CARE and the concerned ministries.

2. The Cooperating Country shall take appropriate action to establish and fund a mechanism by which QHREA may procure sufficient personnel for each year of project activities necessary for successful implementation of the project.

ANNEX A

EGYPTIAN PARTICIPANTS

Egyptian authorities and organizations participating in the preparation of the Project Plan are listed below:

Qattara Hydro Renewable Energy Authority
-Eng. Abdel Latif Mahrouk, Deputy Chairman
-Dr. Anhar Hegazi

Egyptian Electricity Authority
-Dr. Emad El Sharkawi, Deputy Chairman Technical Affairs
-Dr. Mahmoud Hegazi, Managing Director for Research

Ministry of Electricity and Energy
-Dr. Talaat El Tablawi

Field Tests

Solar Water Heating for Milk Products Plant
-Mr. Moustafa Sobhy, Chairman
Misr Milk and Food Co.
Elameria, Cairo

Solar-Assisted Fruit Dehydration
-Agricultural Production Authority
Experiment Station, Giza

Solar Rankine Cold Storage System
-Dr. Hamdy El Hakim, Governor of El Fayoum
-Mr. Husein Dawood, Asst. Secretary General
City of Fayoum

Solar Energy and Heat Recovery for Poultry Processing
-Dr. Ezzat Abdel Hamid, General Manager
-Eng. Salah Elmahdy, Chairman
General Poultry Co.
Dokki, Cairo

Solar Energy and Heat Recovery for Textile Dyeing
-Mr. Ibrahim Ahd Menem Mahar
Bartex Textile Co.
Zagazig

Solar Water Heating for Metal Processing
-Eng. Fahmi Haidar, General Manager
Koldair Co.
Cairo

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Photovoltaic-Powered Fishermen Shelter Systems
- -Mr. Michael Mansour Michael, Manager Engineer of Regional Planning
  Aswan Governorate
- -Mr. Nabil Fawzi, Coordinator
  CAFI/Aswan
- -Messrs. Allan Turnbull and Thomas Zacharias
  CAFI/Cairo
- -Eng. M. Hamdi, Agricultural Engineer
  High Dam Lake Development Authority

Photovoltaic-Powered Irrigation Systems
- -Dr. Hassan Wahby, Director
  Egypt Water Use and Management Project
- -Mr. Mohamed Osman Ismail, Governor of Assiut
- -Dr. Abdel Razik Hassan, President
  University of Assuit
- -Dr. H. G. Hassanein, Soil Scientist
  University of Assiut
- -Mr. M. Nasr Eaid, General Secretary
  Qena Governorate

Photovoltaic-Powered Reverse Osmosis Desalination System
- -Dr. A. Nasser, Governor of Mersa Matruh

Wind-Powered Reverse Osmosis Desalination System
- -Mr. Mahmoud El Bagdadi, Director General of Electricity
  Red Sea Governorate
- -Mr. M. Usury, Asst. Secretary Government Planning
  Red Sea Governorate

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ANNEX B

DETAILED DESCRIPTION OF PROPOSED FIELD TESTS

UNIT CONVERSIONS

Due to the many technologies involved in the 11 field tests proposed herein, unit consistency was sacrificed for clarity. Each technology has its own unit of measurement which facilitates discussions among individuals familiar with the field. However, if the reader wishes to convert units the following should be useful:

$1\ ft^2 = 9.29 \times 10^{-2}\ m^2$

1 gallon $= 3.785 \times 10^{-3}\ m^3$

1 ton $= 9.07 \times 10^{2}$ kilograms (kg)

1 BTU $= 2.93 \times 10^{-4}$ kilowatt-hours (kw-hrs) = 1055 joules

$1\ Hp = 7.46 \times 10^{-1}$ kw

1 psi $= 7.03 \times 10^{-2}\ kg/cm^2$

$1\ m^3$(water) = 264 gal

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SOLAR PROCESS HEAT APPLICATIONS

1. SOLAR WATER HEATING FOR MILK PRODUCTS PLANT

1.1 INTRODUCTION

Background

The Misr Milk Company presently operates eight milk products plants in Egypt, with large operations in Cairo, Alexandria and Upper Egypt. The Cairo plant is the largest company operation, producing milk, yogurt, cheese, and ice cream. The initial identification of the Cairo plant as a candidate for application of solar industrial process heat technology was made by the Qattara Depression Authority.

The plant uses hot water in its operations for sanitation, pasteurizing, and as process water for mixing with powdered milk (rehydration) and preparing yogurt. In addition, an incubator room for yogurt preparation requires relatively low grade thermal energy to maintain a temperature of 42-45°C. Thus, the plant currently uses significant amounts of thermal energy in normal operations, 85 percent of which is provided by steam generated in boilers fueled by Bunker C (No. 6) fuel oil. In addition, No. 2 fuel oil is used in small, pressurized water cleaning units to heat the cleaning water to approximately 70°C.

The Misr Milk Co. in Cairo was visited to discuss with plant management and plant engineering personnel the possibility of a field test for solar water heating. During the second visit a tour of the plant was made accompanied by the Chief Engineer of the plant. The process heat applications which could utilize Solar Industrial Process Heat (SIPH) technology were identified during these visits and are presented in Table 1. In some cases, such as in systems where steam injection is now used, conversion of process heat requirements to use of solar heated water would require significant modification or replacement of existing equipment. Also, according to plant personnel some operational aspects of steam usage are deemed to be preferable to the use of hot water.

In a meeting with the Chairman of Misr Milk Co. it was revealed that the company had previously installed solar hot water heating systems for three of their milk collection centers. These systems were to produce hot water for cleaning, which requires water that is at least 70°C. According to the Chairman, the design of these Egyptian-manufactured systems was apparently inadequate to meet the energy requirements in the milk collection centers.

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Summary Description

As indicated in Table 1, several potential applications of SIPH technology exist at the Cairo plant. Two limitations, related to the rate of energy consumption in the various processes, serve to limit these applications. First, the temperature at which the process heat is needed will constrain the use of solar energy from flat-plate collectors (commonly used for water heating). Secondly, the heat transfer coefficient for condensing steam is much higher than that for hot water of a lower temperature, necessitating a larger heat exchanger for use of hot water (more heat transfer surface area). These constraints were used to rank the process heat requirements listed in Table 1 in order of suitability for application of solar-heated water.

(1) Yogurt Incubation - This heat requirement is relatively low temperature (60-80°C) and a recirculating hot water system can be used in conjunction with a fan coil for heating the air in the incubator room to maintain the desired temperatures. This SIPH system can be used to displace electricity, a high grade energy source, which is currently being used to heat the room.

(2) Plant Cleaning - This heat requirement is also relatively low temperature (70-80°C) and use of solar-heated water for cleaning could displace essentially all of the No. 2 fuel oil required at the plant.

(3) Milk Pasteurization - The temperature attained in pasteurization is critical from a product quality standpoint. The temperature of the milk must reach 70-90°C, so the water temperature must be at least 80°C. In addition, the temperature difference between entering and existing hot water in the pasteurizing heat exchanger is relatively small, requiring the solar heating system to maintain high water temperatures throughout the system, resulting in high heat loss to the environment and low efficiencies of solar collector operation.

(4) Miscellaneous - Uses of steam in existing equipment, particularly where it is desirable to have high heat transfer rates associated with steam, are not compatible with substitution of hot water. Therefore, due to the need to either produce steam from a solar system or to replace existing equipment, these process heat needs are ranked as lowest priority for SIPH application.

Based on the above priority ranking, the Field Test will install a flat-plate, solar water heating, storage delivery and control system which will provide heat in the yogurt incubator room and hot water for use in cleaning the plant and equipment in the Cairo plant of the Misr Milk Company.

1.2 APPLICATION DESCRIPTION

Objective

As in many industrial food processing applications, solar water heating at the Misr Milk plant will demonstrate the economic use of solar energy to supplant non-renewable fuels or utility-supplied electricity in heating

Description	Required temperature	Current Energy Source	Normal Operation	Approx. daily Energy requirement
1. Plant cleaning: Water is heated and used to clean and rinse equipment and facilities	158-176°F (70-80°C)	Mobile water heating units, direct fired by No. 2 fuel oil	16 unit hrs/ day (intermittant usage divided among multiple units)	6.3×10^6 BTU (based on 200 kg/day No.2 fuel oil, 75% water heater efficiency
2. Milk pasteurization: Milk is heated to 70-90°C; 3 units are used, two using 42 psig (3kg/cm^2) steam, one using 176°F (80°C) hot water	176-210°F (80-100°C)	42 psig (3kg/cm^2) steam 80°C hot water	20-24 hrs/day	24×10^6 BTU (based on 500 tons/day milk pasteurized, 80% regeneration rate in pasteurize
3. Yogurt incubation: incubator room is maintained at 108°-113°F (42-45°C)	140-176°F (60-80°C)	Electricity	20-24 hrs/day	1×10^6 BTU (est.)
4. Miscellaneous: - Steam distribution losses - Steam injection for yogurt preparation & heating of ice cream mixture - Steam jacketed vessel for cheese preparation - Water heating using steam/ water mixing	176-250°F (80-120°C)	Plant steam	Intermittent	8.0×10^6 BTU (est. as remainder of steam generated on use of 2200 lbs No. 6 oil/day)

Table 1. Industrial Process Heat Requirements, MISR Milk Co., Cairo

process water to temperatures below 100°C. Sanitation in a food processing plant is critical and strictly enforced by government agencies, as is the case at the Misr Milk Co. Thus, a successful demonstration of SIPH technology to provide hot water for plant clean-up could assist the plant in attaining required sanitation standards, and could be replicated in almost any food processing operation. Since, at present, food processing represents approximately 30 percent of the industry in Egypt, the potential for widespread adoption of the proposed SIPH technology is great. The use of solar heated water for environmental control in the yogurt incubator room of the plant will establish the feasibility of solar energy for space heating. This application can easily be interfaced with the system for heating water for plant clean-up. Thus, the versatility of a central solar water heating system for multiple uses will be demonstrated.

Concept Description

The proposed Field Test will consist of the following components:

(1) Flat-plate solar collector array;

(2) Hot water storage tank;

(3) Recirculating water pump and associated piping;

(4) Control instrumentation;

(5) Central hot water pumping station with back-up steam heating system to deliver hot water to hose stations installed around the plant (with water piping); and

(6) Performance monitoring instrumentation.

The conceptual design is presented in Figure 1. This system will allow common storage from which to supply hot water for both applications in the plant, clean-up and heating of the incubator room.

Siting Information

The plant site is located in an industrial area of Cairo and there is little land owned by the plant which is not presently in use or which is not the site of new building construction. For this reason, the solar collector array may have to be roof-mounted. The plant visit showed that there is no single roof span which could provide the space needed for the estimated collector area of 15,000 ft^2. However, the possibility of using several separate roof areas exists which may be the only viable concept for siting the collector array. The roof areas which were inspected are reinforced concrete and appear suitable for the anticipated loading of a flat-plate collector array with mounting structures. The solar access to the roof areas is essentially unobstructed and orientation is not a problem. Two new buildings are presently under construction which may provide additional options for sites to install roof-mounted collectors.

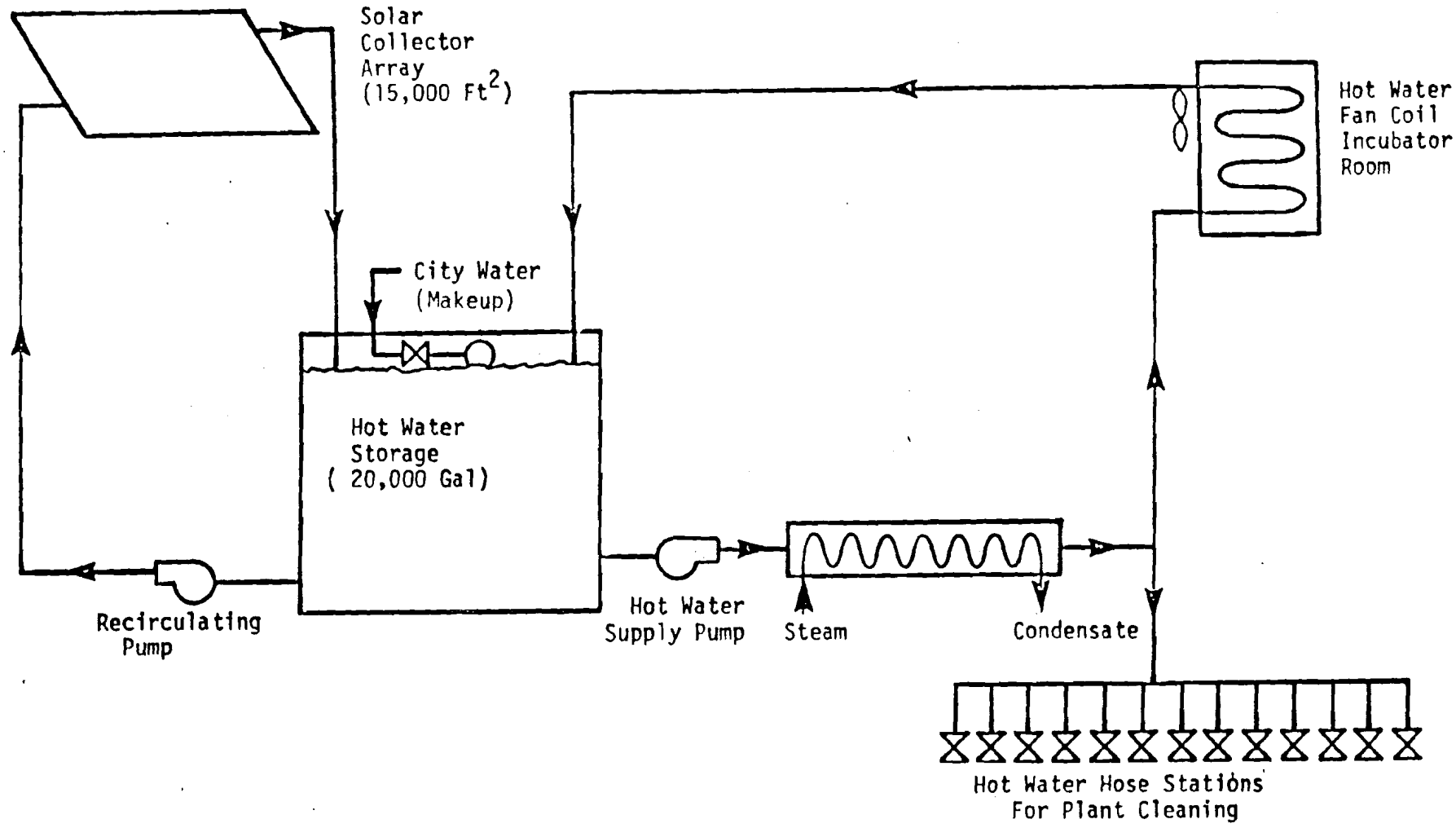

Figure 1. Proposed Solar Water Heating System
MISR Milk Co., Cairo

The site has access to major highways and major construction is ongoing, indicating no problem with site access. The site is served by major utilities, including electric, water and sewer.

System Technical Data and Design Specifications

A total thermal energy requirement of 7.3×10^6 Btu/day is derived from the estimates presented in Table 1. It is estimated that the flat-plate collector area required to meet this demand is approximately 15,000 ft^2. The collectors are proposed to be single-glazed, flat-plate collectors, with a selective coating on the absorber surface. Collector efficiencies in Egypt are expected to remain relatively high (approximately 40 percent depending on the collector performance) due to the high ambient temperatures. No freeze protection will be necessary at the Cairo site, but a purge system to dissipate collected energy when it is not needed will be necessary. The sequence of operation will be to initially fill the water tank for clean-up, using a level-controlled valve to automatically add water to maintain the volume in the tank. Depending on the schedule of plant clean-up operations, the makeup water valve may be interlocked with the pump recirculating water through the collectors to avoid adding unheated water to the tank during night hours. The water from the tank will be recirculated through the collectors and back to the tank, with pump control effected by a differential temperature controller, measuring temperature of the stored hot water and the collector array absorber surface. Hot water will be pumped from the storage tank on demand with a steam heater installed in the water supply line for adding additional heat when needed. The plant presently has two water storage tanks, each with approximately a 24,000 gallon capacity. One of these may be used as the hot water storage tank.

The proposed solar hot water heating system is one of straightforward design. Standard, commercially available components can be used with no special provisions. One aspect of maintenance in the Cairo area is cleaning the glazing of solar collectors regularly, since the area is very dusty. Consideration will be given to inclusion of an automatic washing system for the collector glazing.

The actual detailed design parameters will have to be established based a survey of plant operations during which process heat requirements (i.e, hot water consumption during clean-up) are measured. Details for roof-mounting or ground-mounting of the collector arrays must also be finalized. Finally, a determination of the required hot water storage capacity must be made, and the suitability of using existing water storage tanks established.

Installation of the collector array will be under the guidance of the manufacturer. The remainder of the equipment installation will be completed by a plumbing and electrical contractor. Upon completion of the installation, a performance test of various components and the system as a whole will be a requirement for system acceptance.

Monitoring and Evaluating Data Requirements

Since the primary purpose of the Field Test is to establish the viability of SIPH technology in a water heating application, adequate operational data must be collected to allow reliable performance evaluation. As a minimum, the data collected should include:

(1) Site insolation, ambient temperature data;

(2) Temperatures at various points in the system;

(3) Auxiliary steam added;

(4) Time during which energy is being supplied from the system;

(5) Collector efficiency; and

(6) System efficiency.

1.3 IMPLEMENTATION REQUIREMENTS

Organizational Elements and Responsibilities

The Misr Milk Company Plant in Cairo has a qualified engineer and staff which operate and maintain four boilers, a large refrigeration plant, and extensive production equipment which incorporates pumps, heat exchangers, and other electric and mechanical equipment. The company has installed solar hot water systems in other locations, though these have not performed satisfactorily. For this field test it is recommended that the proposed solar equipment be designed and installed by U.S. contractors, with acceptance testing as part of the installation contract. The proposed solar energy system is relatively simple and uses equipment which is familiar to the plant engineering personnel. Training of plant personnel in the system operation is a necessity, and technical assistance in operation should be provided for at least one year.

A comprehensive monitoring program to continually evaluate the Field Test performance will be required over a period of at least two years after equipment start-up. The Government of Egypt will assume the primary role, either in performance monitoring or as the Project Engineer for the Field Test. The system operating personnel employed by Misr Milk Co. will be considered as the primary project participants after the system is put into service. The viability of the Field Test depends on the successful operation of the equipment and the cognizance of system performance by these operational personnel. A reporting procedure (e.g., operation log) will be implemented for plant personnel to give feedback to the Project Engineer.

Schedule

A schedule and recommended organizational structure in shown in Figure 2.

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FIELD TEST PARTICIPANT	RESPONSIBILITY
Design Contractor (U.S.)	.Establish design parameters .Complete bid package
Installation Contractor (U.S.)	.Procure equipment .Install equipment .Test equipment
Solar Collector Manufacturer (U.S.)	.Site supervision of installation .Test & Startup .Train plant personnel in operation
Project Engineer (U.S. or Egyptian)	.Certify acceptance testing .Oversee training of plant personnel .Provide technical assistance
Plant Technical Staff (Egyptian)	.Provide personnel for training for system operation .Operate and maintain system

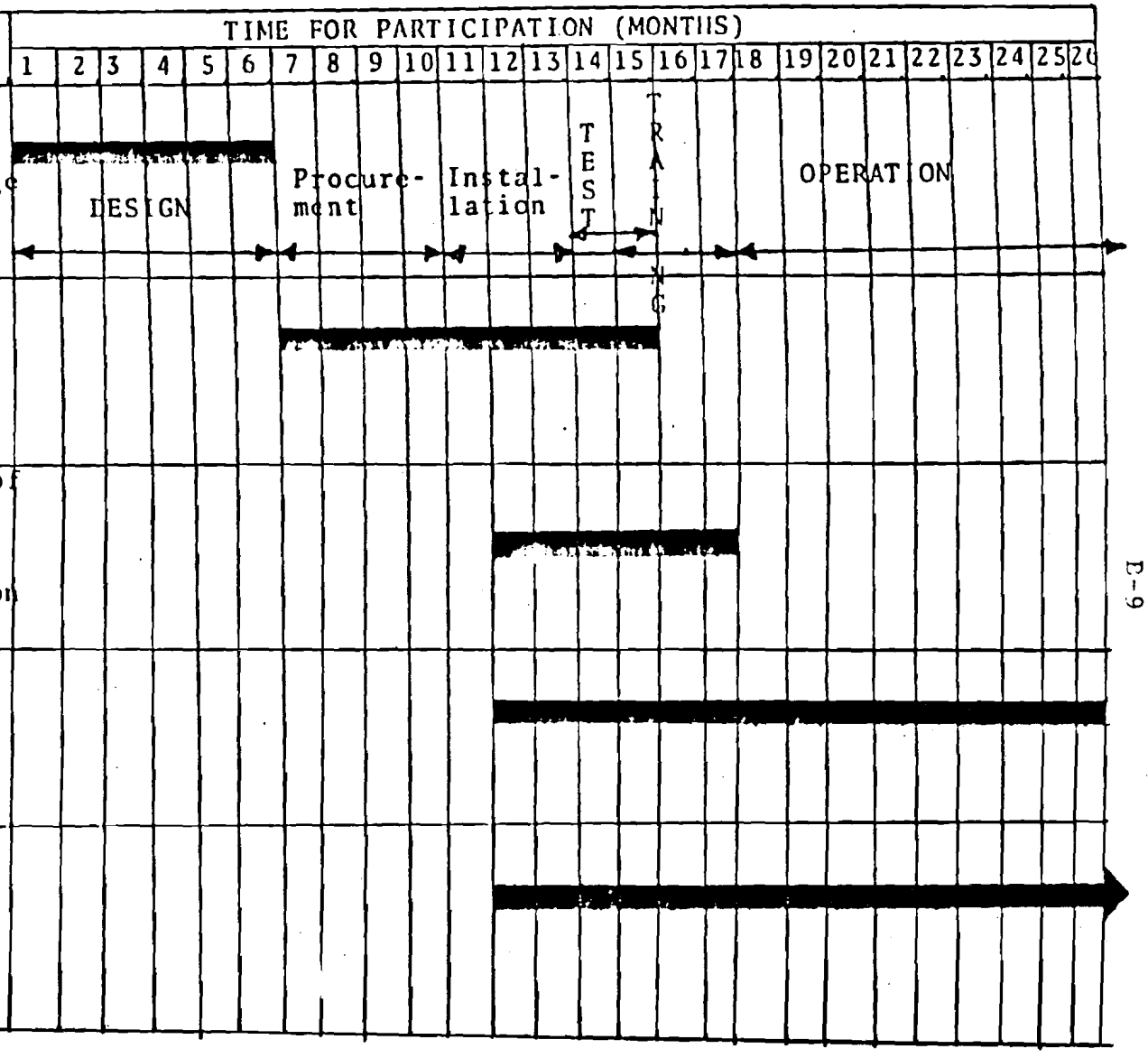

FIGURE 2. FIELD TEST SCHEDULE AND ORGANIZATION STRUCTURE

1.4 FIELD TEST COST ESTIMATE

Design and Engineering	$ 50,000
Equipment	440,000
Shipping	65,000
Manual Development	30,000
Installation and Construction	135,000
Check-out and Start-up (3 months)	50,000
Operations and Maintenance Support (2 years)	140,000
TOTAL	$ 910,000

2. SOLAR-ASSISTED FRUIT DEHYDRATION

2.1 INTRODUCTION

The Agricultural Production Authority operates numerous commercial and experimental farms throughout Egypt. In Giza, adjacent to the Cairo University campus, the Authority has facilities for cleaning, disinfecting, drying and packaging a variety of fruits and vegetables.

An initial concept proposed for utilization of solar energy was a retrofit system to heat air for an existing batch dryer. This concept was discarded because of the condition and design of the existing system. The unit has been operated for over fifty years. It uses a heavy-oil burner to heat air which is sent single-pass through trays of raw fruits. There is no control on either operating temperature or air flow. The system can provide both under-dried products and burned products at the same time.

A renewable energy demonstration program will provide both the solar energy system and the basic fruit dryer. Commitment from the Authority is shown by their willingness to provide modifications as required to existing structures to accommodate the demonstration system.

Although this particular system as configured may not have great potential for replication the objective of this application is to demonstrate a system in the agriculture area close to Cairo where a success will serve to popularize the utilization of solar technology. This is of significance due to the tremendous opportunities for agricultural drying applications throughout Egypt.

2.2 APPLICATION DESCRIPTION

The proposed system will incorporate a dryer of conventional design capable of processing 10 tons/day of fruits into approximately 1.5 tons/day of dried product. The principal product will be dates; however, a variety of fruits and vegetables may be processed as seasonal harvesting dictates. The system is illustrated in Figure 1. Trucks of loaded product trays enter one end of the dryer and the system is closed and operated. As each truck's load is completed drying, the truck is removed from the far end of the tunnel, and a new one may be inserted at the beginning. Thus, the dryer presents a semi-continuous processing line with a capability of both long residence time and variation of residence time with changes in product type.

Sizing of the tunnel dryer is dependent on both the desired production rate and the type of product. Different fruits and vegetables will have different requirements for tray depth, drying temperature and residence time. Based on preliminary information, a 50 ft long tunnel dryer should meet the requirements of the Giza facility.

The fruit is dried by hot air recirculated through the truck trays. In commercially available dryers, the air may be heated either with steam coils or clean flue gases. A portion of the air is replaced continuously in order to provide adequate moisture exhaust. Conventional design includes an exhaust fan so that the system operates at a negative pressure. Dampers are manually adjusted to control air exchanger rates.

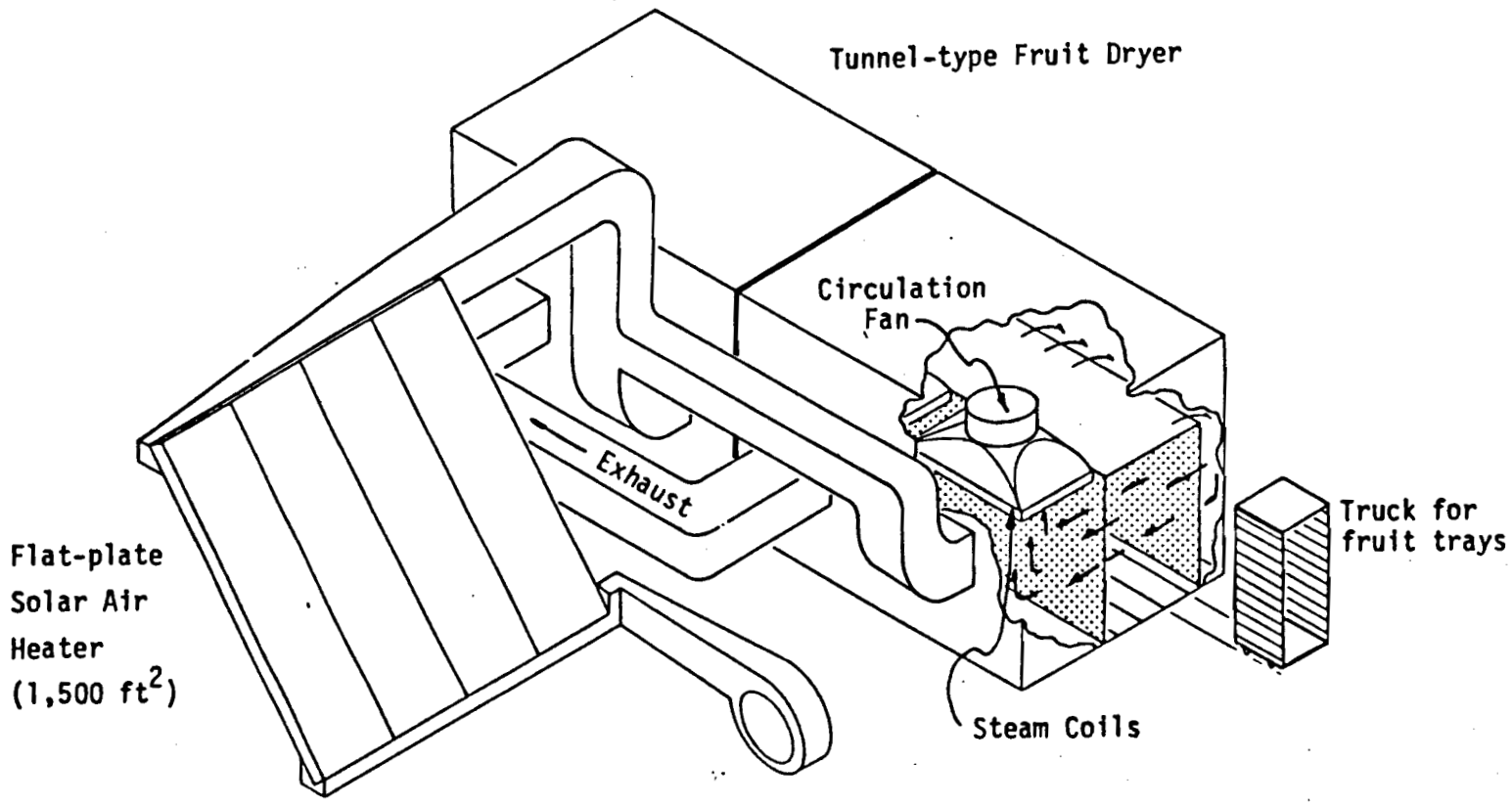

Figure 1. SOLAR ASSISTED FRUIT DRYER

The proposed use of solar energy is to provide preheating of the makeup air to the system. This application contributes to a reduction in use of conventional fuel while minimizing the operating temperature of the solar collector array. It also assures that fluctuations in solar insolation will not have a major direct effect on drying temperatures.

A direct air heating collector array will be used without an energy storage system. This system offers lower capital cost than a water system, and the lower collector efficiency normally encountered with air systems will be compensated for by avoiding the use of a water-to-air heat exchanger.

The flow resistance through the collector will be greater than in a normal inlet duct. For this reason, a forced draft system is used through the collector. The fan is sized so that the dryer itself operates at a negative pressure as with conventional systems.

Both operating temperature and air makeup rate are process variables which may differ with product type and which will affect energy requirements. The moisture content of the feedstock will also impact energy requirements. For these reasons, total energy requirements for the system will be difficult to project without a more detailed study. This will be performed by the designer/manufacturer of the dryer.

The sizing of the solar collector array is determined by both the required energy contribution and the allowable pressure drop at anticipated air makeup rates. As a first approximation, a dryer of this size will require about 3000 cfm of makeup air. Commercially available flat-plate air heaters recommend a flow rate of about 2 cfm/ft^2 for a collector pressure drop of about 0.2 inches of water. These figures suggest a collector area in the range of 1500 ft^2.

A collector array of this size should be capable of providing peak preheat temperatures in the range of 16-27°C above the ambient temperature with an average energy contribution of about .70 to .75 MMBtu per day. For a projected utilization of 260 days/year, the annual energy contribution will be 190 MMBtu.

Adequate space for the collector array or the dryer is not available in the immediate vicinity of the existing fruit dryer. Since an entirely new system is to be provided, there is not necessarily a constraint to keep the operations in the same buildings. Managerial personnel indicate that there will be no problem modifying or constructing buildings as necessary, nor obtaining land space in their complex.

2.3 IMPLEMENTATION REQUIREMENTS

Figure 2 presents the organization and schedule for the field Test. The staff of the Agricultural Production Authority should be fully capable, after training of operating and maintaining the tunnel dryer and most of the solar energy equipment. Support from a Project Engineer will be required in order

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to assure proper system performance and to monitor and evaluate its operation. The facility staff will be relied upon to have the expertise to evaluate the process performance of the dryer and to lend technical support for alternative energy systems.

FIELD TEST PARTICIPANTS	RESPONSIBILITY
Design Contractor (U.S.)	•Establish design parameters •Complete bid package
Installation Contractor (U.S.)	•Procure equipment •Install equipment •Test equipment
Solar Collector Manufacturer (U.S.)	•Site supervision of installation •Test & Startup •Train plant personnel in operation
Project Engineer (U.S. or Egyptian)	•Certify acceptance testing •Oversee training of plant personnel •Provide technical assistance
Plant Technical Staff (Egyptian)	•Provide personnel for training for system operation •Operate and maintain system

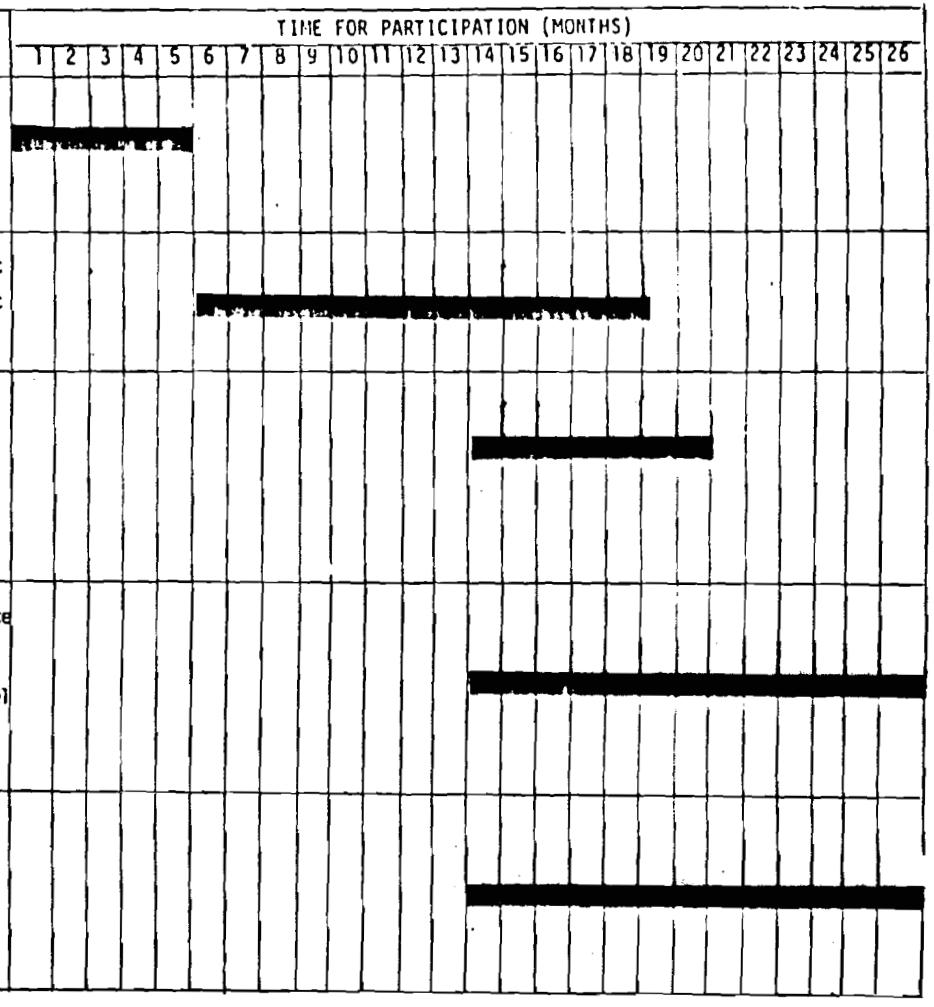

FIGURE 2. FIELD TEST ORGANIZATION

2.4 FIELD TEST COSTS ESTIMATE

	Cost
Design and Engineering	$ 40,000
Equipment	210,000
Manual Development	30,000
Shipping	50,000
Construction and Installation	45,000
Startup, Check-out and Training	50,000
Operations and Maintenance Support (2 yrs)	90,000
Total	$515,000

3. SOLAR ENERGY AND HEAT RECOVERY FOR POULTRY PROCESSING

3.1 INTRODUCTION

Background

The General Poultry Company (GPC) of Egypt is the largest government-owned poultry operation in the country, producing more than 100,000,000 broilers per year. The company operates several poultry processing plants in Egypt. The proposed site for the Field Test is the GPC plant in Heliopolis. Discussions concerning a possible renewable energy project at the plant were held with the General Manager and Chairman of GPC, as well as with plant personnel.

Process heat is supplied by steam in the Heliopolis plant, and the main energy requirements are the poultry scalding and the by-products rendering. In addition, plant clean-up occasionally uses hot water provided by a portable steam cleaner. Hot water at 65-70°C at the scalder is needed to replace water lost with the chickens and by evaporation. Present demands for scalder makeup are about 6000-7000 gallons/day (assuming a makeup rate of 0.33 quart/bird and an initial tank fill of 2000 gallons). Within two years, however, the plant will expand to twice the current capacity and the hot water demand for scalding should increase proportionately. This hot water demand and the additional hot water for clean-up are the suggested process heat requirements which can be supplied by the proposed solar/waste heat recovery system. Water at 170°C is required for by-product rendering and, therefore, this operation is unsuitable for solar applications utilizing flat-plate collectors.

As with many food processing plants, the GPC plant operates a large refrigeration plant which can provide large quantities of condenser heat for applications such as water heating. The proposed Field Test will incorporate both waste heat recovery from the plant's refrigeration condenser and solar water heating using an array of flat-plate collectors.

Summary Description

The Field Test will be located at the GPC broiler processing plant in Heliopolis. The plant presently processes 40,000-50,000 chickens/day over an 8-9 hour period. The application will use a flat-plate solar array, in conjunction with a waste heat recovery system on the plant's refrigeration system, to heat water to 70-80°C, store it, and supply hot water to the poultry scalding operation and the plant clean-up operation. The system will be sized to provide the hot water needed by the expanded plant capacity (approximately twice current production rates), since this expansion is scheduled to be completed in 1983.

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3.2 APPLICATION DESCRIPTION

Objective

The objective is to establish the concepts of both solar energy and waste heat recovery for use in industrial process water heating. The concept can have a wide applicability in Egypt's food processing plants (which make up about 30% of the country's industry) where refrigeration and hot water needs usually occur concurrently. In addition, the Field Test is to determine the economic viability of using energy conservation in conjunction with solar energy technology.

Concept Description

The use of waste heat recovery in poultry processing plants for heating process water has been demonstrated to be a cost-effective means of energy conservation in the U.S. through DOE-sponsored research projects. However, in Egypt the poultry processing plants operate somewhat differently in that the poultry scalder is not overflowed (a waste heat source in U.S. plants) and the scalder is operated at 65-70°C, compared to operation at 50-55°C in U.S. plants. Another difference between Egyptian and U.S. plants is product refrigeration. U.S. plants typically manufacture ice for packing processed poultry, while Egyptian plants freeze their poultry. This fact affects the type of refrigeration systems which are used - U.S. plants using ice often employ single stage refrigeration (with high superheat), while Egyptian plants use compound compression or two stage refrigeration (with lower refrigerant condenser superheat temperatures). These differences, as well as the different temperatures of the water supply, result in less waste heat recovery potential in Egyptian plants. An additional potential source of waste heat that can be employed is heat recovery from the condenser of the rendering cookers. This will be more thoroughly evaluated at the next stage of the Field Test.

The proposed solar/waste heat recovery water heating system is presented in schematic form in Figure 1. The sequence of operation of the system is as follows:

(1) The hot water storage tank is filled with plant water which is pre-heated by the waste heat recovery heat exchanger installed in the hot ammonia gas line.

(2) Water from the storage tank is recirculated through the collector array during daylight hours and heated to 70-80°C.

(3) As the processing plant starts up (in the early morning), stored hot water is used to fill the poultry scalder (2500-3000 gallons per line).

(4) During processing, hot water is supplied to the scalder as required by the level control. The pre-heated makeup water is added continuously.

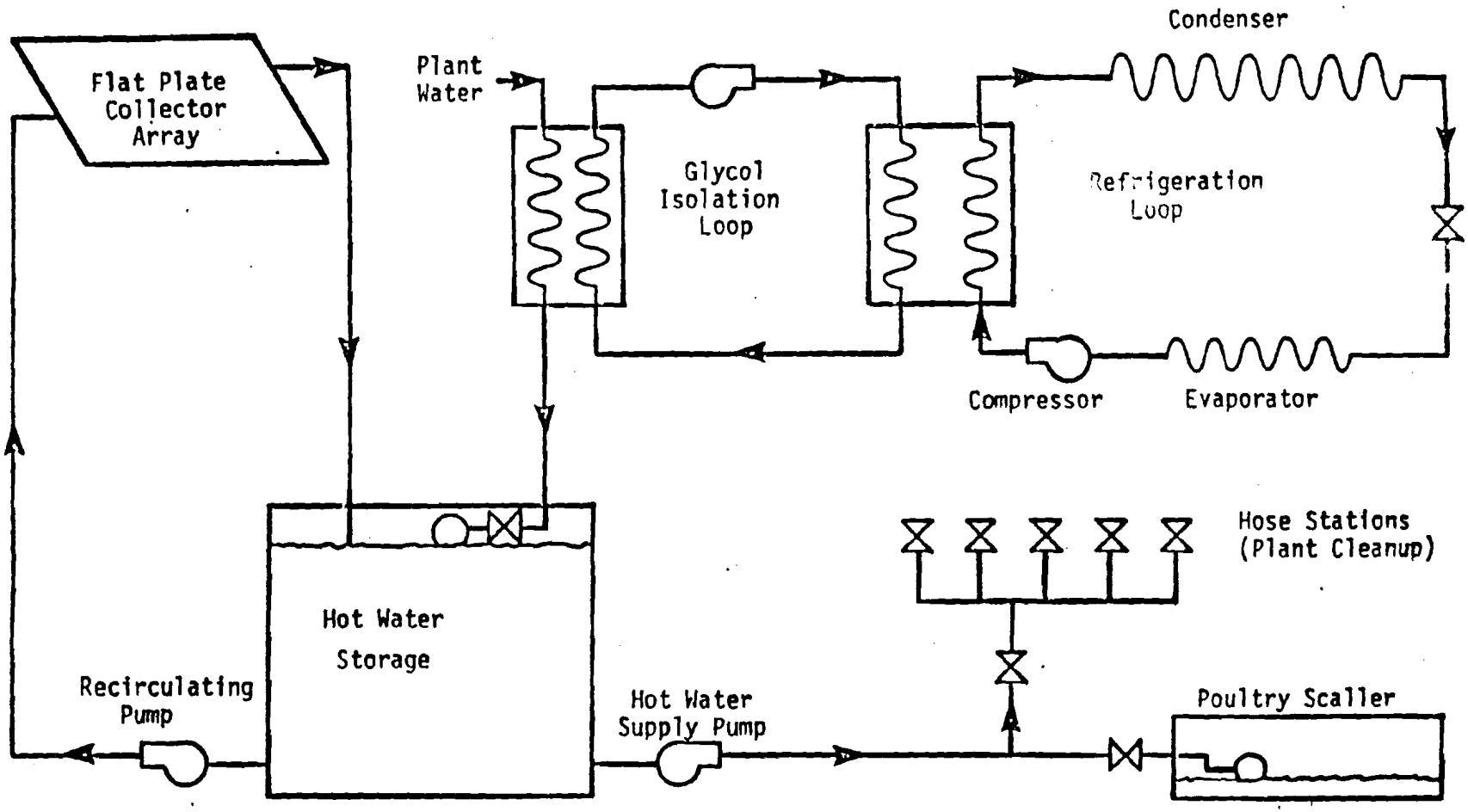

Figure 1

Solar Energy/Waste Heat Recovery System
General Poultry Company

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(5) After the processing is completed, plant clean-up requires hot water, intermittently, as the hoses are used, for approximately one hour.

(6) The tank is filled to capacity (again with pre-heated makeup water) after clean-up hours, solar energy is collected and added to the stored water.

The use of the heat of the refrigerant for pre-heating water to the storage tank is appropriate because the temperature of the hot ammonia is not expected to exceed 82°C, thus making this heat source one of lower temperature than the solar collectors. The primary drawback to such an arrangement is the fact that hot water is stored at the highest system temperature. The tank must be well-insulated to compensate for this.

Siting Information

The site has access to major highways and rail service, with no perceptible problems in construction, operation or maintenance access. The building has a roof which is, according to the plant personnel, suitable for mounting solar collectors. However, some large trees around the site may cause small shading problems and have to be removed. The plant has electricity, water and sewer service provided by public utilities. The fuel used for boilers and steam cleaning is No. 2 fuel oil. The plant has the technical staff presently to operate and maintain extensive mechanical, electrical and refrigeration equipment. There is no problem with the resident capability to operate and maintain Egyptian poultry industrial equipment and the proposed Field Test in Heliopolis would make an excellent showcase for other poultry processing plants in Egypt.

System Technical Data and Design Specifications

Assuming that the water heating system capacity is sized for the expanded plant capacity (i.e., twice existing capacity or approximately 100,000 birds/day), the required energy is 10 to 12 x 10^6 Btu/day. It is estimated that 4 x 10^6 Btu/day could be supplied by a waste heat recovery system on the refrigeration plant. Thus, 8 x 10^6 Btu/day would be needed from the solar collector array, or an estimated 16,000 ft^2 of flat-plate collectors. The storage tank volume should be a least 10,000 gallons and the tank should be well-insulated. The storage tank must be designed to provide a measure of thermal stratification since hot water will be drawn off while colder makeup water is being added. An auxiliary steam heater should be installed in the hot water supply line to provide additional heat, if necessary. Solar collectors should be flat-plate, single glazed, with black chrome coating and suitable for roof-mounting. All hot water piping should be insulated. The heat recovery system in the hot ammonia line (between compressor discharge and condenser) should be an indirect heat exchange system, with propylene glycol (food grade) used in a shell and tube counterflow heat exchanger to heat water with the recirculating propylene glycol. This type of system has proved to be the most trouble-free system for this type of application.

The design of the system will carefully address the planned schedule of operation to determine accurate design parameters. Since details of the plant expansion were not finalized as of July, 1981, final equipment and operational specifications must be obtained from GPC before commencing detailed design. A contractor with experience in refrigeration or heat recovery systems as well as with solar water heating systems will be retained. Installation should be conducted in conjunction with the solar collector manufacturer and with the local refrigeration service contractor. The waste heat recovery system should be performance-tested separately from the solar system. In addition, the whole system should be tested for performance, according to the planned operation (i.e., hot water should be produced and withdrawn from the system according to the anticipated plant energy demand).

Monitoring and Evaluating Data Requirements

In order to establish the viability of the proposed system, the following data should be collected with appropriate instrumentation:

(1) Solar radiation (insolation)
(2) Collector efficiency
(3) Temperatures at various points
(absorber, surface, inlet and outlet water to collectors, hot water storage tank, water temperature at usage points, etc.)
(4) Thermal stratification in storage tank
(5) Total energy delivered by system

3.3 IMPLEMENTATION REQUIREMENTS

Figure 2 presents the organization and schedule for the Field Test. The General Poultry Company plant personnel are very enthusiastic about the project and the Chairman is capable of committing the plant resources necessary to operate the system. As with all the industrial applications in this project, a Project Engineer will closely observe and monitor the Field Test. The success of operation will depend on the plant personnel and how they are trained.

FIELD TEST PARTICIPANTS	RESPONSIBILITY
Design Contractor (U.S.)	•Establish design parameters •Complete bid package
Installation Contractor (U.S.)	•Procure equipment •Install equipment •Test equipment
Solar Collector Manufacturer (U.S.)	•Site supervision of installation •Test & Startup •Train plant personnel in operation
Project Engineer (U.S. or Egyptian)	•Certify acceptance testing •Oversee training of plant personnel •Provide technical assistance
Plant Technical Staff (Egyptian)	•Provide personnel for training for system operation •Operate and maintain system

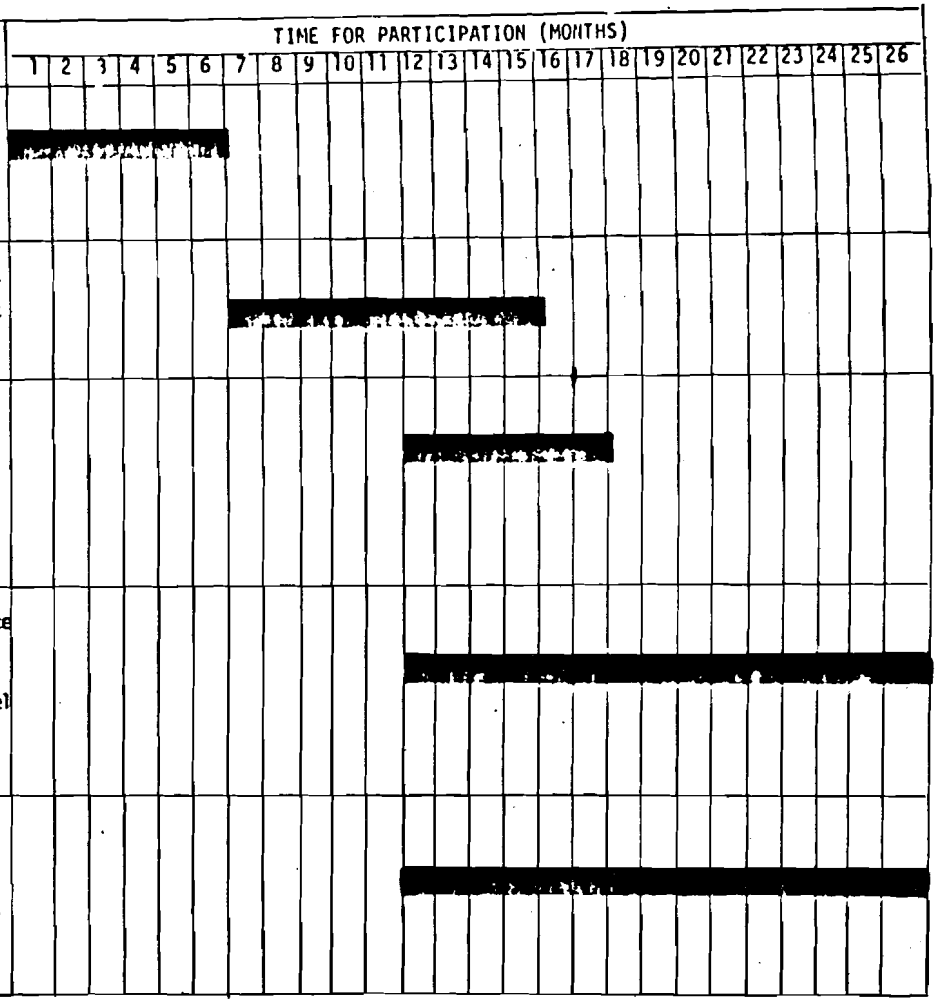

FIGURE 2. FIELD TEST ORGANIZATION

3.4 FIELD TEST COST ESTIMATE

Design and Engineering	$ 50,000
Equipment	455,000
Manual Development	30,000
Shipping	30,000
Construction and Installation	140,000
Check-out, Start-up and Training	50,000
Operation Support (2 years)	185,000
Total	$940,000

4. SOLAR ENERGY AND HEAT RECOVERY FOR TEXTILE DYEING

4.1 INTRODUCTION

Background

Based on data collected during a visit to the Bortex Textile Company facilities in Zagazig, Governorate of Sharqiya, preheating of water for the dyeing operations was identified as an appropriate application for a field test of solar industrial process heat (SIPH). Favorable factors which exist for this application include:

1. Moderate plant size
2. High proporation of thermal energy need of the plant is in the dyeing operations
3. Moderate end-use temperature (less than 100°C)
4. Moderate energy usage
5. Existing plant technical staff
6. Interest on the part of plant management

4.2 APPLICATION DESCRIPTION

The objective of the proposed system is to provide an improved method for heating of water for dyeing of textile fabrics. The concept proposed is similar to SIPH systems employed in the U.S. and includes solar energy for heating, recovery of heat from waste streams and continued use of conventional fuels. Basic conservation measures will also be taken and an integrated system approach is recommended for water heating. In current operations, cold water and chemicals are loaded into the dye beck which holds approximately 1.25 m^3. The fabric is introduced in a continuous loop which is draped over a horizontal drive roll that provides agitation. The dye bath is heated by direct sparging of low pressure steam at the bottom of the vessel. Process temperatures of 100°C are used for some process cycles while others (rinses) use cold or warm water. The becks are open to the atmosphere and there appears to be considerable energy loss with the water vapor emitted to the atmosphere.

There are several opportunities evident for energy conservation. Some may be implemented immediately while others require further evaluation as to the effect on product quality. The following represent some of the conservation opportunities:

1. Enclosing the dye becks
2. Closed steam loop for heating (condensate recovery)
3. Low temperature dyeing
4. "Bump-and-run" temperature control

In addition to these conservation measures, waste heat recovery techniques may be implemented through reuse of dye baths or heat transfer from waste water to incoming water. All of these conservation and heat recovery techniques have been demonstrated at plants in the United States and several should be applicable to the Bortex processes.

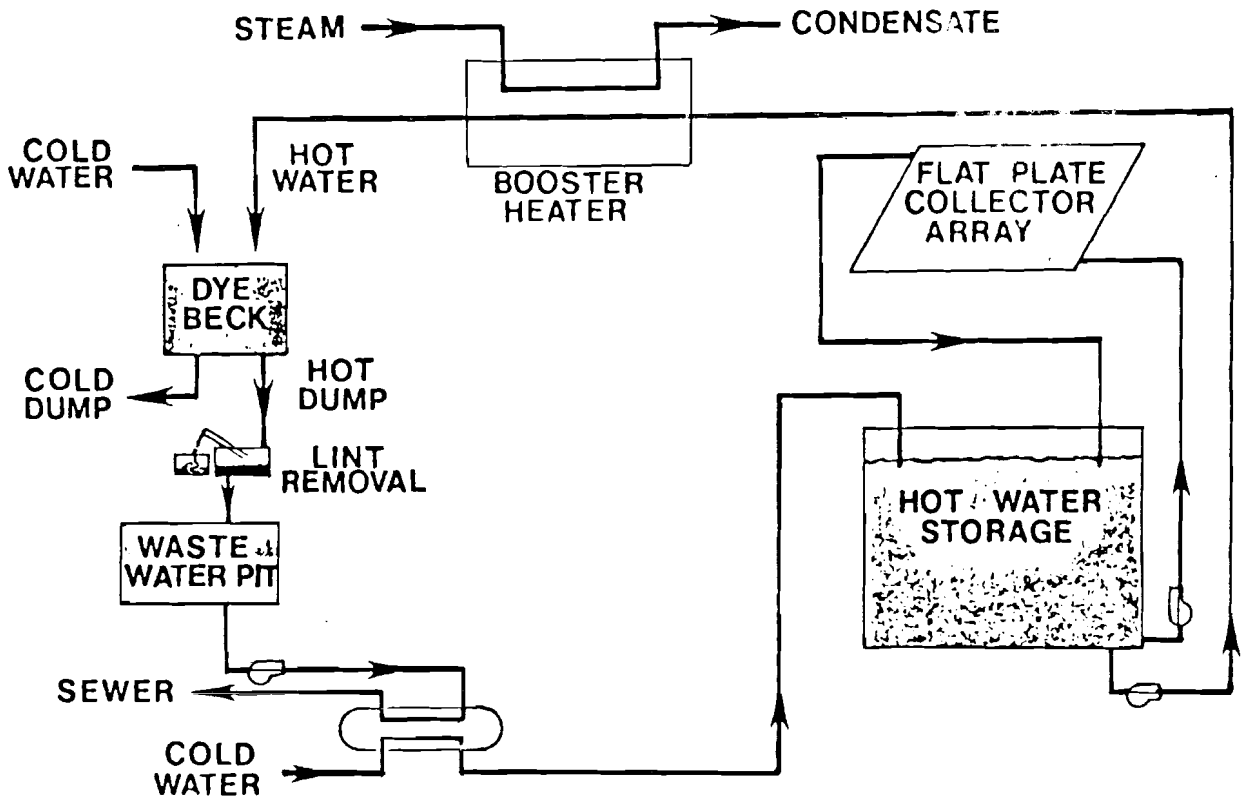

FIGURE 1. PROPOSED HEAT RECOVERY/SOLAR ENERGY SYSTEM

The system recommended for the Bortex dye house is a combination of waste heat recovery and solar energy utilizations. A schematic of the system concept is presented in Figure 1. Waste water from the dye beck is segregated according to temperature. Hot water is passed through a lint removal system to a waste water pit. This water is pumped through a heat exchanger where it warms the incoming water flowing to a warm water storage tank. Both the waste water pump and the cold water inlet valve are controlled by a float in the storage tank.

Water in the tank is recirculated through an array of flat-plate solar collectors to boost the water temperature. Water from the storage tank is pumped through an auxiliary water heater to provide the desired temperature. This auxiliary heater may use steam (as shown) or be a fired unit.

Through use of this system, water may be pre-heated to any desired temperature before being introduced to the beck. This will decrease energy loss by improving processing time and minimizing losses in steam sparging.

System Sizing and Projected Performance

The proposed heat recovery system will provide pre-heating of the 15 m^3/hr flow of water from 25°C. This energy recovery will save about 1.96 x 10^6 Btu/hr.

For a design temperature of 70°C leaving the hot water storage tank, a collector array size of approximately 14,000 ft^2 is warranted. This array will provide adequate heating for an average of more than twelve hours of operation per day. For nighttime operation, after stored energy is depleted, and for days with inadequate insolation, the heating requirements will be provided by the booster heater.

The combined heat recovery/solar energy system will have the capability of providing over 16,000 MMBtu/year assuming 24 hour operation six days a week. Actual energy contributions will depend greatly on the plant's operation schedule and the utilization of the system.

4.3 IMPLEMENTATION REQUIREMENTS

Figure 2 presents the organization and schedule for the Field Test. The staff of the Bortex Textile Company plan has the ability to operate and maintain the conventional portions of the test system and, after training, they should be able to provide the same services for the renewable energy system. Support from a Project Engineer will be provided in order to assure proper system performance and to monitor and evaluate its performance.

FIELD TEST PARTICIPANTS	RESPONSIBILITY
Design Contractor (U.S.)	•Establish design parameters •Complete bid package
Installation Contractor (U.S.)	•Procure equipment •Install equipment •Test equipment
Solar Collector Manufacturer (U.S.)	•Site supervision of installation •Test & Startup •Train plant personnel in operation
Project Engineer (U.S. or Egyptian)	•Certify acceptance testing •Oversee training of plant personnel •Provide technical assistance
Plant Technical Staff (Egyptian)	•Provide personnel for training for system operation •Operate and maintain system

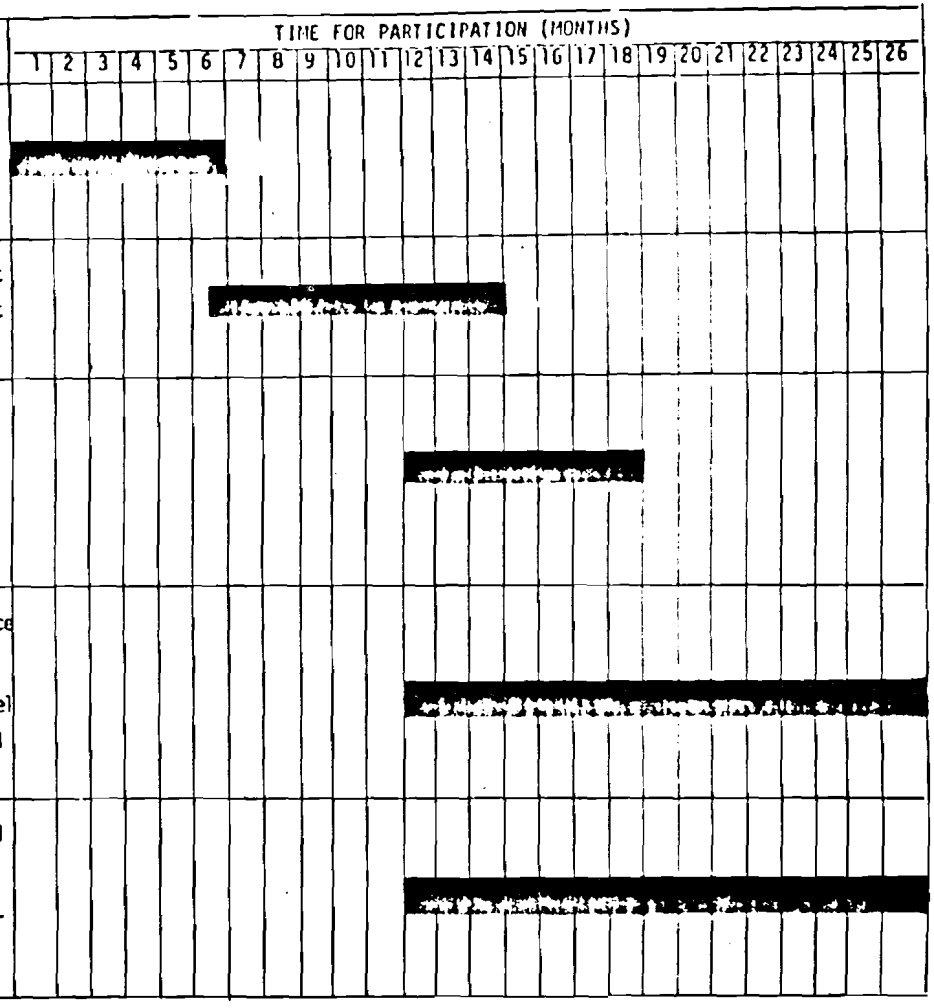

FIGURE 2. FIELD TEST ORGANIZATION

4.4 FIELD TEST COST ESTIMATE

	Cost
Design and Engineering	$ 50,000
Equipment	424,000
Manual Development	30,000
Shipping	30,000
Construction and Installation	100,000
Check-out, Start-up, and Training	50,000
Operations and Maintenance Support (2 yrs)	206,000
TOTAL	$890,000

5. SOLAR WATER HEATING FOR METAL PROCESSING

5.1 INTRODUCTION

The Koldair Company, located in Giza, manufactures water coolers, freezer units, commercial air conditioning equipment and window unit air conditioners. Metal parts for these products are chemically-treated in dipping tanks prior to painting. Degreasing, phosphatizing, chrome dip, and one hot rinse treatment operations require water at 70-80°C. Two new automatic production machines are being installed which will provide continuous chemical treatment and subsequent painting of metal parts for window units and water coolers. The energy required to maintain the desired bath temperatures in the dip tanks and also provide a forced air drying prior to painting for these two machines is 4000 to 5000 lb steam/hr. This energy rate would be very high to supply by a solar system and there is not enough area to mount collectors for such a capacity. However, a more reasonable use of solar is to heat the water which is used to fill the tanks initially. The total water needs for such an application are estimated to be about 30,000 gallons per day. However, during detailed design it will be determined how often the tanks should be refilled.

If 30,000 gallons/day of hot water were needed, a solar water heating system of some 50,000 ft^2 and a storage tank would be necessary. This solar energy system would be displacing No. 2 fuel oil presently burned in the plant boiler.

5.2 APPLICATION DESCRIPTION

The plant is large (3000 employees) and has some 200 engineers at the site. A new, large expansion is under construction and will house some of the equipment requiring hot water. The roof of this structure is a sawtooth design, constructed from concrete, with the south-facing surfaces inclined approximately 45°. This may be an ideal place to mount collectors. The application must be further detailed to determine the quantity of hot water that is needed.

5.3 IMPLEMENTATION REQUIREMENTS

The project is very large compared to the other candidate solar industrial process heat applications. However, it is a good application from an economic standpoint (relatively low temperatures required) and the engineering resources at the site are exceptional. A solar system implemented at the Koldair plant could provide a great deal of exposure for SIPH applications from the engineering sector in Egypt, since the engineers at the site do a significant amount of outside consulting.

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5.4 FIELD TEST COST ESTIMATE

	Cost
Design and Engineering	$ 50,000
Equipment	1,245,000
Shipping	75,000
Manual Development	30,000
Construction and Installation	325,000
Check-out, Start-up, and Training	50,000
Operation and Maintenance Support (2 yrs)	260,000
Total	$2,035,000

6. PHOTOVOLTAIC-POWERED FISHERMEN SHELTER SYSTEMS

6.1 INTRODUCTION

Background

A joint effort by the Ministry of Development and New Communities, the High Dam Lake Development Authority and CARE work is aimed at assisting organized group efforts to settle the High Dam Region by providing means to ameliorate the difficult living conditions of the Region. The High Dam Lake Region of Southern Egypt offers both great promises and challenges. The lake is rich in fish and there is significant agricultural potential along its shoreline. The fish harvest has risen from 12,000 metric tons in 1974 to 30,500 metric tons in 1980 and is forecast at 85,000 metric tons in 1985.

Approximately 6000 fishermen now fishing the lake live under incredibly harsh conditions. Individual fishermen may spend 6-10 months at a stretch on the lake, with only short visits to their families, mainly in the Sohag and Qena Governorates. The fishermen normally fish at night and repair boats and knots, process their catch and rest during the day. Often, their only shelter is their boats. Primitive shacks of reeds or stones offered little protection from scorpions, vipers, jackals and hyenas. Their diets are deficient in vitamins and micro-nutrients due to the absence of fruits and vegetables. Health care is non-existent except for the incipient (once a month) delivery system established by CARE. The men suffer from gastroenteritis, respiratory problems, heat exhaustion, sun stroke and eye problems. Bilharzia infects 25-35% of the men.

In an effort to improve living conditions for the fishermen, 22 shelters/base camps will be constructed around the lake. These shelters will be built along traditional Nubian architectural lines and will provide sleeping quarters, kitchen, and sheltered work areas grouped around a courtyard for 10 to 40 fishermen. A separate building will be constructed for salting and drying fish. There will also be kitchen gardens (up to 2 feddans) and some sites will have wind-breaks and fruit trees.

The present program envisions an engine-driven water pump for potable and irrigation water as the only appliance for the shelters. Experience at a few of the sites already constructed has shown the engine-driven pump to be a major impediment to water delivery because of fuel delivery problems and the inability of the fishermen to cope with repairs and maintenance. Health delivery is severely impeded by the inability to preserve medications in the extreme heat of the region. There is, therefore, an urgent need at the shelters for safe drinking water, adequate water for kitchen gardens and fruit trees, a refrigerator for preserving medications and a modest amount of lighting. Most importantly, these services should be provided by very reliable appliances powered from a renewable energy source to obviate the need for maintenance and fuel delivery.

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The primary purpose in demonstrating PV systems here is to establish the technical and social feasibility of remote systems. The economics of such systems now are not good. However, there are other factors, difficult to quantify, which should be considered. In light of the reality that there are some locations, such as new settlements in the frontier governorates, where the Government of Egypt is pushing for development, where the grid might never be extended and diesel fuel is unavailable on a regular basis, there is no alternative. It may be in the not too distant future that PV-powered systems for small amounts of electricity will make sense and be an economic option.

6.2 APPLICATION DESCRIPTION

The field test of photovoltaic power systems and appliances for fishermen shelters will consist of three separate power/loads systems located at three different but representative shelter sites. These proposed renewable energy applications will use one or two flat-plate photovoltaic arrays at each site to power a range of different things, possibly a small (100 liter) refrigerator/freezer designed specifically for medication storage, up to three low-voltage fluorescent lights, a water purifier and/or a water pump. The water pump would be integrated into an automatic pumping/storage/delivery system that would not require batteries for the pump motor and which would use subsurface irrigation for the kitchen garden and trees.

Objective

The objective of the proposed application is to demonstrate the feasibility of using stand-alone PV power systems and energy efficient loads to supply the minimal basic services of small settlements in remote or frontier regions in Egypt where alternative conventional power sources are not appropriate.

Concept Description

The proposed Fisherman Shelter PV/Load System could consist of all or some of the following or other applications pending detailed review of individual site needs:

(1) A complete PV power system including the PV array,controls, instrumentation, and energy storage.

(2) Water pump for potable (5 litres/person/day), domestic uses (20 liters/day/person), and irrigation (10 m^3/feddan/day) water (i.e., kitchen gardens up to one feddan in area).

(3) Three each, 20-watt fluorescent light for common areas in the shelter.

(4) One each, refrigerator/freezer designed specifically for the storage of medications and vaccines in high ambient temperature (43°C) environment.

(5) One each, water purifier to provide 5 litres/person/day of purified potable water.

The specific loads may vary depending on the location and the requirements for each shelter, e.g., only one refrigerator may be needed for a group of shelters or two-way radio communication for emergency purposes may be established.

The PV power system will be low-voltage to enhance personnel safety and will be designed for unattended operation. The PV array and battery size will vary to meet the needs of each site. All loads will be DC-powered to reduce system cost and increase system reliability through the use of fewer components. The power/load system will also contain automatic instrumentation to allow U.S. and Egyptian technical personnel to monitor and evaluate system technical performance. Data will be recorded automatically on a magnetic tape cassette which could be changed and forwarded to monitoring personnel by the CARE medical team during their regular visits.

The pump would be designed to operate automatically whenever the PV array is generating sufficient power and may be located near the shelter or at the intake in the lake. The intake line will be designed to float on the surface of the lake or lay on the ground as the level of the lake varies with the time of year. The pump intake will be designed to take in water below the surface and above the bottom to avoid surface and bottom debris and contamination.

The pump will deliver all of its output to a water storage tank located above the level of the kitchen garden and the shelter. The tank will be designed such that a one to two day domestic water supply would constitute the lower volume of the tank and irrigation water would flow through the upper volume of the tank. Such an arrangement removes the need for practically all pump controls. Additionally, it provides an opportunity for the design and installation of a subsurface irrigation system that could operate unattended. Figure 1 presents a schematic of the proposed PV system and associated loads.

The refrigerator/freezer (R/F) for medical supplies will be a chest-type unit and will have a usable interior volume of approximately 100 litres which will provide adequate space for medication storage. Such an R/F has been developed for the U.S. Center for Disease Control and the Department of Energy as a high performance unit.

Siting Information

Constructed and to-be-constructed shelter locations are shown in Figure 2. Three sites will be identified by the High Dam Lake Development Authority, Qattara, CARE, USAID. Sites will be selected on the basis of demonstrating PV/load system use over the range of geographic conditions and shelter sizes (i.e., small, medium, large).

In general, the shelters will be located 2-4 meters above the maximum pool elevations of 182 m. Those sites on steep gradient shorelines will remain close to the water's edge as the lake elevation varies between low pool elevation and the 182 m maximum elevation, while others located on low gradient shorelines may be several kilometers from the water's edge at low pool elevation. There is ample room at the shelter sites for PV array siting, and consideration may be given to locating the solar array over the shelter courtyard to provide additional shade. The kitchen gardens will be located close to the shelter areas, providing suitable soil is available. It is anticipated that the gardens will not be more than 12 m above low pool elevation.

System Technical Data and Design Specifications

The following data are developed for a shelter for 25 men and 1-feddan garden:

FIGURE 1.
FISHERMAN SHELTER
PV/LOAD SYSTEM
DIAGRAM

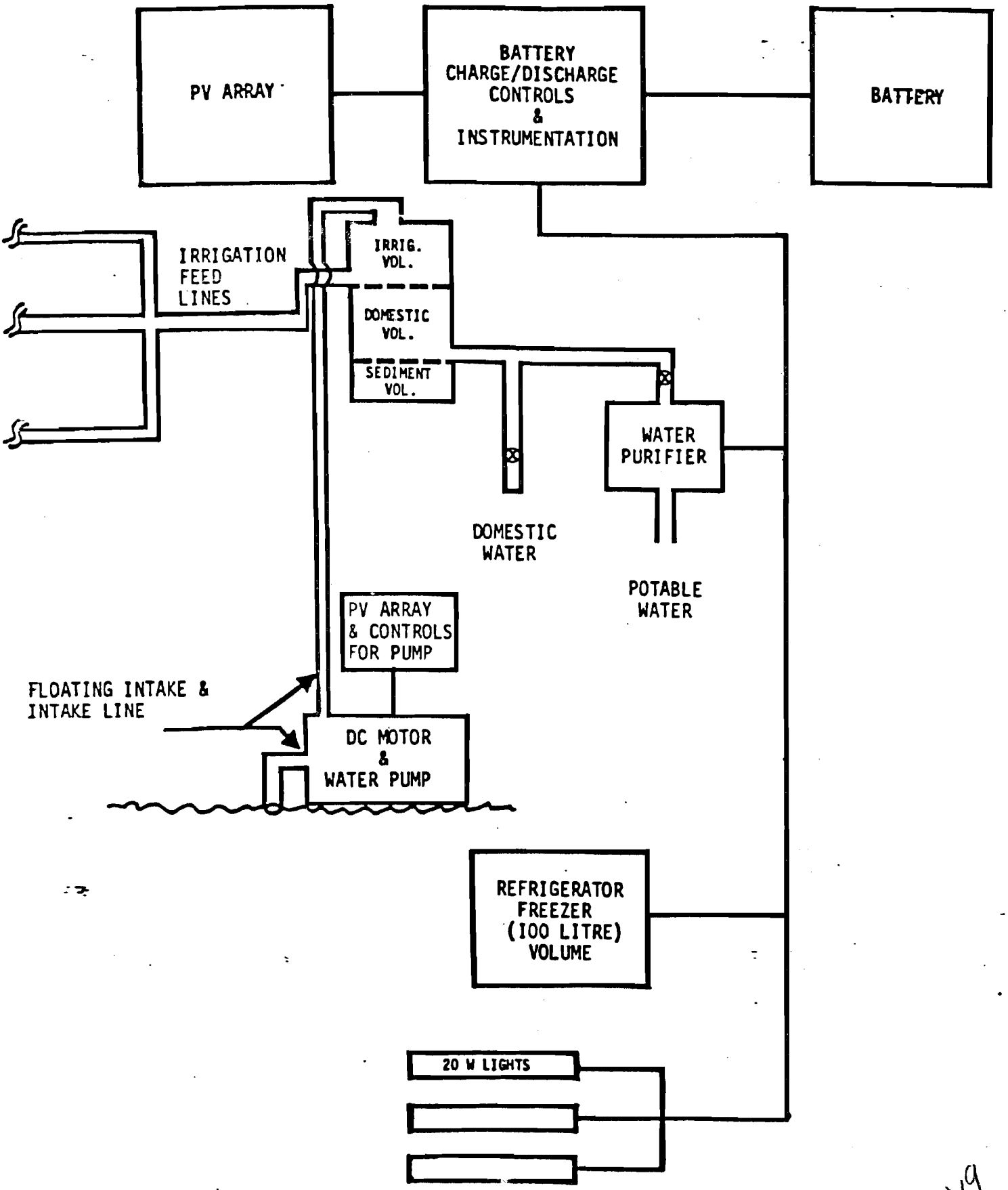
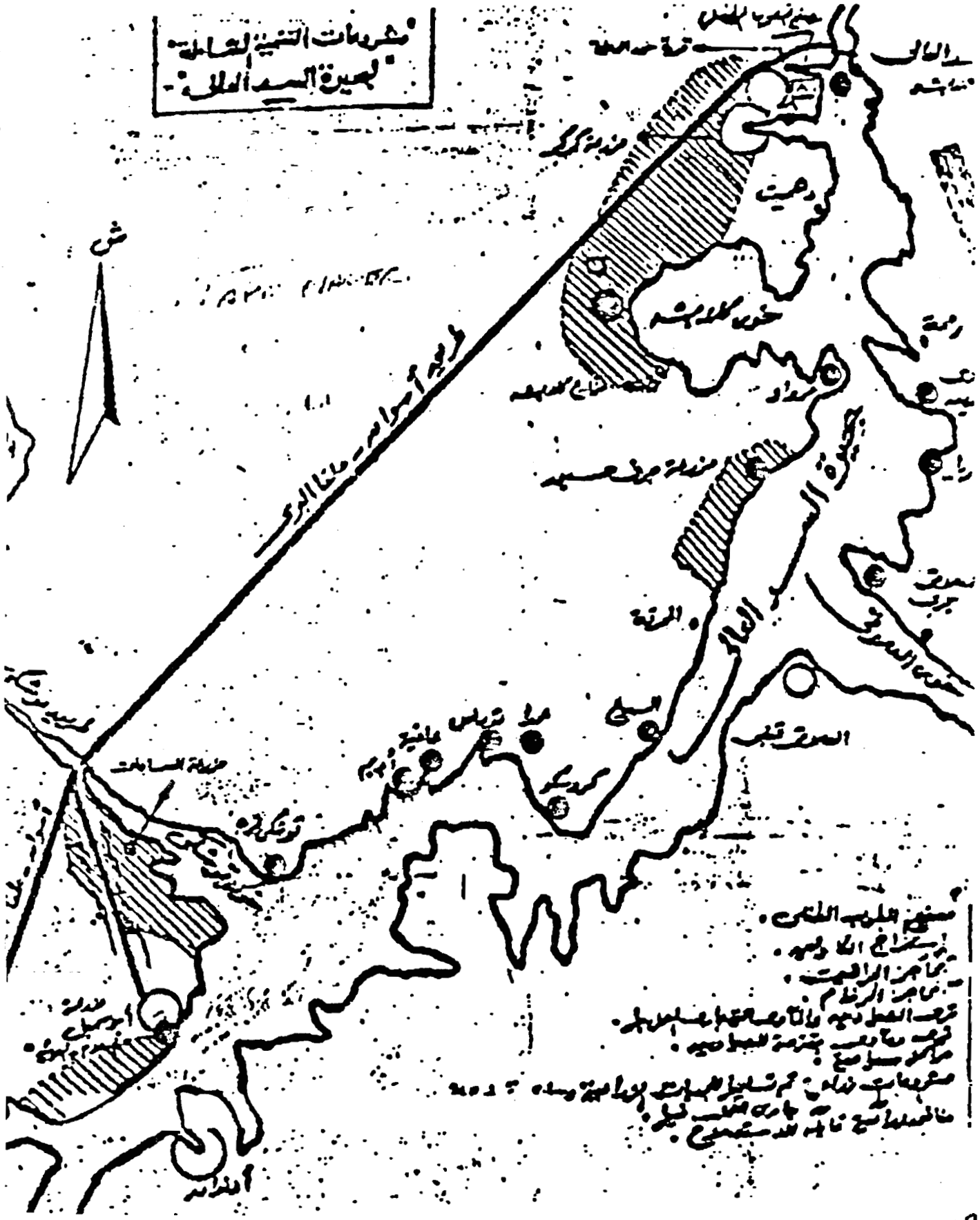


Figure 2

Shelter Locations



(1) Water Requirements

Irrigation, @ $10m^3$/feddan/day/x 1 feddan	10.000 m^3/d
Potable, @ 5 litres/person/day x 25 people	.125 m^3/d
Domestic, @ 20 litres/person/day x 25 people (bathing, kitchen, fishing gear clean-up)	.500 m^3/d
Total	10.625 m^3/d

(2) Pump Energy, @ 80 Whr/m^3 — 850 Whr/d

(3) Lighting Requirements, 3 fixtures
4 hr/day x 2 lamp/fixture x 21 w/lamp — 520 Whr/d

(4) Refrigerator/freezer, @ 43°C ambient — 735 Whr/d

(5) Water Purifier, for 125 l/day — 190 Whr/d

Total daily energy requirements — 2295 Whr/d

(6) PV Array Size and Battery Capacity
PV array: 815 watts @ 28°C, fixed tilt 20°
Battery: 660 amp-hrs based on:
- 40 percent night R/F operation
- all lights at night
- 10 percent purifier at night
- 10 percent maximum daily depth-of-discharge (DOD) (June-August) (This DOD yields a cycle life of 1400 cycles. Actual cycle life would be longer due to shallower winter cycles)

(7) Controls
Maximum voltage regulator (shunt or switching type)
Low voltage cutout
Pump controls for daytime only pumping

The shelter PV/loads systems will be composed of proven off-the-shelf hardware. Specific components of known design which have passed established qualification tests will be specified. The first shelter system (separate systems for water pumping and the other appliances as appropriate) shall undergo a factory test of the complete system(s). Subsequent systems components and subsystems will undergo individual factory test to assure proper operation before shipment. Following installation and check-out, each system at each site will be subjected to an acceptance test which will be designed to demonstrate operational status of the system.

Training

- o Train fishermen in system use and minor maintenance
- o Train personnel in data tape acquisition and maintenance and minor trouble-shooting and repair
- o Major trouble-shooting and repair

Monitoring and Evaluation Data Requirements

- o PV system performance: generated energy
- o Load system performance:
  - m^3/d water pumped
  - hr/d refrigerator operation
  - R/F temperature record
  - total load energy used
- o Social and health benefits
- o Maintenance, problem, failure records

6.3 IMPLEMENTATION REQUIREMENTS

Schedule

SOW Prep.	0 to 2 months	
Procurement Cycle	2 to 9	
Preliminary Design	9 to 11	
CDR & Final Design	11 to 12	
Procurement/Fabrication/Test	12 to 18	
Ship (FOB-to-Site)	18 to 21	
Install/Check-out/Accept. Test/Train	21 to 22	#1 System
	21.5 to 22.5	#2 System
	22 to 23	#3 System

6.4 FIELD TEST COST ESTIMATES

(For 3 Sites)

Design & Engineering	50,000
Equipment	100,000
Shipping	9,000
Manuals	15,000
Construction & Installation	35,000
Check-out/Start-up	8,000
Operation Support (2 yrs)	55,000
TOTAL	275,000

7. PHOTOVOLTAIC-POWERED IRRIGATION SYSTEMS

7.1 INTRODUCTION

Background

The advent of highly efficient battery-less photovoltaic-powered pump systems specifically designed for low-lift applications complement Egypt's ideal insolation profile and almost mandatory need for more efficient use of irrigation water. Photovoltaic-powered pumps free additional land for productive agriculture and, since they are portable, they can be utilized more intensively.

7.2 APPLICATION DESCRIPTION

The need for irrigation and water pumping exists in many areas in Egypt. All of the sites have not yet been identified. Since the low-head pumping sites in Egypt are similar, however, a system will be designed for a standard configuration with a range of water lift from 1.5 to 3.0 meter.

The irrigation system will consist of:

(1) A PV array

(2) Controls to provide daytime-only pumping (no electrical storage)

(3) A water pump optimized for low-head

(4) An appropriate water distribution system

(5) Instrumentation to measure PV system and pump performance

Objective

The objective is to evaluate the concept of small PV-powered low head water pumping/irrigation systems for Egypt.

Concept Description

It is proposed to evaluate three systems for subsurface irrigation. The pump set will be selected from commercially-available units for maximum efficiency at 1.5 to 3 meter head for operation from canals, dug wells, shallow tube wells, etc. The self-priming pump would be coupled to either a permanent magnet or brushless DC motor to obtain high efficiency. The designed pumping rate would be approximately 150 m^3/day at 1.5 meter head or 75 m^3/day at 3.0 meter head.

The water would be discharged into a holding tank. A subsurface irrigation system consists of main distribution tubing from the holding tank

and double wall tubing under the plant bed. The water is placed directly in the root zone for the plant's use. Since subsurface irrigation requires about one-third the water per crop as does flood type, three times as much land will be irrigated by subsurface as by flood methods. Thus the pumping systems will be capable of irrigating up to 15 feddans by subsurface. Since the pumping system is portable, these land areas would not need to be contiguous, but could represent various fields within a reasonable distance of each other. The subsurface systems (hold tank, laterals, sublaterals, etc.) would be designed for the specific field by the contractor in cooperation with the Egyptian authorities. The hardware would be provided and installed by the project contractor.

The PV array, pump and pump controls would be designed for unattended operation with maximum array power utilization and minimum maintenance. To reduce maintenance and system cost, the system would be designed for battery-less operation. Since the need for irrigation is concurrent with good insolation, the elimination of the battery causes only a minor loss of available energy. To accomplish battery-less pump operation, the PV array/pump controls would be designed to extract maximum power from the PV array and deliver it to the pump motor at an operating voltage which will obtain maximum output from the pump.

The PV pump system will also contain a minimum amount of automatic instrumentation to allow U.S. and Egyptian technical personnel to monitor and evaluate system technical performance. Data would be read daily by operating personnel and recorded on appropriate data logs. These logs would be forwarded to monitoring personnel for evaluation.

Schematics

A block diagram showing the main components and operation is shown schematically in Figure 1.

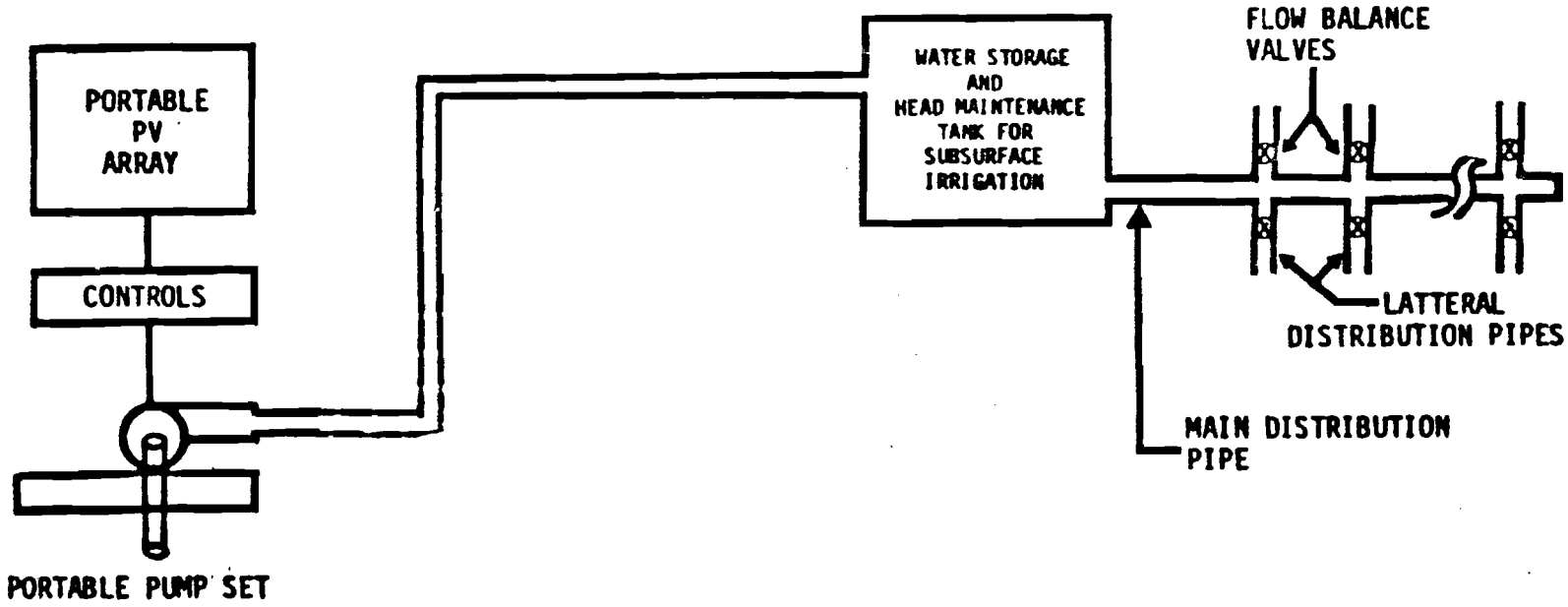


FIGURE 1. PHOTOVOLTAIC-POWERED IRRIGATION SYSTEM

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Siting Information

Specific sites for these systems have not been identified; however, many candidate sites exist in the Governorates of Assiut and Qena. Since the low-head pumping situations in Egypt are relatively similar, the system design will be for a standard system for a specific range of lift (1.5 - 3.0 m). The water output will be a function of the lift and the insolation at each site, thus the land area serviced will need to be sized appropriately. The array will require a reasonably flat area (approximately 5 m^2) with full sun access. Thus, no major site preparation should be required for the PV array. The pumps will be designed to float on the surface of the water, requiring very little, if any, site preparation.

System Technical Data and Design Specifications

The following data are developed for irrigating (5-15 feddans) by the subsurface method:

(1) Array size: 250 Wp
(2) Water pumped: 150 m^3/day @ 1.5m head
75 m^3/day @ 3.0m head
(3) Controls: Maximum Power Controller
(4) Battery: None
(5) Irrigated Area:
15 feddans @ 1.5m head
7.5 feddans @ 3m head

Design, Installation and Testing Requirements

- Low-head PV-powered pump systems are commercially available, therefore no design effort is required
- Minimal installation is required
- Testing:
  Factory test of full system
  Final acceptance test following installation and check-out

Monitoring and Evaluation Data Requirements

In order to evaluate the performance of these systems, the following data should be collected:

(1) Insolation (langley/day)
(2) System output: water pumped (m^3/d)
(3) Head (m)
(4) Maintenance, problem, failure records

The basic system evaluation will be the value of the increased crop yields versus the prorated cost of the system. Intermediate evaluation criteria will include the amount of water pumped for the quantity of insolation available (Langley/day versus m^3/day of pumped water).

7. IMPLEMENTATION PLAN

Organization

The detailed definition of roles and responsibilities and the identification of QHREA and responsible Egyptian organizations (Ministries of Agriculture and Irrigation) will be delineated upon project approval. The University of Assiut will also be participating in all phases of this field test. This project would tie in with the Mission's Water Use and Management Project, providing useful information on solar-powered pumping.

Schedule

	Months after go-ahead
Purchase Req.	0 to 0.5
Proc. Cycle	0.5 to 2
Fab/Test	2 to 5
Ship.	5 to 6
Install/Check-out/Accept Test/Train	6 to 7

7.4 FIELD TEST COST ESTIMATE

	Cost
Subsurface Irrigation (3 sites)	
Design and Engineering	10,000
Equipment	52,000
Shipping	4,000
Manuals	1,000
Construction/Installation/Check-out/Training	30,000
Operations and Maintenance (2 yrs)	25,000
TOTAL	$132,000

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8. PHOTOVOLTAIC-POWERED REVERSE OSMOSIS DESALINATION SYSTEM

8.1 INTRODUCTION

Background

The Governorate of Mersa Matruh, consisting of the entire north coast of Egypt west of Alexandria, needs fresh water for development. The largest city in this region is Matruh. No fresh water supply exists in this region. Mersa Matruh's fresh water requirement for the existing population is now in excess of 2000 m^3 per day. These needs are now partially met by two water trains per week from Alexandria, a small diameter water main from Alexandria from which the flow is very intermittent, a 3-inch brackish water main from the village of El Kasr located 15 km west of Matruh, and some fresh water from a seawater multistage flash 2000 ton/day desalination plant. The desalination plant has been intermittently inoperative since its construction and is now producing only 21 m^3 per hour on about a half-time basis. A visit was made to the desalination plant (see Figure 1) and the plant's problems were discussed with the Plant Manager. The plant operated from 1973 through 1978 and was then shut down due to excessive corrosion and scaling. A firm was hired in 1980 to assist in making the plant operational again. The first of the four 12-stage flash units has been rebuilt and has been in operation since April. Every week the unit must be shut down for two days to mechanically remove about 1/8" salt scale. This operation was in progress during our visit. The second and third units are expected to be on-line in August and the fourth unit near the end of 1981.

A visit was made to El Kasr, the brackish water pumping and holding station (see Figure 2) located on the coast 15-20 km west of Matruh. The water wells are 4-6 meters in depth and located 1-1.5 km west and northwest of El Kasr on the inland side of the sand dunes along the Mediterranean Sea. It was stated that this brackish water contains about 12,000 PPM dissolved solids. The electrical utility from Matruh (gas turbines and diesel-generated, independent of the national grid) electrical power is connected to a transformer station located at the pumping and holding station in El Kasr supplying the energy for the brackish well and water line pumps to Matruh. The transformer station steps down the 11 kV line voltage to three phase, 380V power for El Kasr village and pump use. The brackish water pumped to Matruh is used for washing and toilets and fresh water is trucked to El Kasr to supply the needs of about 4000 people of the village.

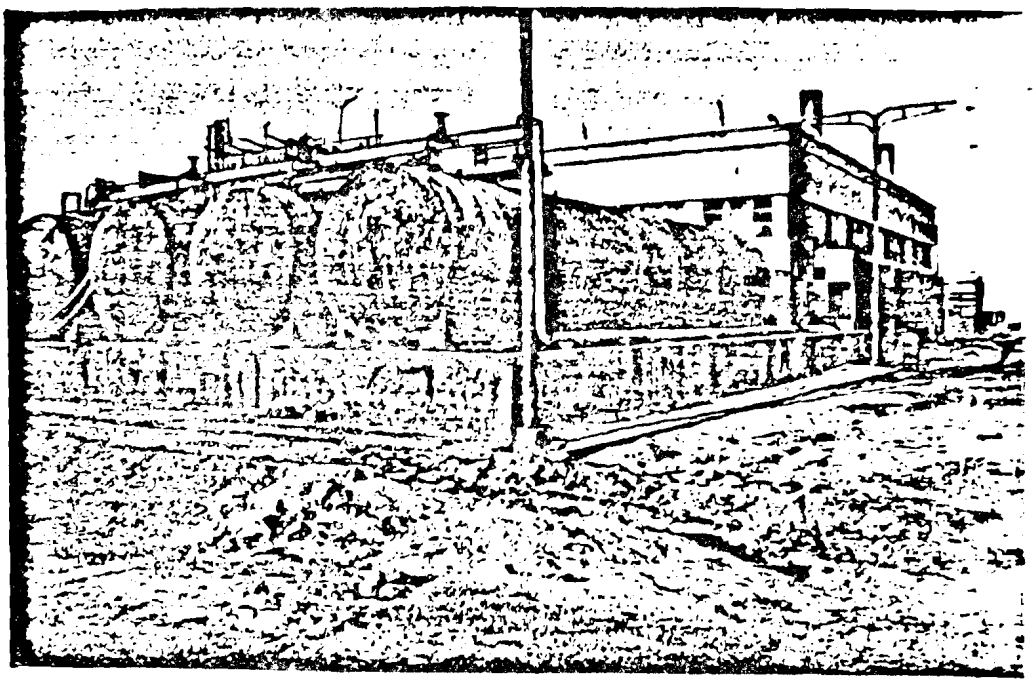

Figure 1. Desalination Plant at Marsa Matruh

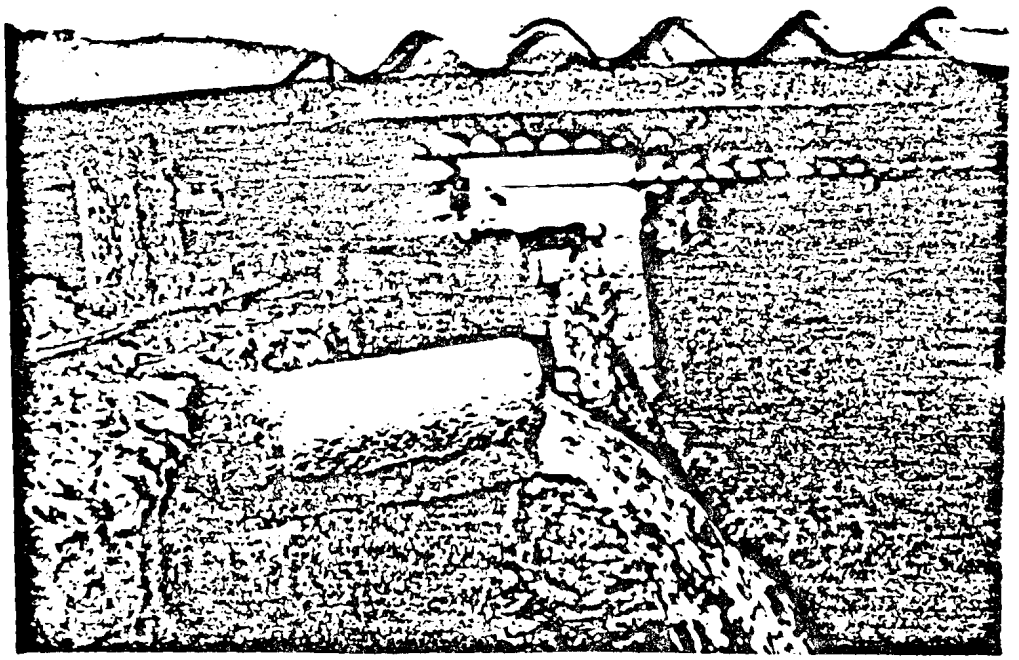

Figure 2. 12,000 PPM Brackish Water Pumped Into Holding Tanks at El Kasr

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Summary Description

The field test is a reverse osmosis desalination pilot plant powered by a photovoltaic system. Water desalination by reverse osmosis is the most energy-efficient technique commercially available. Recent advances in membrane technology have been significant and very large (10,000 m^3/day) plants powered by conventional sources are in operation or are being designed. In Egypt solar-powered reverse osmosis systems appear to be attractive options for applications in the frontier governorates. The field test will be of sufficient size to demonstrate the technical and economic feasibility of the concept and to acquire operational and maintenance data applicable to larger-sized systems. The modularity of reverse osmosis and solar systems is an especially attractive characteristic and lends itself to the proposed field test approach.

It is proposed that the field test be conducted near the center of the village of El Kasr at an existing brackish water site. The system will produce 10-20m^3/day of fresh water for the village. A 26 kwp PV system will supply sufficient electrical energy on an annual basis to power the reverse osmosis unit. During those daylight hours when the PV system output exceeds the requirements of the reverse osmosis unit, the excess power will be fed into the local grid. When the output of the PV system is insufficient to supply the reverse osmosis unit, and when the fresh water storage tank is sufficiently low, the grid will supply power to the reverse osmosis unit (see Figure 3). A buffer storage system to provide autonomous operation will be considered in the detailed design of the system. Meters will be installed to measure the power taken from the grid and supplied to the grid.

Alternative concepts employing other solar power systems will also be investigated and compared with the PV system concept during the engineering design phase of this field test. (See also Field Test Description 10. - Wind-Powered Reverse Osmosis Desalination System).

8.2 APPLICATION DESCRIPTION

Objective

The primary objectives of this field test are to:

(1) Determine the technical feasibility of a stand alone PV power system to desalinate brackish water in Egypt;

(2) Monitor the overall system efficiency;

(3) Provide hands-on operational and maintenance experience for Egyptian personnel; and

(4) Evaluate the economics in an Egyptian context.

A secondary objective is to identify potential modifications to the system which will optimize the system for replication in the Egyptian environment.

Concept Description

A description and flow diagram of a reverse osmosis plant can be found in 10.2. The final specifications for this field test will be defined after completion of detailed siting and engineering design studies. The major components of this field test include:

(1) a 26kWp PV system.

(2) A 10 to 20 M^3/day fresh water capacity reverse osmosis unit capable of desalination of the approximately 12,000 PPM brackish water from the holding tanks at El Kasr. The units will be shop-assembled at the factory with both the pre-treatment and reverse osmosis systems skid-mounted for transportation on a standard truck and for installation on a level concrete slab such that piping connections can be made in less than a week.

(3) A fresh water storage tank.

(4) Piping from the brackish water holding tank to the pump located on a part of the reverse osmosis unit.

(5) Brine discharge pipe to the Mediterranean or to an evaporation pond (if that option is selected).

(6) Transformers, switches, meters and wiring connecting the desalination electrical units from the 11 kV grid.

(7) A buffer storage system as required for operations and a degree of autonomy.

A detailed engineering design study will be conducted during the first phase of the field test to configure an optimum solar-powered desalination system. Other solar and desalination technologies, e.g., wind, solar thermal, electrodialysis and solar-diesel hybrids, will be investigated to determine the best technical system concepts, given actual solar energy resources and input water quality data for specific site locations. Levelized costs per cubic meter of potable water produced will be calculated as a criterion for economic feasibility. Following a critical design review of candidate concepts, an engineering design will be prepared for the field test.

It is anticipated that the activities and tasks associated with this field test will be combined with those in the wind-powered desalination field test (section 10) under one contract, competitively awarded to a U.S. engineering corporation.

System Schematic

A typical schematic for the PV-powered reverse osmosis desalination system is shown in Figure 3.

Siting Information

The reverse osmosis unit will be located next to the existing transformer station which is adjacent to the brackish water holding tanks (Figure 4) in the center of the village of El Kasr. El Kasr is located on the inland side of the sand dunes along the Mediterranean Sea about 25 kms west of Matruh. The PV system will be located inland of the sand dunes, directly west of the existing brackish water pumping station at El Kasr (see foreground in Figure 5). The brine from the reverse osmosis unit will be pumped the 0.5 km north to the sea for discharge or to a plastic-lined pond for evaporation.

System Technical Data and Design Specification

Figure 6 presents a typical plot layout and Figure 7 presents technical specifications for reverse osmosis system designed for seawater having 35,000 PPM total dissolved solids. The pressure will be reduced to accommodate the 12,000 PPM brackish water. Calculations to obtain data similar to those presented will be made after a brackish water sample is obtained and analyzed.

A 10-20 m^3/day unit will weigh about 7 tons, is about 3.0 meters long, 2.0 meters wide, and 3.5 meters high. A reverse osmosis system flow diagram is shown in Figure 8.

Design, Development, Installation, and Testing Requirements

This PV-powered reverse osmosis system to produce fresh water from brackish water uses low-risk, proven technology. The system would make full use of the experience acquired in the U.S. from designing, maintaining, and evaluating the system performance of PV units and production reverse osmosis systems over the last four years. To maximize the reliability and reduce the maintenance, the system will use proven hardware concepts. This will be one of the first PV-powered reverse osmosis systems and, because operation will ultimately be required with a minimum of detailed technical attention, the implementation plan shown for the field test incorporates U.S. assembly, check-out and testing of critical system elements. This will allow evaluation and modification, if required, prior to shipment to Egypt.

Monitoring and Evaluation Data Requirements

The field test will incorporate instrumentation which will allow the system efficiency (i.e., insolation energy available versus fresh water output) to be determined. The instrumentation is expected to include sensors to measure insolation, and temperature as well as a water meter and a recorder. In addition, statements of equipment failures, if any, and/or malfunctions will be logged.

8.3 IMPLEMENTATION REQUIREMENTS

The required activities to implement the project are listed below and on the schedule in Figure 9.

(1) Site selection, conceptual design, and specifications

(2) System design and engineering

(3) Hardware procurement and manufacture

(4) U.S. system critical element, installation, check-out and test

(5) Disassembly, packing and shipment

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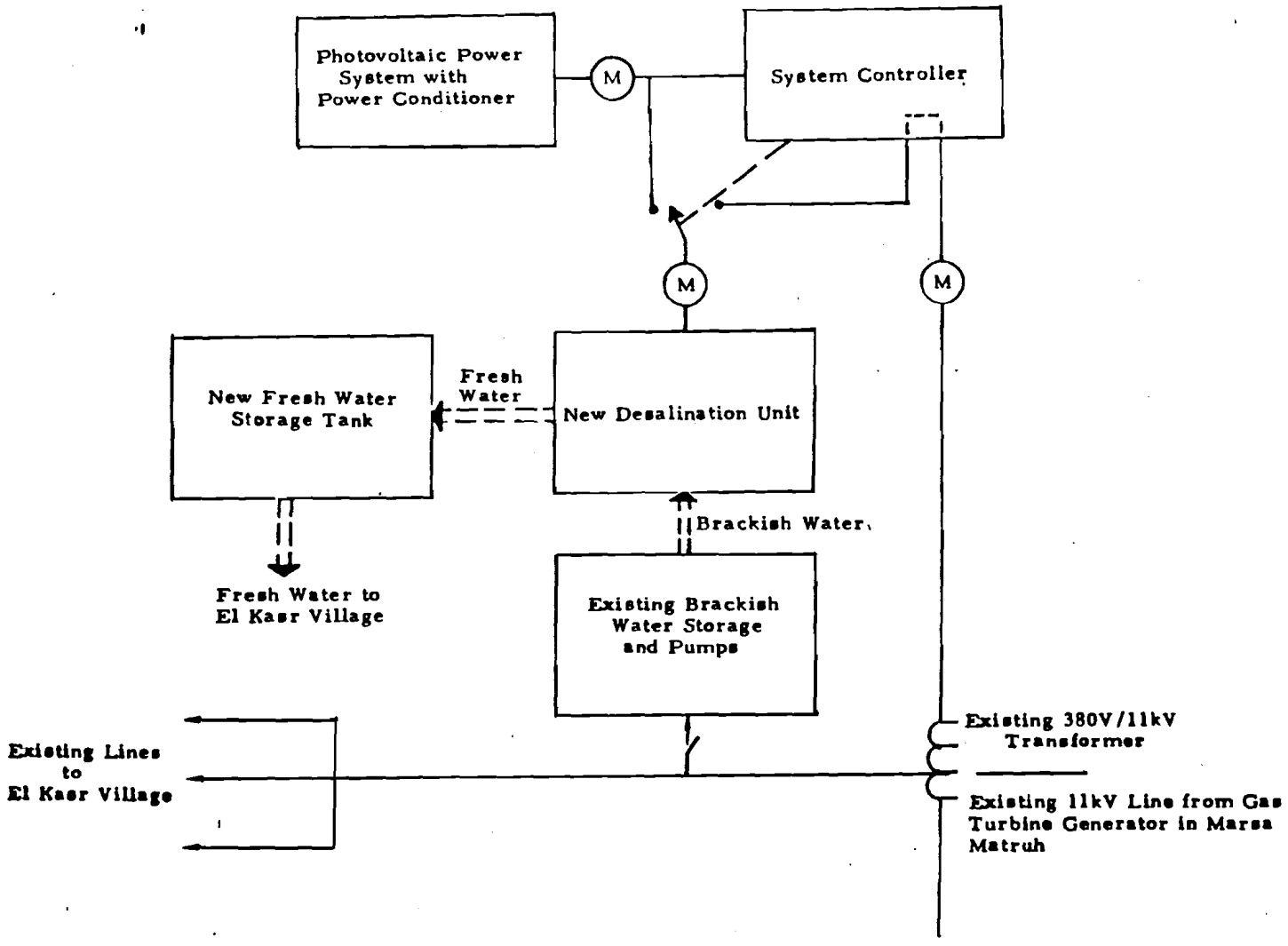

Figure 3. Baseline Photovoltaic Powered Reverse Osmosis Desalination System Schematic

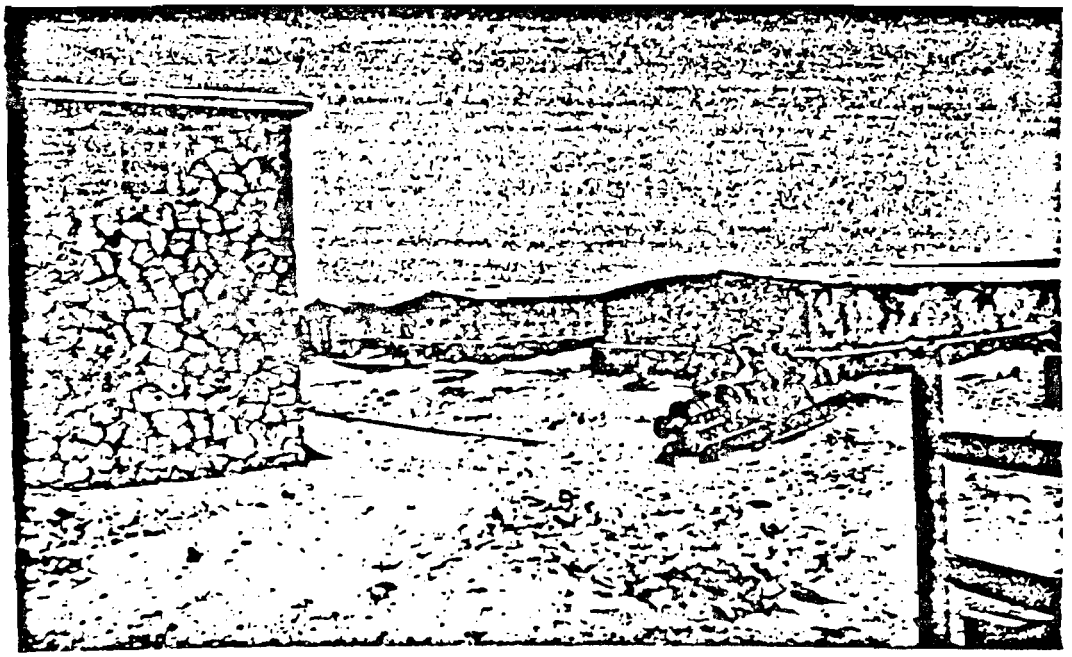

Figure 4. Brackish Water Holding Tanks at El Kasr

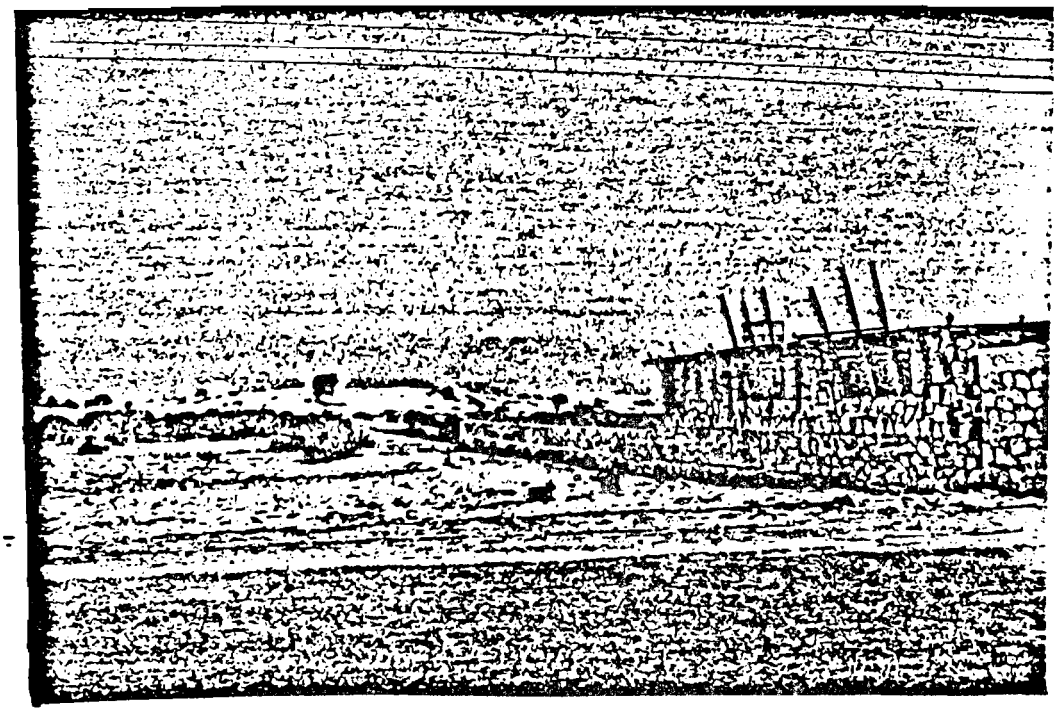

Figure 5. View Looking North of Potential Photovoltaic System Sites at El Kasr

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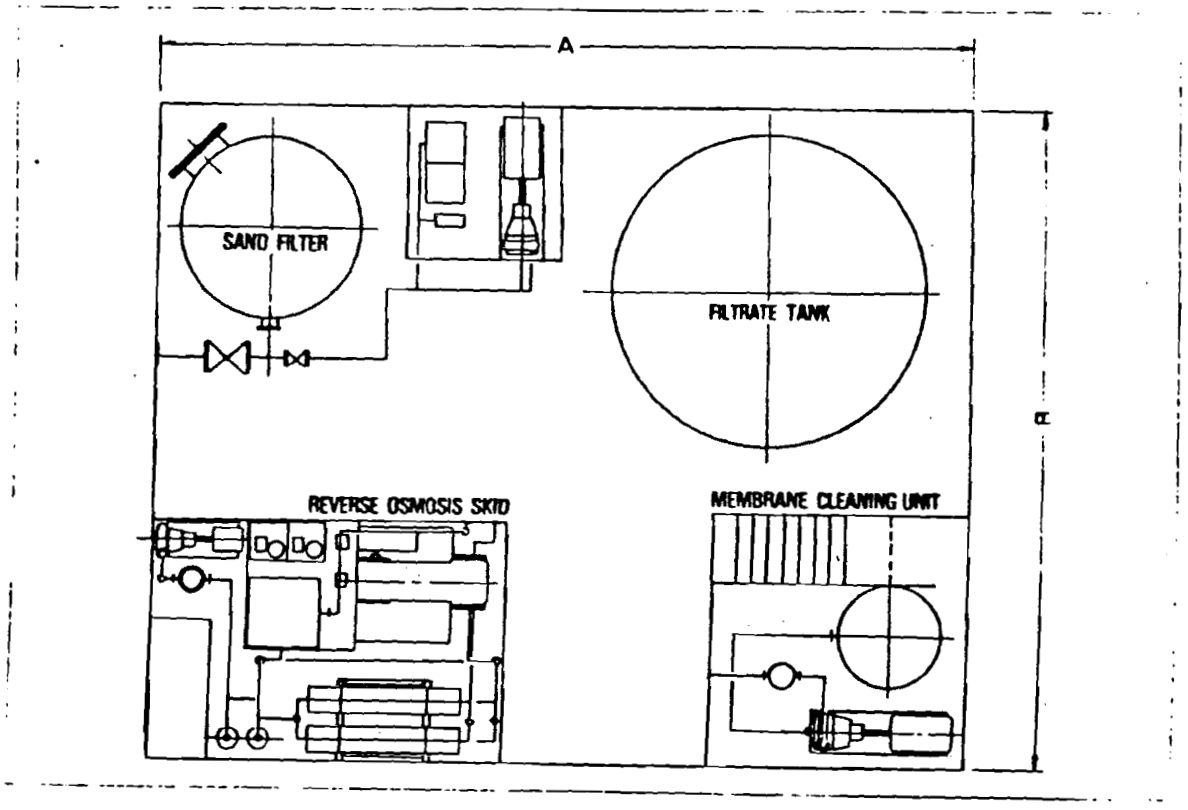

Figure 6. Typical Reverse Osmosis Layout

	Capacity	m^3/day	15	30	45	120	240
Concentration	Seawater	PPM TDS			35,000		
	Product Water	PPM TDS			500		
Seawater Temperature		°C			25		
Flow Rate	Supplied Seawater	m^3/day	54.5	109	165	437.7	874.8
	Backwash Drain	m^3/day	4.5	9	15	37.7	74.8
	Concentrated Brine	m^3/day	35	70	105	280	560
Pressure	R.O. Module Inlet	Kg/cm^2	56	56	56	56	56
	Supplied Seawater	Kg/cm^2	−0.2	−0.2	−0.2	−0.2	−0.2
	Product Water Discharge	Kg/cm^2	3.5	3.5	3.5	3.5	3.5
Chemical Consumption	$FeCl_3$ (37%)	Kg/day	2.8	5.5	9.1	24.1	48.1
	NaOCl (10%)	Kg/day	2.8	5.6	8.3	21.9	43.7
	H_2SO_4 (98%)	Kg/day	–	–	4.1	10.8	21.6
	HCl (35%)	Kg/day	2.8	5.6	–	–	–
	$NaHSO_3$	Kg/day	1.4	2.8	4.1	11.0	22.0
Power Consumption		kWH/day	172.8	304.6	440	985	1,960
Electric Power	Seawater Pump	kW	1.5	1.5	1.5	2.2	3.7
	Back Wash Pump	kW	3.7	5.5	11	22	30
	Booster Pump	kW	–	–	1.5	1.5	3.7
	High Pressure Pump	kW	5.5	11	15	37	37 × 2
	Chemical Dosing Pumps	W	0.235	0.235	0.210	0.210	0.235
	Cleaning Pump	kW	–	–	7.5	11	11
	Mixer	kW	–	–	0.2	0.4	0.4
Weight	R.O. Unit	Ton	6.1	7.9	1.5	3.3	3.4
	Sand Filter	Ton			8.3	19	39
	Rack Unit	Ton				0.4	0.6
	Cleaning Unit	Ton			0.5	0.8	1
	Filtrate Tank	Ton	0.2	0.4	1.8	4.5	9
Plot Size	Width	mm	3,000	3,200	6,000	8,000	10,000
	Depth	mm	1,700	2,000	6,600	6,500	7,500
	Plant Height	mm	2,400	2,600	3,500	5,500	7,500

Figure 7. Typical Reverse Osmosis Technical Specifications

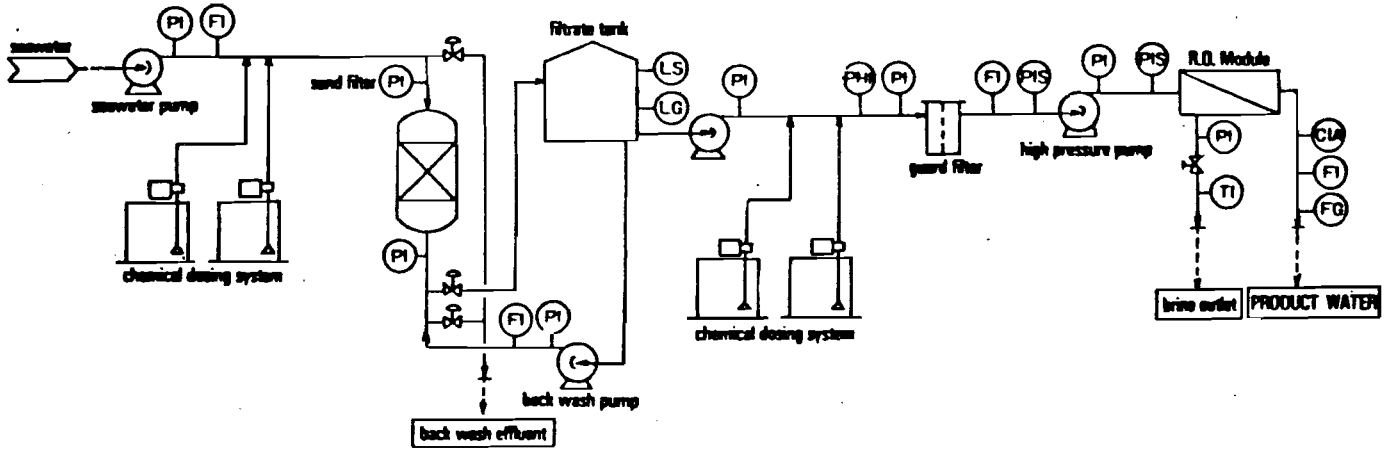

Figure 8. Reverse Osmosis Flow Diagram

(6) Preparation of operational and training manuals

(7) Egyptian site work, construction and installation

(8) Check-out, start-up and training

(9) System operation, monitoring and evaluation

Qattara and the Governorate Ministries of Supply and Electricity for Mersa Matruh will be responsible for the site selection and preparation, system operation, monitoring and evaluation activities of the project, with technical assistance from the U.S. contractor. A U.S. contractor, under the direction of the U. S. Field Test Project Manager and working in cooperation with Egyptian counterparts, shall be responsible for the the development of system specifications suitable for the solicitation of bids for the procurement, engineering design and installation of all Project equipment. The U. S. Project Manager, working in cooperation with the Ministries and using outputs of the design activity, shall procure under AID regulations the services of a U.S. contractor for the supply of the project hardware, U.S. installation and test, packing, shipping, Egyptian installation and training.

The U.S. contractor shall also furnish and install the reverse osmosis unit and instrumentation package. As part of the U.S. critical system element test, the U.S. contractor shall, if the system does not meet specification, modify and retest the hardware to specification before shipment. In addition, the U.S. contractor shall prepare and furnish operational, maintenance, and training manuals of sufficient detail that the operation and service of the system can be accomplished by Egyptians.

The U. S. Project Manager, working in cooperation with the ministries, shall direct the U.S. contractor in the installation of the field test. It is expected that the U.S. contractor will select and subcontract to an Egyptian contractor the site preparation, construction and foundation work. The U.S. contractor shall be responsible for the successful check-out and start-up of the system. He shall also train site personnel and staff members of the ministries and an assigned site manager in the operation and maintenance of the system.

The U.S. contractor shall visit the installation periodically during a two-year operations period for the purpose of ensuring that the system is in good operating condition. The contractor and site manager shall perform scheduled maintenance activities and effect system repairs, as required. The site manager shall be responsible for the collection and evaluation of all

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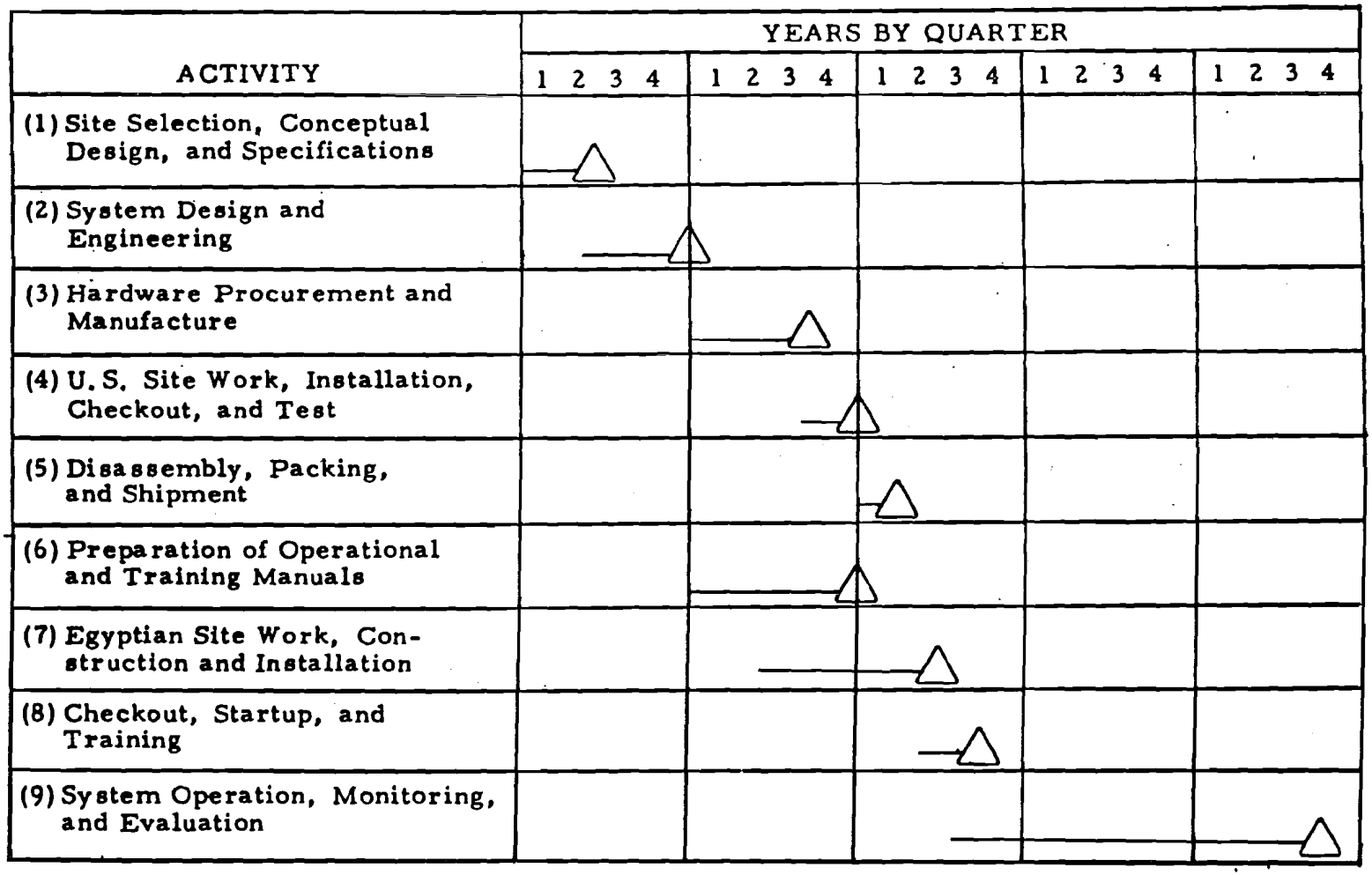

Figure 9. Schedule

project data. The U. S. Project Manager, the ministries, and the site manager shall prepare progress reports and a final report. This final report shall present, as a minimum:

(1) An itemized account of all project expenses;

(2) The collected monitoring data;

(3) Statements of equipment failures and malfunctions;

(4) A characterization of the site insolation, temperature, and wind regime;

(5) Recommendations as to the suitability of such systems for use in the Egyptian context and,

(6) Recommendations for modifications to the system which might improve the system operation in the Egyptian environment.

8.4 FIELD TEST COST ESTIMATE

The field test cost is estimated to be $1,970,000. The major elements are itemized below.

	COST
System Design and Engineering	$ 300,000
Equipment FOB Manufacturer	675,000
U.S. Site Work, Assembly, Installation, and Test	50,000
Operation and Maintenance Manuals	50,000
Packing and Shipping	85,000
Egyptian Site Work and Installation	410,000
Check-out and Start-up (3 months)	100,000
System Operation, Monitoring and Evaluation (2 yrs)	300,000
TOTAL	$1,970,000

WIND POWER APPLICATIONS

9. VILLAGE WIND POWER SYSTEM

9.1 INTRODUCTION

Background

There are many outreach villages in Egypt which the Government of Egypt (GOE) wishes to electrify. Unfortunately, the existing grid will not be extended to many of these villages because of the distance involved and the relatively small size of these villages. Renewable solar energy offers an alternative to grid interconnects. Wind energy is judged to be a viable source of electrical energy. A significant amount of wind data was made available during the in-country visit. As a result, small wind energy conversion systems (WECS) may supply a sufficient amount of electricity, satisfying village needs.

An outreach village energy requirement was chosen to be about 50 kw hr/day though a somewhat smaller energy requirement of 10 kw hr/day was also examined.

The field test of wind energy conversion systems would be limited to wind turbines of about 20 kw rated output (about 10 meter diameter blades). Evaluation of these small systems, in the Egyptian environment, will hopefully lead to replications and upgrading to meet the needs of many more Egyptian outreach villages, both small and large.

Summary Description

The proposed field test is for a wind energy conversion system (WECS) which would supply electrical energy to an outlying Egyptian village. The Egyptian village chosen for the field test of the WECS would have the required environmental and technical conditions judged beneficial to the field testing and evaluation of Egyptian village power wind energy conversion systems. As envisaged, the WECS will supply the total or a portion of the basic village energy needs. A small diesel generator would be used as a back-up energy source for the field test. The WECS application will be implemented through a turnkey system from U.S. contractors. The GOE will furnish an electrical distribution network in the village, prepare the site and participate in the operation of the installed system. This direction is reflected in the project methodology.

9.2 APPLICATION DESCRIPTION

Objectives

The objectives of the proposed WECS installation are to:

(1) Test and demonstrate the technical feasibility of stand alone, wind-powered systems in Egypt;

(2) Monitor the overall system efficiencies;

(3) Provide actual operation and maintenance experience for stand alone wind-powered systems;

(4) Evaluate the economics of stand alone, wind-powered systems in an Egyptian context; and

(5) Identify potential modifications to the stand alone system which might better adapt the system to the Egyptian environment.

Concept Description

The application site of wind energy was not identified during the in-country visit. However, many sites were judged to exist in Egypt. Data which would have permitted a specific WECS to be designed were not available and the following assumptions and conditions have been applied to the WECS design in order to permit initial development of the application:

1. Two generic sites were chosen for analyses, one having a high wind regime approximating that at a site with adequate wind energy and another site having a low wind regime profile. The wind profiles analyzed are those shown in Figure 1.

2. The wind turbine chosen has a capacity factor of 5.2% for the low wind regime site and a capacity factor of 13.0% for the high wind regime site. Though the chosen capacity factors are less than normally used in WECS sizing, they represent those attainable using Egyptian wind regime data available to the project planners. Figure 2 shows the annual energy available from various size wind turbines at the two generic wind sites discussed above.

3. The village energy requirements considered are those representative of two Egyptian villages. The first requires 50 kw hr/day and the other requires substantially less, 10 kwhr/day (18.25 mw-hr/yr. and 3.65 mw-hr/yr respectively). Figure 2 contains these village energy requirements as horizontal lines labled "energy needs A" and "energy needs B."

4. A small (4 kw) diesel back-up is proposed for the field test, should the WECS system fail to supply critical energy needs of the village. The diesel is not considered part of the WECS.

5. Efficiency of the power transfer networks and storage system for the WECS was assumed to be 100%.

6. It is assumed that the stand alone WECS will supply A.C. power to an existing village distribution network which will not be expanded.

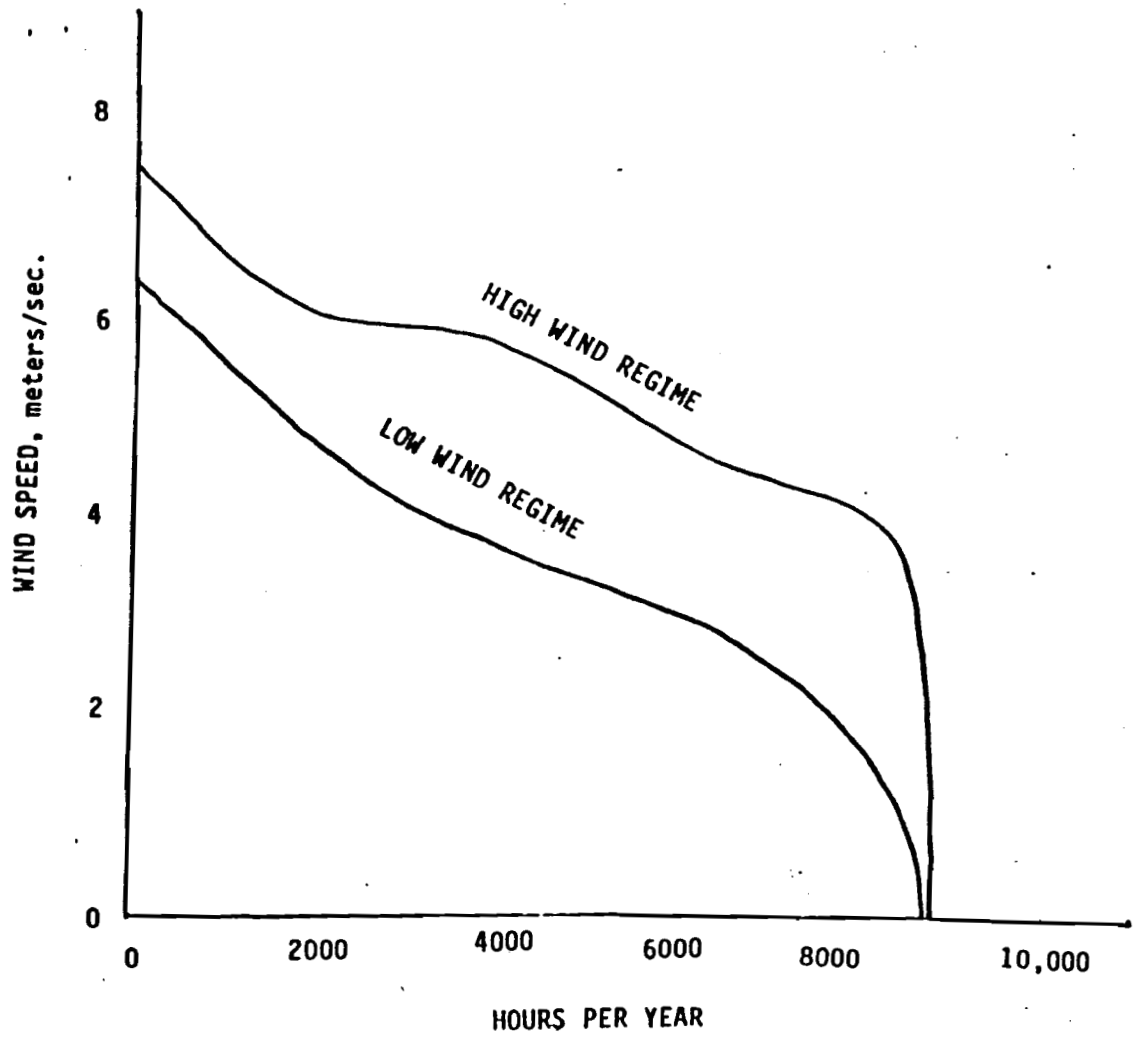

FIGURE 1. WIND DURATION CURVES

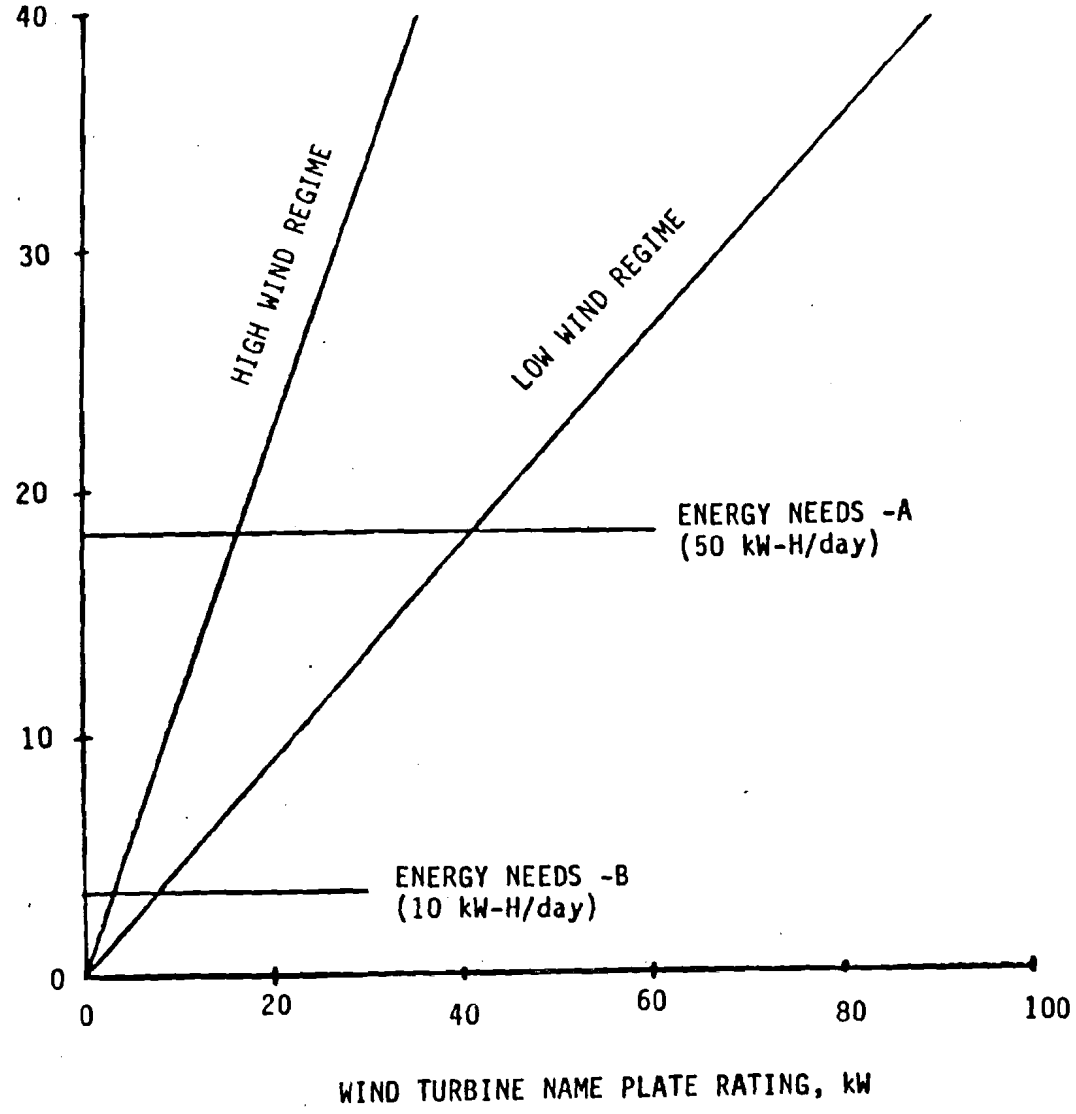

FIGURE 2. WIND TURBINE AND VILLAGE ENERGY NEEDS

(7) A lead-acid storage system will provide for three days of energy storage and shall be considered as part of the WECS.

(8) The activity related to the choice of a proper site is not included in costing or scheduling portions of this paper.

Schematics

Figure 3 illustrates the conceptual design of the proposed system.

Siting Information

A site for the Field Test has, as yet, not been selected. However, the chosen sites will have an enclosed area to house the battery storage, back-up diesel and electronic controls. Also a distribution network and desired loads must be in place prior to installation of the WECS.

The proper choice of a site for the WECS field test shall be made by USAID with substantial inputs from Qattara, GOE Ministries, site officials and the U. S. Project Manager. The basic criteria for the selection shall be:

1) Technical data available for site
   a. Wind Regime
   b. Load demands of village
2) Replication potential
   a. Proximity of other potential application sites
   b. Availability of grid power, present or future
   c. Exposure to decision-makers
3) Non-Technical policy factors.

System Technical Data and Design Specifications

Figure 2 can be used as a rough estimate of the size of the wind turbine needed. It can be seen that the WECS wind turbine size varies from about 3 kw to 40 kw.

For further analysis only two systems shall be considered - a 4 kw and a 20 kw wind turbine placed in a village having a high wind regime.

The two WECS's shall satisfy the following criteria:

	4 kw	20 kw
Rated output	4 kw @ 12 m/sec	20 kw @ 12.9 m/sec
Cut-in speed	3.6 m/sec	3.6 m/sec
Survival wind speed	45 m/sec	45 m/sec
Environment	Sand + Marine	Sand + Marine
Electrical Output	D.C. from turbine 220 VAC to Load	D.C. from turbine 220 VAC to Load
Storage	3 days	3 days

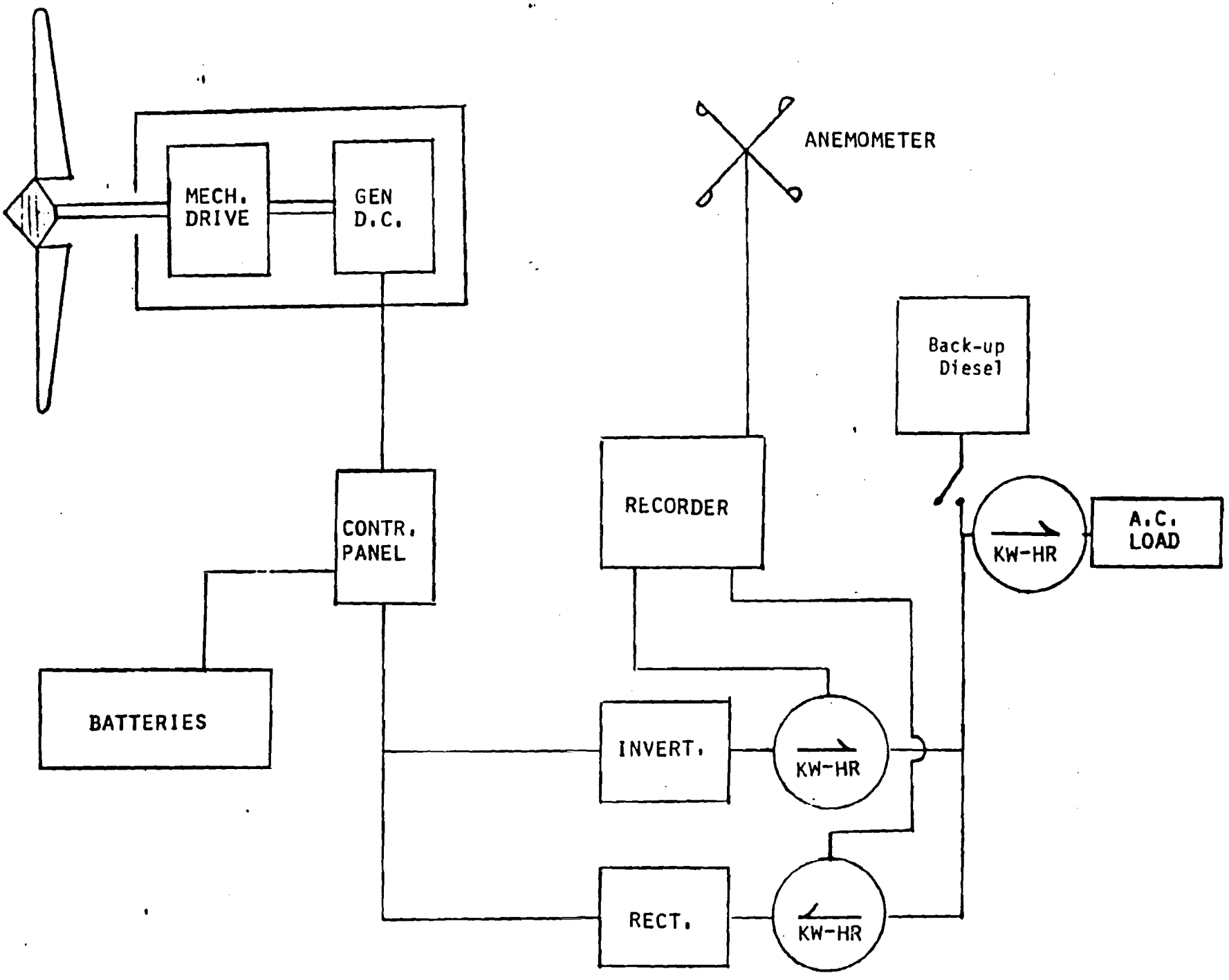

FIGURE 3. CONCEPTUAL DESIGN

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Detailed Design, Development, Installation, and Testing Requirements

System Design and Engineering - A U.S. contractor, under the direction of the U. S. Project Manager and working in cooperation with the QHREA shall:

(1) Design the WECS, back-up, and instrumentation systems;

(2) Design the battery/instrument enclosure; and

(3) Develop system specifications which are suitable for the solicitation of bids for the procurement and installation of all project equipment.

Equipment FOB Manufacturer - The U. S. Project Manager, working in cooperation with the QHREA and using the outputs from the System Design activity, shall procure, under AID regulations, the services of a U.S. contractor for the supply of project hardware, installation and training. The U.S. contractor shall install the WECS, including foundation, and make the final connections to the distribution system. The contractor shall also install the instrumentation package.

Packing and Shipping - After satisfactory factory tests by the U.S. contractor, the WECS shall be packed and shipped to the chosen Egyptian site.

Egyptian Site Preparation - The U. S. Project Manager, working in cooperation with the QHREA and the selected U.S. contractor, shall direct the installation of the WECS and the battery/instrument enclosure according to the design prepared by the System Designer. Qattara will be charged with the construction of the battery/instrument enclosure.

System Start-up and Training - The U.S. contractor shall be responsible for the successful start-up of the WECS. The contractor shall also train personnel of the Ministry of Electricity and village representatives, in the operation and maintenance of the WECS and provide instruction manuals to village representatives and the QHREA.

System Monitoring, Evaluation and Operation - The U.S. contractor shall visit the installation every six months for a period of 2 years after installation for the purpose of ensuring that the system is in good operation condition, perform scheduled maintenance and effect system repairs. Qattara shall be responsible for the collection and evaluation of all project data and, in cooperation with the U. S. Project Manager, prepare progress reports and the final project report. This final report shall present, as a minimum:

(1) An itemized account of all project expenses;

(2) The monitoring data collected;

(3) Statements of equipment failures and/or malfunctions;

(4) A characterization of the site wind regime;

(5) Recommendations as to the suitability of such systems for use in the Egyptian context; and

(6) Recommendations as to modification to the WECS which might better adapt the WTG to the Egyptian environment.

Monitoring and Evaluation Data Requirements

The project will provide instrumentation which will allow the WECS efficiency (wind energy available vs. electrical energy produced) to be determined. The instrumentation is expected to include three kWhr meters, an anemometer and a recorder. In addition, statements of equipment failures and malfunctions should be logged together with the amount of fuel used for the diesel and its operating time.

9.3 IMPLEMENTATION REQUIREMENTS

Organizational Elements and Responsibilities

Qattara and the Governorate authorities for the site chosen will be involved in the site preparation and system monitoring, evaluation and operational activities of the project. A U.S. contractor, under the direction of the U.S. Project Manager and working in cooperation with the GOE counterpart, will be involved in the remaining activities.

Schedule

The schedule assumes a site has been chosen prior to starting detailed engineering system design activities.

	Months after go-ahead
System Design and Engineering	0 to 4 months after go-ahead
Hardware Procurement and FAB	4 to 10 months
Shipping	10 to 12 months
Site Preparation	11 to 12 months
Installation and Start-Up	12 to 13 months
Monitoring (2 yrs.)	13 to 37 months

Required Actions

The required activities to implement the project are shown below and on the schedule above:

(1) Choice of field test site

(2) System Design and Engineering

(3) Equipment FOB Manufacturer

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(4) Packing and Shipping

(5) Egyptian Site Preparation

(6) Preparation of Operational and Training Manuals

(7) Check-out and Start-up

(8) System Operation, Monitoring, and Evaluation (2 years)

9.4 FIELD TEST COST ESTIMATE

The estimated field test costs for a 20 kw WECS village Power System (with 3 day storage and diesel back-up) are shown below:

	20 KW Turbine
System Design & Engineering	$ 50,000
Equipment FOB Manufacturer	120,000
Manual development	30,000
Shipping	25,000
Site Preparation and Installation	50,000
System Start-Up and Training	20,000
Maintenance & Monitoring (2 yrs)	112,000
	$407,000

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10. WIND-POWERED REVERSE OSMOSIS DESALINATION SYSTEM

10.1 INTRODUCTION

Background

The entire Red Sea Governorate lacks and urgently needs fresh water for its present population and will require a tremendous increase in the water supply to support growth in the region. Presently, the Governorate capital of Hurghada's sole source of fresh water is a pipe line from Qena. Water is allowed to flow to buildings (houses) three days a week for 1/2 hour on each day. Each house pays 5 Egyptian piastres for their allotment; however, because of the low water pressure created with all taps open simultaneously, most homes do not get more than 100 litres per delivery. Additional water is available from a town tank for 35 PT per m^3 plus about 1 LE for delivery. The same pipeline from Qena supplies Safaga and a 6 inch branch line is being extended 80km to Quseir (five years in progress and at least two years yet to complete). This line is also used to supply water boats for deliveries from Safaga to Quseir, Berenice and Marsa El Alam (see Figure 1). Cost of pumping water from Qena to Hurghada is about 1.13 LE per m^3 which does not include cost of pipeline. The cost of boat delivery water from Safaga to ports south is 4-8 LE per m^3.

5,000-10,000 PPM brackish water exists at a phosphate mine at El Hamrawein, 140 km south of Hurghada. The mine uses this water to supply a $200m^3$/day reverse osmosis system providing fresh water for its employees. A French solar desalination unit also is installed at the same site. It is designed to produce $50m^3$/day. The solar system (see Figure 2) was not operating during the visit. Additional small wells exist 500 km below Hurgada at Bir Shalatein.

The Red Sea area was included in a wind survey of Egypt conducted by Dr. William Hughes of Oklahoma State University. This work indicates that the Red Sea region and Hurghada, in particular, has moderate velocity prevailing winds. It is possible, therefore, to harness this wind energy to power a reverse osmosis desalination systems to furnish fresh water for the region.

Summary Description

The proposed field test is a reverse osmosis desalination pilot plant powered by a wind machine. As noted in the PV-powered reverse osmosis field test in 8.0, solar-powered reverse osmosis systems appear to be attractive options for applications in the frontier governorates and lend themselves to field tests of pilot plants. A 24m diameter blade, 200kW rated wind machine or a suitable combination of other smaller size machines will be installed along the coast in the Red Sea region. This size machine will generate a peak power of 76 kW and an average daily power delivery of 500 kWhr/day using available Hurghada wind data or 61 kW peak and 750 kW hr/day using available Ras Ghareb wind data.[1] This is sufficient electrical

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1 "Egyptian Wind Energy Resources Study, Final Report, Phase II" for the National Science Foundation, Contract Number EH-78-C-02-4638, November 1979, by W. L. Hughes.

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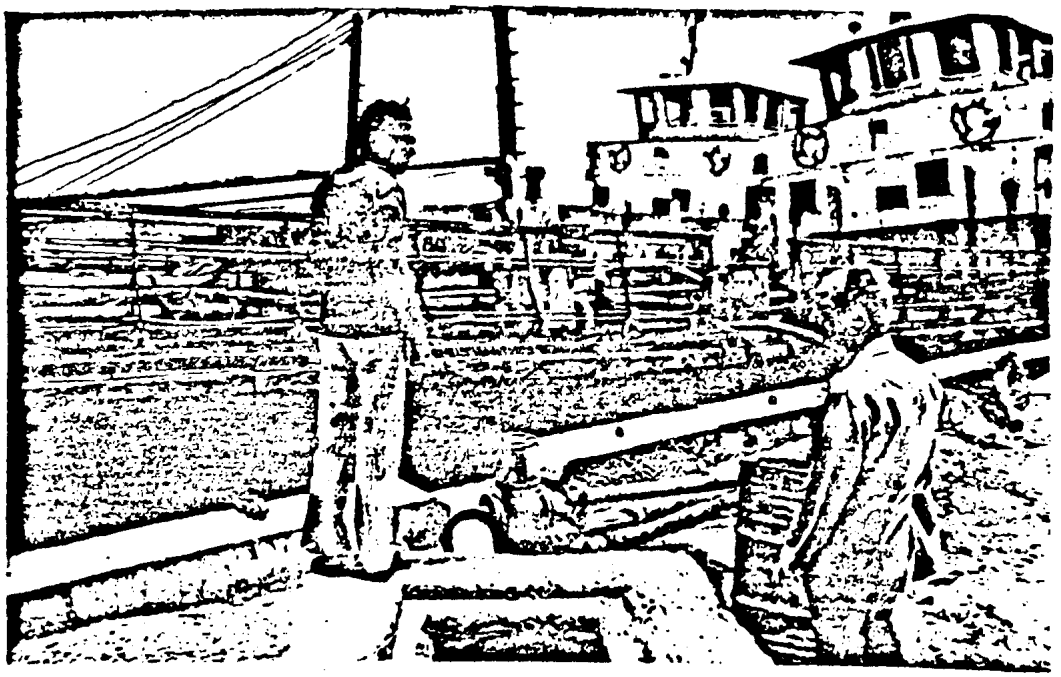

Figure 1. Water Boats Loading at Red Sea End of Qena to Safaga Fresh Water Line

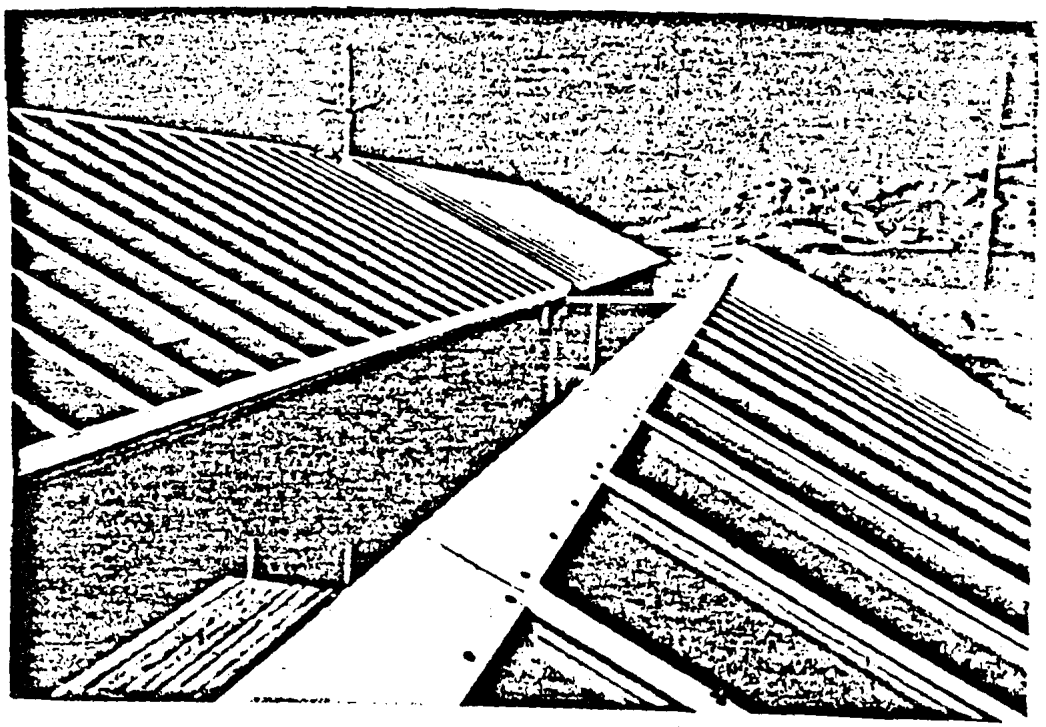

Figure 2. French Solar Desalination Plant at Phosphate Plant at El Aweina

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power for a reverse osmosis unit in the 40 to 75 m^3/day capacity range using 43,000 PPM Red Sea water. This field test is of sufficient size to demonstrate the technical and economic feasibility of the concept and to acquire operational and maintenance data applicable to larger-sized systems. Before a system configuration is selected, detailed conceptual design studies will be required. In a stand alone system, the wind machine will generate energy to charge a storage system, either battery or pressure vessel, which will power the reverse osmosis units. For this field test the local grid will be used as a back-up when the wind is not of sufficient speed to produce the needed power. A buffer storage to provide autonomous operation will be considered in the design of the field tests system. Reverse osmosis systems of the 40 to 75m^3/day size are commercially available as are wind machines in the 20 to 500 kW peak power rating range. The brine will be returned to the ocean and the potable water transferred into the existing fresh water supply and distribution system.

Alternative concepts employing other solar power systems will also be investigated and compared with the wind-powered concept during the engineering design phase of the field test. (See also Field Test Description 8.0 Photovoltaic-Powered Reverse Osmosis Desalination System).

10.2 APPLICATION DESCRIPTION

Objective

The primary objectives of this proposed wind-powered, reverse osmosis desalination field test are to:

(1) Determine the technical feasibility of providing fresh water from Red Sea water by reverse osmosis powered by a wind system;

(2) Monitor the overall system efficiency;

(3) Provide hands-on operational and maintenance experience for Egyptian personnel; and

(4) Evaluate the economics in an Egyptian context.

A secondary objective is to identify potential modifications to the system which may improve operation for replication operation in the Egyptian environment.

Concept Description

This system will employ a reverse osmosis system similar to the reverse osmosis plant located in Jeddah, Saudi Arabia, that produces 12,000 m^3/day of fresh water from Red Sea water. Only pumping pressure energy is used in the reverse osmosis process, resulting in 60 to 70 percent energy savings when compared with distillation processes. The use of membranes which produce drinking water from a single pass allows compact and simple plant design having the lowest combined construction and operating cost of any desalination process. The plant simplicity results in easy operation. The plant start and stop buttons are the only controls for start-up and shutdown and can be done almost instantaneously. During operation only routine checking of instruments is required.

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The standard models available from several manufacturers are supplied preassembled and require only flat foundations and simple interconnections at site. The versatility of the membranes has been proven in reverse osmosis systems operating with many types of seawater in the Far East, North America. the Gulf of Mexico, the Carribbean and the Middle East.

The conceptual design of a typical reverse osmosis desalination system is shown in Figure 3. Chemicals are injected into the raw water to adjust proper pH and to assist coagulation of suspended particles which are then removed by sand filters. The clean filtered water is pumped at high pressure into the membrane chambers. Reverse osmosis takes place through the membranes, separating the feed into a stream of purified water and a stream of reject brine containing most of the dissolved salts.

The larger reverse osmosis plants are divided into four or five packages for shipment but only a few days are needed to make the interconnections at the site. Prefabricated metal buildings are usually furnished with the units. Figure 4 shows a typical plot layout. Figure 5 is a photograph of a reverse osmosis plant taken at the Misr Phosphate Plant near Quseir on the Red Sea.

The wind machine will be large enough to provide the annual energy requirements of the reverse osmosis plant along with any distribution losses of the complete wind reverse osmosis system. To determine the suitability of a wind machine in Egypt the wind duration curves (Figure 6) were examined for four sites for which data was available. Two of the sites are on the Mediterranean Sea - Matruh and Borg El Arab, and two sites are on the Red Sea - Hurghada and Ras Ghareb. A production U.S. wind machine that is rated at 200 kW in 30 mph wind was used for the evaluation. The peak power, average daily energy delivery and annual energy delivery were calculated and the results are summarized in Table 1.

Table 1 Wind Site Comparison for 200 kW Machine

	Peak Power kW	Dailey Energy kWhr/day	Annual Energy kWhr/year
Matruh	76	209	76,500
Borg El Arab	30	288	105,000
Hurghada	76	504	184,000
Ras Ghareb	61	748	273,000

Of the four sites evaluated Ras Ghareb ranked first and Hurghada second. The wind duration curves for the 24 m hub height and the power duration curves for the 200 kW wind machine at Hurgada are shown in Figure 7.

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A detailed engineering design will be conducted during the first phase of the field test to configure the optimum solar-powered desalination system. Other solar and desalination technologies, e.g., photovoltaic, solar thermal, electrodialysis and solar-diesel hybrids, will be investigated to determine the best technical system concepts, given actual solar energy resources and input water quality data for specific site locations. Levelized costs per cubic meter of potable water produced will be calculated as a criterion for economic feasibility. Following a critical design review of candidate concepts, an engineering design will be prepared for the field test.

It is anticipated that the activities and tasks associated with this field test will be combined with those in the PV-powered desalination field test (section 8.0) under one contract, competitively awarded to a U.S. engineering firm.

System Technical Data and Design Specifications

The technical specifications for various size reverse osmosis desalination plants are presented in Table 2. These specifications were prepared for 35,000 PPM seawater and requires a 800psi (56 Kg/cm^2) pressure to operate with the standard seawater osmotic pressure of 23 Kg/cm^2 for 35,000 PPM seawater. The 43,000 PPM Red Sea Water has an osmotic pressure 36 Kg/cm^2 which will require a pump pressure of 900-1000 psi (63-67 Kg/cm^2). The final reverse osmosis design specifications will be prepared based on data obtained from specific water samples taken at the selected site.

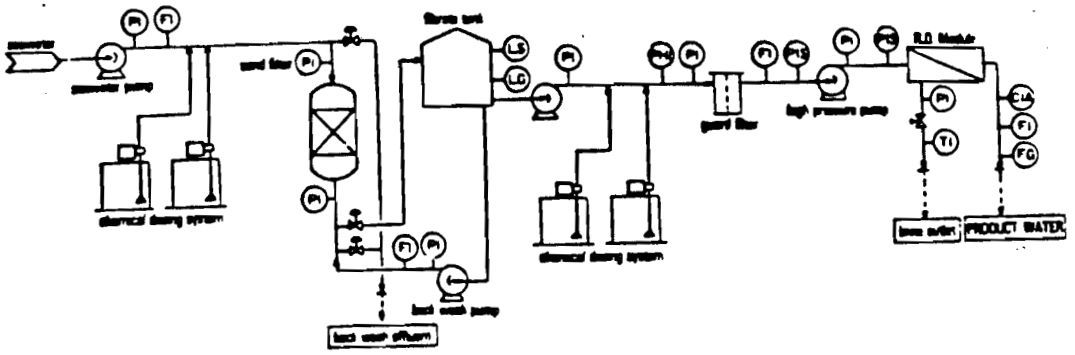

Figure 3. Flow Diagram

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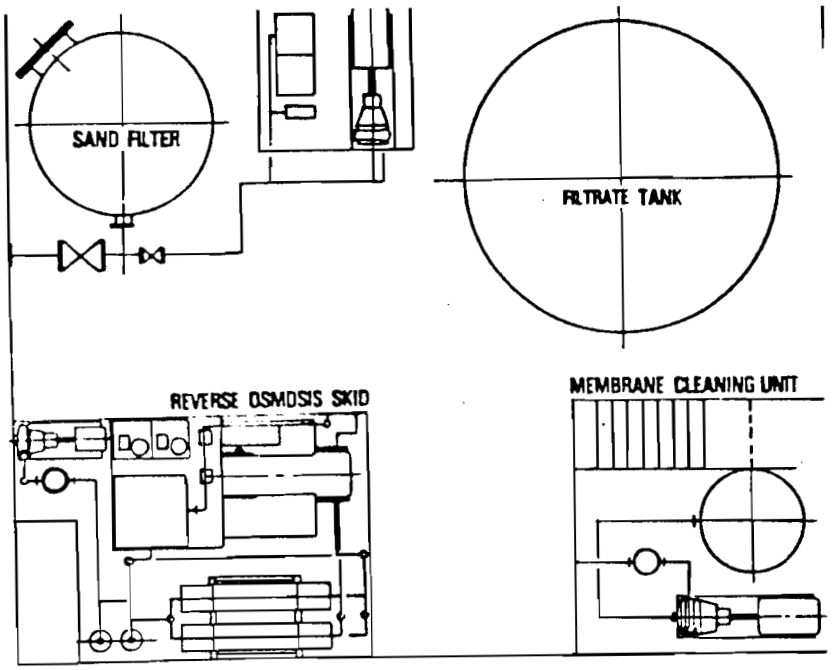

Figure 4. Typical Plot Layout

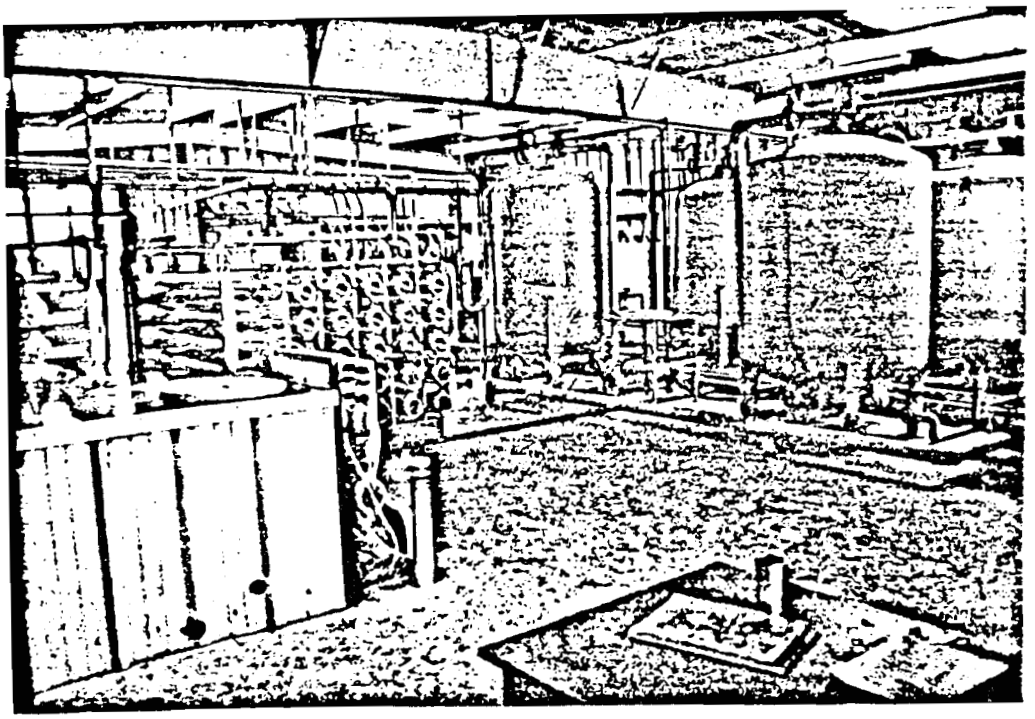

Figure 5. Misr Phosphate Plant Reverse Osmosis Unit

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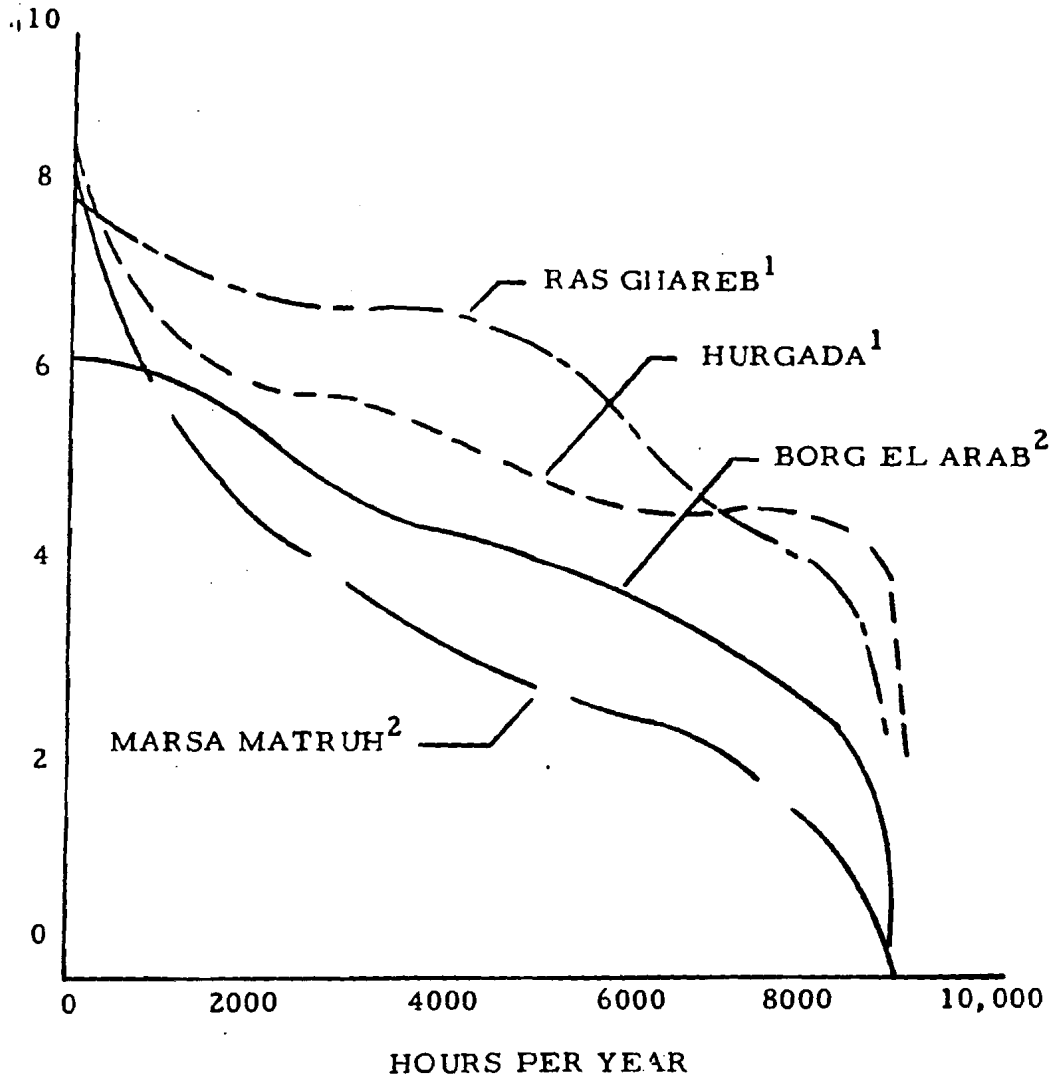

Figure 6. Wind Duration Curves for Two Red Sea Sites (1), and Two Mediteranean Sites (2) at 6 Meters Elevation

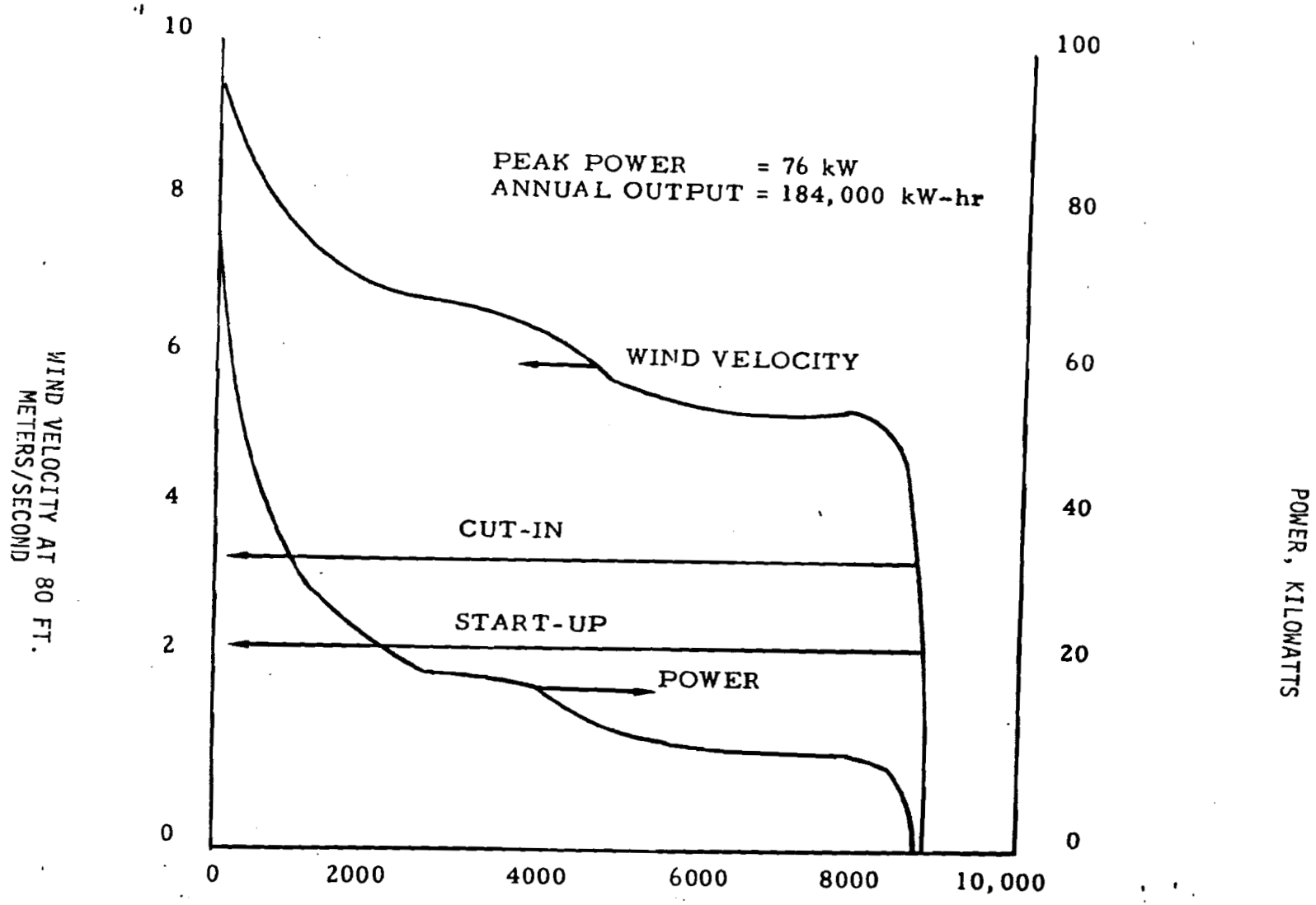

Figure 7. Wind Duration and Power Duration Curves for Hurgada at 80 Foot Hub Height

	Capacity	m^3/day	15	30	45	120	240
Concentration	Seawater	PPM TDS			35,000		
	Product Water	PPM TDS			500		
Seawater Temperature		°C			25		
Flow Rate	Supplied Seawater	m^3/day	54.5	109	165	437.7	874.8
	Backwash Drain	m^3/day	4.5	9	15	37.7	74.8
	Concentrated Brine	m^3/day	35	70	105	280	560
Pressure	R.O. Module Inlet	Kg/cm^2	56	56	56	56	56
	Supplied Seawater	Kg/cm^2	−0.2	−0.2	−0.2	−0.2	−0.2
	Product Water Discharge	Kg/cm^2	3.5	3.5	3.5	3.5	3.5
Chemical Consumption	$FeCl_3$ (37%)	Kg/day	2.8	5.5	9.1	24.1	48.1
	NaOCl (10%)	Kg/day	2.8	5.6	8.3	21.9	43.7
	H_2SO_4 (98%)	Kg/day	—	—	4.1	10.8	21.6
	HCl (35%)	Kg/day	2.8	5.6	—	—	—
	$NaHSO_3$	Kg/day	1.4	2.8	4.1	11.0	22.0
Power Consumption		kWH/day	172.8	304.6	440	985	1,960
Electric Power	Seawater Pump	kW	1.5	1.5	1.5	2.2	3.7
	Back Wash Pump	kW	3.7	5.5	11	22	30
	Booster Pump	kW	—	—	1.5	1.5	3.7
	High Pressure Pump	kW	5.5	11	15	37	37×2
	Chemical Dosing Pumps	W	0.235	0.235	0.210	0.210	0.235
	Cleaning Pump	kW	—	—	7.5	11	11
	Mixer	kW	—	—	0.2	0.4	0.4
Weight	R.O. Unit	Ton	6.1	7.9	1.5	3.3	3.4
	Sand Filter	Ton			8.3	19	39
	Rack Unit	Ton				0.4	0.6
	Cleaning Unit	Ton			0.5	0.8	1
	Filtrate Tank	Ton	0.2	0.4	1.8	4.5	9
Plot Size	Width	mm	3,000	3,200	6,000	8,000	10,000
	Depth	mm	1,700	2,000	6,600	6,500	7,500
	Plant Height	mm	2,400	2,600	3,500	5,500	7,500

Table 2. Reverse Osmosis Technical Specifications

For the technical and economic analyses performed pursuant to preparation of this project paper, the design specifications for the wind system are based on a 200kW machine with a 24m diameter blade operating in a wind regime characterized by the Ras Ghareb and Hurgada data. Detailed design specifications, however, will be prepared after the specific site is selected as discussed in the Siting Information Section below.

The baseline schematic for the proposed wind-powered reverse osmosis desalination system is shown in Figure. 8. This wind-powered reverse osmosis system providing fresh water from the Red Sea uses experimentally proven wind and reverse osmosis technologies. The system would make full use of the experience acquired in the U.S. and Near East from designing, maintaining, and evaluating the system performance of several wind and reverse osmosis units over the last four years. This will be the first system of this type and, because operation will ultimately be required with a minimum of detailed technical attention, the implementation requirements shown for this field test incorporates U.S. assembly, check-out and testing of critical components. This will allow evaluation and modification, if required, prior to shipment to Egypt.

Siting Information

The actual site will be determined after a review of the several available sites along the Red Sea. The selection will be based primarily on the annual wind profiles and, secondarily, on the cost of connecting to the existing water lines, lines to dump brine into the Red Sea, and connections for back-up power to the local grid. Additional local wind measurements will be required to select the best site.

Monitoring and Evaluation Data Requirements

The field test will incorporate instrumentation which will allow the system efficiency (i.e., wind energy available versus fresh water output) to be determined. The instrumentation will include sensors to measure temperature and wind velocity, as well as a water meter and a recorder. In addition, statements of equipment failures and/or malfunctions will be logged.

10.3 IMPLEMENTATION REQUIREMENTS

The required activities to implement the project are listed below and on the schedule in Figure 9.

(1) Site selection, conceptual design, and specifications

(2) System design and engineering

(3) Hardware procurement and manufacture

(4) U.S. check-out and test of critical components

(5) Disassembly, packing and shipment

(6) Preparation of operational and training manuals

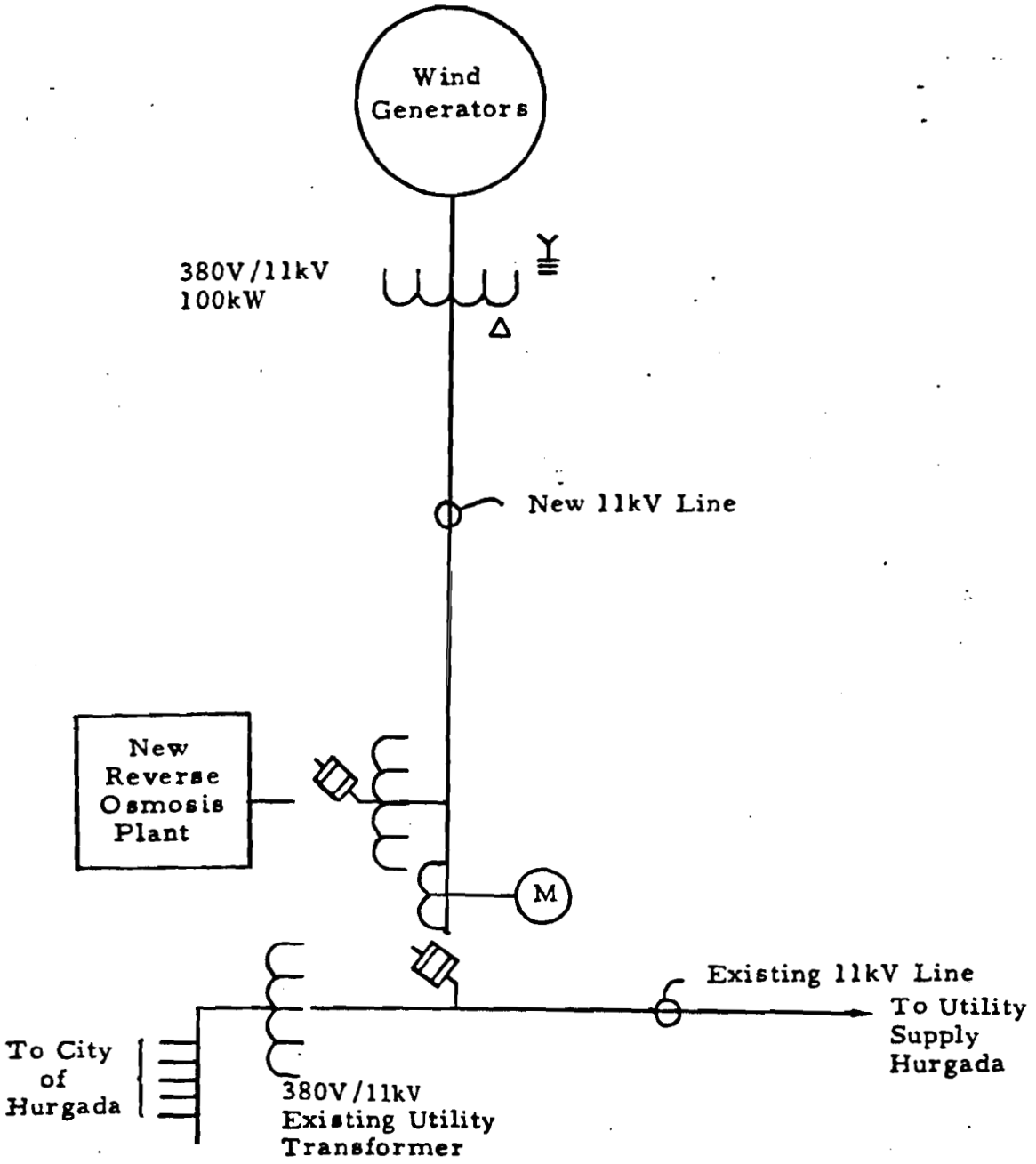

Figure 8. Wind/Reverse Osmosis System Schematic

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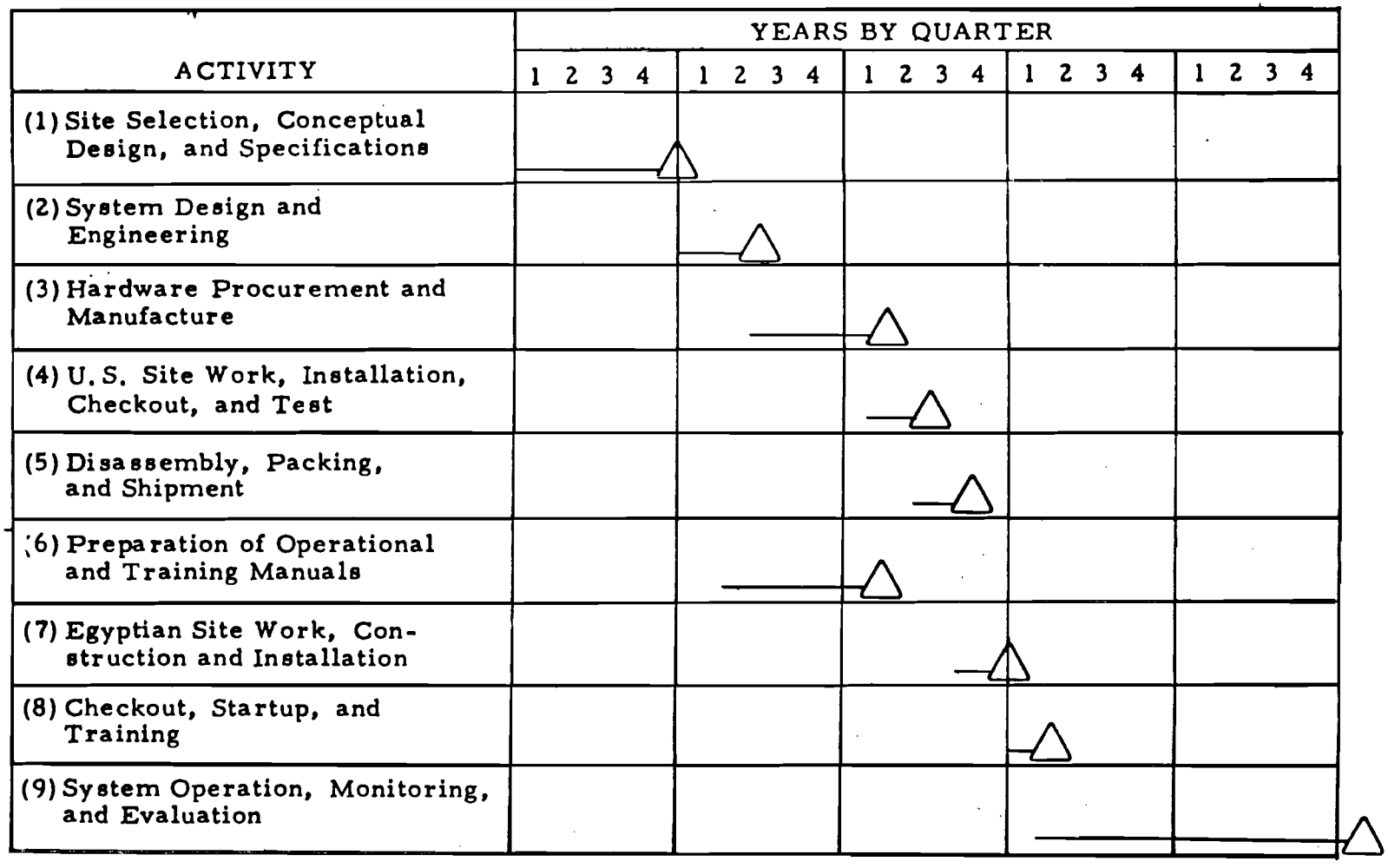

Figure 9. Schedule

(7) Egyptian site work, construction and installation

(8) Check-out, start-up and training

(9) System operation, monitoring and evaluation

Qattara and the Red Sea Governorate Ministry of Supply will be responsible for the site preparation, system operation, monitoring, and evaluation activities of the project, with technical assistance from the U.S. Contractor. A U.S. contractor, under the direction of the U.S. Project Manager and working in cooperation with Egyptian counterparts, shall be responsible for the detailed design of the system and the development of system specifications suitable for the solicitation of bids for the procurement and installation of all project equipment. The U.S. Project Manager, working in cooperation with the ministries and using outputs of the detailed design activity shall procure, under AID regulations, the services of a U.S. contractor for the supply of the project hardware, U.S. test of critical components, packing, shipping, check-out, start-up, installation, and training of the Egyptians who will be responsible for the operation and maintenance. The U.S. contractor, as part of the installation task, shall also include the foundations and final connections to the grid. The U.S. contractor shall also furnish and install the instrumentation package. As part of the U.S. test, the U.S. contractor shall, if the system does not meet specification, modify and retest the hardware to specification before shipment. In addition, the U.S. contractor shall prepare and furnish operational, maintenance, and training manuals of sufficient detail that the operation and service of the system will be accomplished by Egyptians.

The U.S. Project Manager, working in cooperation with the Ministries, shall direct the U.S. contractor in the installation of the field test. It is expected that the U.S. contractor will select and subcontract to an Egyptian contractor the site preparation, construction and foundation work. The U.S. contractor shall be responsible for the successful check-out and start-up of the system. He shall also train site personnel and staff members of the ministries and the assigned site manager in the operation and maintenance of the system.

The U.S. contractor shall visit the installation periodically during a two-year operation support period for the purpose of ensuring that the system is in good operating condition. The contractor and site manager shall perform scheduled maintenance activities and effect system repairs, as required. The site manager shall be responsible for the collection and evaluation of project data. The Project Manager, the site manager, and the GOE ministries shall prepare progress reports and the final report. This final report shall present, as a minimum:

(1) An itemized account of all project expenses;

(2) The collected monitoring data;

(3) Statements of equipment failures and/or malfunctions;

(4) A characterization of the site temperature and wind regime;

(5) Recommendations as to the suitability of such systems for use in the Egyptian context; and

(6) Recommendations for modifications to the system which might improve the system operation in the Egyptian environment.

10.4 FIELD TEST COST ESTIMATE

The field test cost is estimated to be $2,130,000. The major elements are itemized below.

	COST
System Design and Engineering	$ 325,000
Equipment FOB Manufacturer	775,000
U.S. Site Work, Assembly, Installation, and Test	50,000
Operation and Maintenance Manuals	50,000
Packing and Shipping	110,000
Site Work and Installation	400,000
Check-out and Start-up (3 months)	100,000
System Operation, Monitoring and Evaluation (2 years)	320,000
Total	$2,130,000

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11. SOLAR RANKINE CYCLE COLD STORAGE SYSTEM

11.1 INTRODUCTION

Background

Currently, about 25 tons/day of fish are taken from the lake in Wadi El Ruwayan. The fish are collected at a lakeside terminal which is about 12 km west of the edge of the Fayoum Oasis and approximately 45 km west of the Fayoum city of El Fayoum (Figures 1 and 2). The fish are then mixed with crushed ice and put in sacks for transporting to Fayoum and Cairo by truck. Since these trucks are not equipped with any insulation and must transport the block ice from the nearest ice maker in Fayoum (and often from Cairo when there is not sufficient ice at Fayoum), the loss of ice is significant. The distance from Cairo to Fayoum is about 90 km and the trip requires some 1.5 hours. The trip from Fayoum to the terminal over narrow, crowded, poor roads and trails requires an additional travel time of 1.5 hours. Also, since there is no refrigeration, or insulated storage available at the terminal site, fish spoilage at the terminal during holding and during transport results in the loss of an important protein food source.

Electric power lines run as far as the village at the edge of the Oasis, some 12 km from the lakeshore, but this line is currently taxed to its full capacity and no electric power is available from the existing grid system for this project. The water feeding the lake is tailwater from irrigation of fields fertilized with chemical and animal fertilizers. This water is somewhat brackish and not suitable for human consumption even though the fish thrive in the lake.

This site was visited by USAID representatives in February 1981 and the Governor identified cold storage as first priority. The initial project concept was to provide a solar-powered cold storage unit at the lakeshore terminal. However, during the meeting with the Governor in El Fayoum in July 1981, he emphasized the need for a better means to transport the vital fresh fish resource to Fayoum and Cairo and asked if an ice-making unit also could be considered in the project to eliminate the need for trucking block ice.

Summary Description

The field test is a solar-powered cold storage system installed at the lakeside terminal with additional system components to facilitate the application operations. The facility proposed for the cold storage terminal will include:

(1) A solar Rankine cycle-powered refrigeration system to provide cold storage (1-4°C) for up to 100 m tons of iced fish (1-2 parts ice for 3 parts of fish by weight).

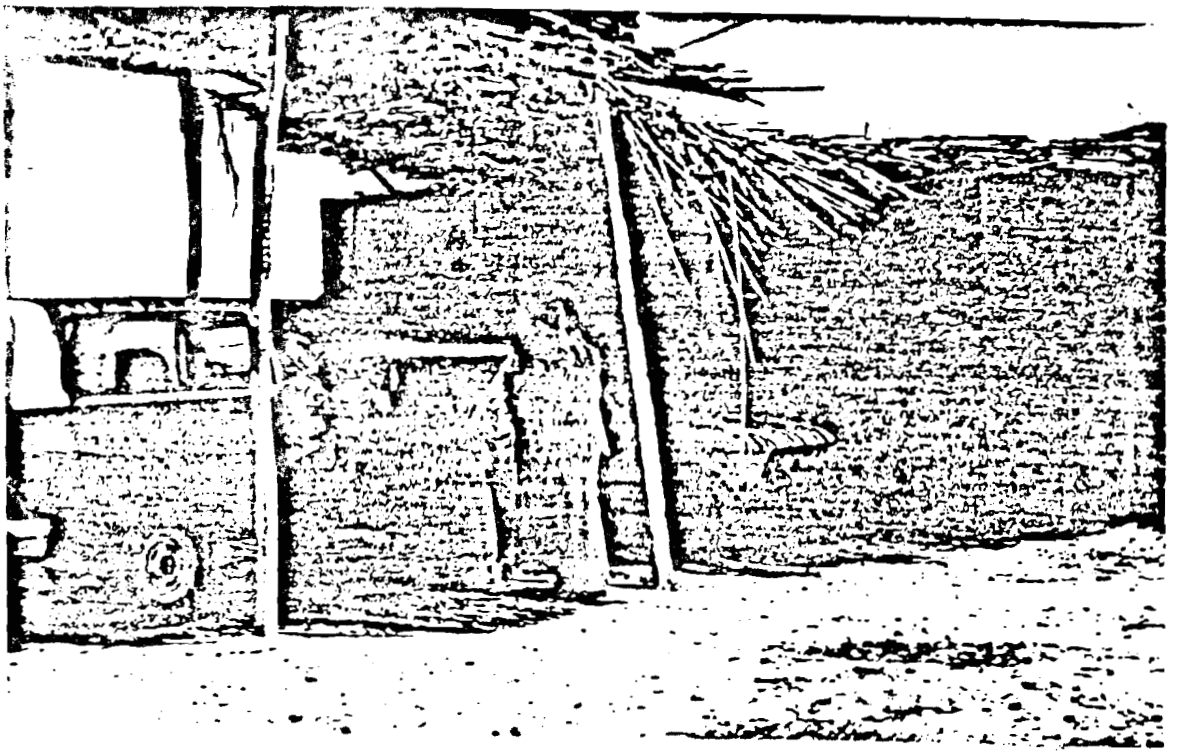

Figure 1. Existing Terminal, Easterly Side

Figure 2. Lake Looking Westerly

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(2) A continuous ice machine to provide 20 tons of ice per day. Chlorination or other treatment of the water for the ice machine may be required.

(3) A terminal building to house the cold storage lockers, the ice machine, insulated ice storage locker for 40 m tons of ice, service area and receiving and loading docks.

(4) A dual unit, diesel-powered generator, with all controls to provide power for the ice machine, water cooling tower, water pumps, ice handling conveyors as well as back-up power for the solar-powered refrigeration units.

(5) Water lines, pumps, controls for supplying water from the lake for the ice machine and cooling tower.

It is proposed that the fish would be iced upon receipt at the terminal with 1 to 2 parts of ice for 3 parts of fish by weight, packaged in fabric sacks, put into the solar-refrigerated holding storage space at once, and held for truck transport to the cities.

Optional phased additions to the above described system could include:

(1) Insulated, unitized transport containers to be carried on the existing trucks;

(2) A well to provide water for ice maker (if appropriate);

(3) Special refrigerated transport trucks;

(4) A small solar-powered desalination unit to provide potable water (and ice) for the terminal personnel, including fisherman and truckers, of about 10 gal/day/person capacity; and

(5) Growth of the facility capacity to handle a fish catch rate of about 60 tons/day anticipated in 3-5 years.

Appropriate road improvements should be made to reduce the truck transport time from the terminal to Fayoum. This would be the responsibility of the GOE. Living quarters for the personnel operating the terminal will be provided at the site. The personnel would include, as a minimum, one trained technical person and two assistants, permanently located at the terminal, and up to five transient personnel for periodic inspections, maintenance and repair. In addition, telephone or radio communications should be provided and maintained with the Governor's office in the city of Fayoum.

A resident Egyptian project engineer and technicians trained to operate and maintain the system will be required after the field test.

A constraint in this Project is that only systems that have demonstrated performance will be used. While the proposed Rankine cycle units have performed satisfactorily in space cooling usage which provides chilling to approximately 4-7°C, the deep-cooling application required for cold storage 1-4°C has not been demonstrated. While there are no technical reasons why

Rankine cycle units cannot power this cold storage application, it must be emphasized that this application of Rankine cycle units is experimental (ten air conditioning units have been produced to date) and that no previous experience exists for producing cold storage with these units. Thus, this field test represents a higher risk than the other tests. However, the need for cold storage and the large potential for replicated solar systems in Egypt warrants the inclusion of this field test in the Project.

11.2 APPLICATION DESCRIPTION

Objective

The primary objective of the proposed application is to provide refrigeration and cold storage facilities to decrease the spoilage of fresh fish delivered from the lake at Wadi El Ruwayan to the cities of Fayoum and Cairo. Additional objectives of this proposed installation are to:

(1) Determine the technical feasibility of a solar stand alone refrigeration and cold storage system in Egypt;

(2) Monitor the overall system efficiency;

(3) Provide hands-on operational and maintenance experience for Egyptian personnel;

(4) Evaluate the economics in an Egyptian context; and

(5) Identify potential modifications to the system which might better adapt the system for stand alone operation in the Egyptian environment.

Concept Description

The baseline solar-powered cold storage terminal is shown in Figure 3. The solar-powered portions of the system are indicated schematically in Figure 4. The terminal consists of the following parts:

(1) Solar-powered organic Rankine chiller with a rated capacity of 25 tons (derated for desert use and cold storage application). operating continuously, adjusted for non-frost conditions and employing water-cooled condensors. The chilled fluid will be a halocarbon suitable for operation of a cold storage unit described below. The organic Rankine chiller is indicated in Figure 5.

(2) 6,000 ft^2 of flat plate, double glazed solar collectors or 3,000 ft^2 of parabolic trough will provide the thermal power to operate the chillers. The collectors are to be ground-mounted on metal truss assemblies of modular design for fast and simple field erection. The flat plates will be tilted about 25° from the horizontal to the south. The collector field arrangement requires 336 collectors with a net area of 18 ft^2 each. Solar-heated fluid circulates through the closed-loop piping, transferring the absorbed energy to the Rankine unit or to the thermal storage tank described below.

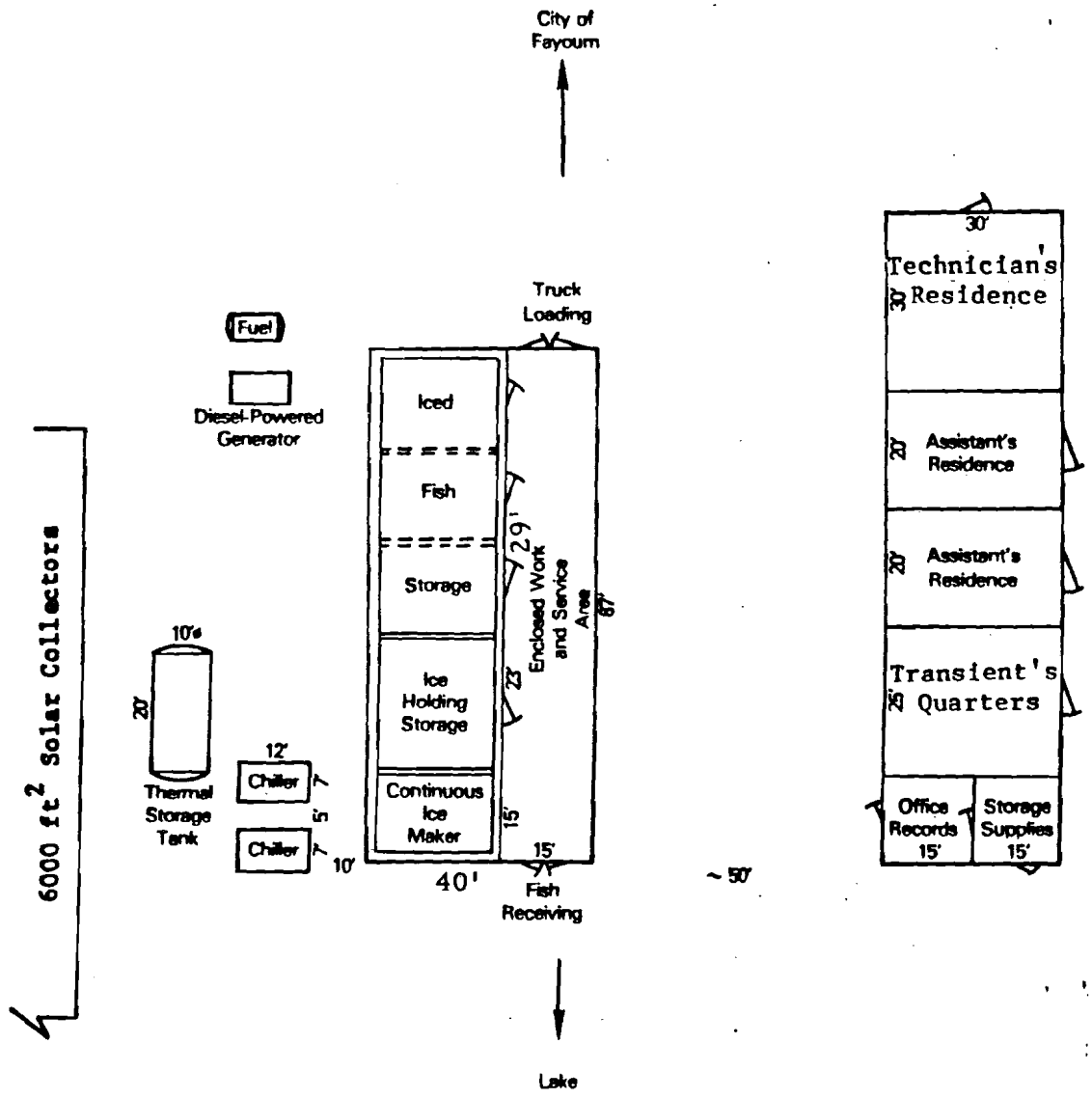
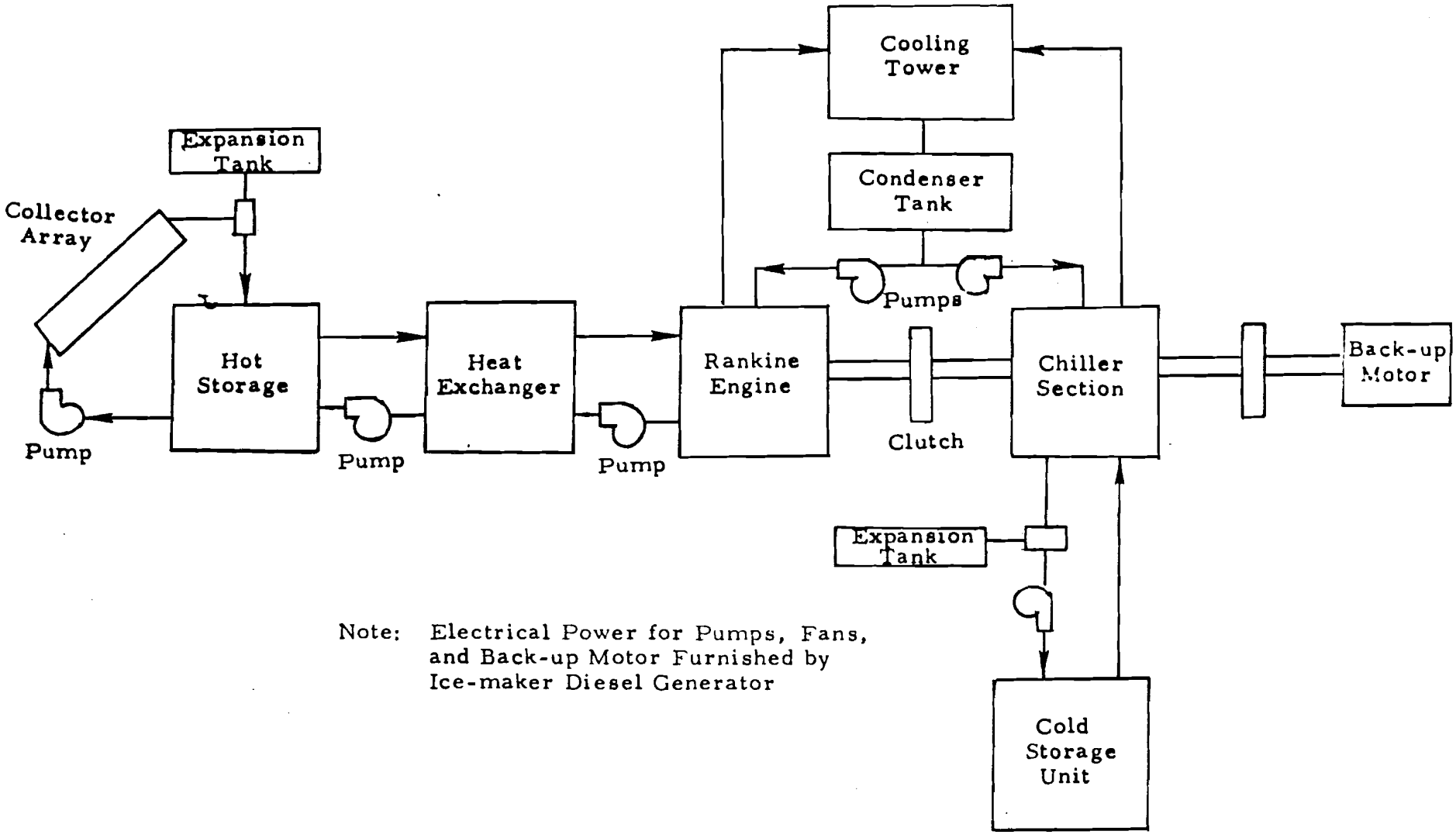


Figure 3. Solar-Powered Cold Storage Terminal Facility Site Layout



Note: Electrical Power for Pumps, Fans, and Back-up Motor Furnished by Ice-maker Diesel Generator

Figure 4. Baseline Solar Refrigeration System for Cold Storage

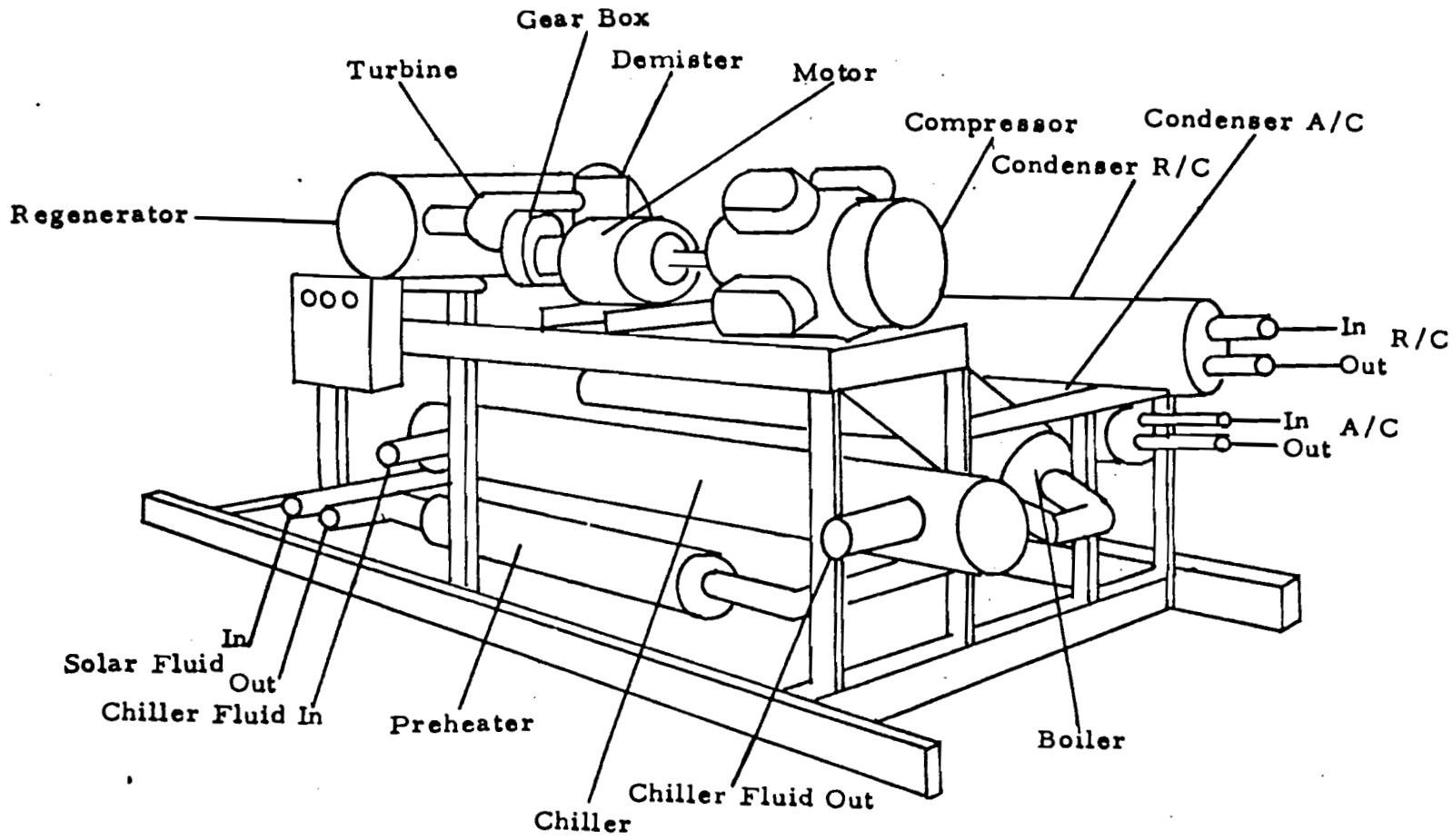


Figure 5. Rankine-Assisted Chiller

(3) A 7,000 gallon above ground, very well insulated, storage tank is part of the solar-powered system. During periods of transient low insolation and beyond the solar collection hours, the Rankine cycle turbines derive their energy from the solar-heated fluid contained in the storage tank.

(4) The control system consists of solid state controls that are integral to the system. These controls are in addition to the controls within the Rankine units used for maintenance. These controls should be compatible for remote operation, deriving power current from the diesel-powered generator for normal operations and electric storage batteries for emergency shutdown.

(5) Commercial, continuous ice-making unit with a capacity of 20 tons/day of crushed ice. The ice maker will be located in a terminal building configured and designed to operate while exposed to desert sun and ambient temperatures up to 50°C. This unit will be operated from dual unit, diesel generators.

(6) A commercially available, diesel-powered generator (dual unit) is required to provide full electrical power for the ice maker, pumps, and water tower and back-up power for the Rankine cycle unit. Each diesel generator must provide a start-up electrical output of about 125kW (approximately 300 amperes). This dual unit must be provided with controls which are compatible with the solar-powered Rankine cycle unit.

(7) Cold storage holding space is needed for two days' ice production (40 tons). This requires approximately 3,500 ft^3 with allowance for loading and unloading access. This holding space is to be located adjacent to the ice maker for easy access for conveyor handling of ice (see Figure 3). Sufficient insulation of the floor, ceiling and exterior walls is required to hold the ice for at least 5 days in an exposed desert environment with ambient temperatures of up to 50°C. Drainage for melt water is required.

(8) Refrigerated cold storage holding space is required for iced fish from two days' catch, (100 tons). This requires approximately 9,200 ft^3 with allowance for loading and unloading access. This storage space is chilled by the solar-powered organic Rankine unit described above. It is partitioned into three spaces, each with a separate access to facilitate loading and unloading without undue heat gain into the other spaces. This holding area is located adjacent to the ice storage area to facilitate access and to take advantage of common interior wall structures (see Figure 3). Insulation of the floor, ceiling and exterior walls shall be as required for the ice storage area. Drainage for the melt water is required.

(9) The prefabricated terminal building shall consist of a slab-on-grade concrete floor/foundation, prefabricated steel super structure, walls, roof and access doors. The roof shall be ventilated with wind-powered exhaust units. The walls shall be provided with windows to provide suitable light. The ice maker and insulated storage spaces will be located within the terminal building as shown in Figure 3.

(10) Residences, transient quarters, office, and storage shall be provided as indicated in Figure 3. The design and materials for the

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residences shall be appropriate for the area and usage. Design and construction shall be coordinated with the construction and installation schedule for the remainder of the terminal.

Siting Information

The terminal site is located on the northerly shore of the lake in Wadi El Ruwayan, some 12 km from the village at the edge of the Fayoum Oasis and about 45 km west of the city of El Fayoum. The site is near the outfall of the irrigation drainage line, a canal through the oasis and an underground pipe (tunnel) across the Wadi, that drains the irrigated fields in the oasis. Except at the lakeshore, there is no vegetation in the Wadi. There is no other land in use in or near this site except for the existing drainage line, so the specific locations of the buildings and solar units can be arranged in almost any fashion. The ambient temperature can reach 50°C during the year and this area is also subject to winds. As previously stated, an electric power line terminates at the village at the edge of the oasis but cannot provide power for this project.

System Technical Data and Design Specifications

Specifications for typical ice makers are given in Table 1. Preliminary specifications for the solar-powered cold storage and ice maker diesel are presented in Table 2.

Detailed Design, Development, Installation, and Testing Requirements

The component units of the system shall be designed to be integrated into, and function as, a total system. The basic loads and environmental factors are described in the Concept Description and arranged as indicated schematically in Figures 3 and 4. The prefabricated, insulated locker units for ice storage, cold storage of iced fish, and the ice maker and conveyor will be designed and planned for installation in the facility building at the site. The organic Rankine cycle chiller units, solar collectors, controls, and instrumentation shall be designed, developed, and assembled as a functioning system (against a dummy load) and tested in the United States to assure proper fit and operational performance. These units shall be adjusted, with emphasis on the control and instrumentation portions, to demonstrate the proper performance of the solar-powered units. Following successful demonstration testing, they shall be dismantled and shipped to the site in Egypt where they will be reassembled with the non-solar portions of the system according to the construction and installation plans and schedule. The installed system will then be thoroughly checked and tested to ensure that it performs properly. After system check-out in Egypt is completed satisfactorily, the system will undergo an operational testing period of two years during which complete diagnostic data will be recorded and analyzed.

Monitoring and Evaluation Data Requirements

The Solar Rankine Cycle System (SRCS) will incorporate instrumentation which will allow the solar Rankine cycle-powered cold storage system efficiency (i.e., insolation available versus mechanical energy output) to be

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determined. The instrumentation is expected to include sensors to measure total insolation, external and internal temperatures, and wind velocity, as well as a recorder. In addition, tonnage of fish packed and shipped, and equipment failures and/or malfunctions will be logged.

11.3 IMPLEMENTATION REQUIREMENTS

The required activities to implement the project are listed below and on the schedule in Figure 6.

(1) Site selection, conceptual design, and specifications

(2) System design and engineering

(3) Hardware procurement and manufacture

(4) U.S. site work, installation, check-out and test

(5) Disassembly, packing and shipment

(6) Preparation of operational and training manuals

(7) Egyptian site work, construction and installation

(8) Check-out, start-up and training

(9) System operation, monitoring and evaluation

Qattara and the Governorate Ministries of Supply and Electricity for Fayoum will be responsible for the site preparation, system operation, monitoring and evaluation activities of the project, with technical assistance from the U.S. contractor. The U.S. contractor(s), under the direction of the U.S. Project Manager and working in cooperation with Egyptian counterparts, shall be responsible for the conceptual design of the system and development of system specifications which are suitable for the solicitation of bids for the procurement and installation of all project equipment. The U.S. Project Manager, working in cooperation with the Ministries and using outputs of the conceptual design activity shall procure under AID regulations the services of a U.S. contractor for the supply of the project hardware, U.S. installation and test of the SRCS, packing, shipping, installation, check-out, start-up, and training of the Egyptians responsible for the operation and maintenance of the system. The U.S. contractor shall provide the foundations for the equipment and also furnish and install the instrumentation package. As part of the U.S. SRCS test, the U.S. contractor shall, if the system does not meet specification, modify and retest the hardware to specification before shipment. In addition, the U.S. contractor shall prepare and furnish operational, maintenance, and training manuals of sufficient detail that the operation and service of the system can be accomplished by Egyptians.

The U.S. Project Manager, working in cooperation with Qattara and the ministries, shall direct the U.S. contractor in the installation of the field test. It is expected that the U.S. contractor will select and subcontract to an Egyptian

SPECIFICATIONS

	MODEL P-24A		MODEL P-34A
	Capacity, Tons Per 24 Hours		Capacity, Tons Per 24 Hours
Water Temperature	Breaker Cutter Cylinder or Crushed	Saw Cutter Cylinder	Cylinder or Crushed
85°	17	14	33
75°	18	15	35
65°	19	16	37
55°	20	17	39
Weight	Operating: 14,000 lbs. Shipping: 12,000 lbs.		Operating: 23,000 lbs. Shipping: 21,000 lbs.
Standard Electrical Requirements	Power: 460 volt, 3 phase, 60 hertz. Controls: 230 volt, 1 phase, 60 hertz. Other electrical requirements can be furnished.)		
Standard Condensing Unit	50 hp ammonia compressor — Refrigerant 12 also available		100 hp ammonia compressor
	Shell and tube water cooled condenser		
Water Connections	Make-Up: ¾" FPT		Make-Up: 1" FPT
	Drain: 2" FPT		Drain: 2" FPT
	Condenser: 3" FPT		Condenser: 6" FPT
Ice Size	Cylinder: 1¼" diameter x 1" long (adjustable to 2"). Crushed: 3/16" - ¼" thick.		

NOTE: Capacity based on Ambient (Air) Temperature 90°F.
Ice capacity of Refrigerant 12 units slightly lower than P-24A.

Table 1. Typical Icemaker Specifications

COLLECTOR ARRAY	6000 FT^2 (NET), FLAT PLATE PANELS, DOUBLE GLAZED, SOUTH-FACING, GROUND-MOUNTED, 25° TILT, DOUBLE STACKING ARRANGEMENT
ENERGY TRANSPORT FLUID	25 PERCENT ETHYLENE GLYCOL-WATER (DOWTHERM SR-1)
SOLAR SYSTEM FLOWRATE	100 to 120 GPM
ENERGY CONVERSION ENGINE	BARBER-NICHOLS NOMINAL 25-TON RANKINE ENGINE, R-113 WORKING FLUID DRIVING A COMPRESSOR AND AN ELECTRICAL MOTOR
COLD STORAGE LOAD	24 HOUR STORAGE SPACE LOAD RATE OF 225,000 BTU/HR, COMPRESSOR ON TIME OF 18 HOURS (NO-FROST CONDITION)
SOLAR SYSTEM ELECTRIC POWER CONSUMPTION	MAIN CIRCULATION PUMP 3 HP 2.24 kW CONDENSER WATER PUMP 1 HP 0.75 kW RANKINE POWER CONSUMPTION 0.50 kW SYSTEM CONTROL 0.25 kW TOTAL 3.74 kW
DIESEL/GENERATOR	REDUNDANT UNITS, 125 kW EACH. PROVIDES POWER FOR ICE-MAKING MACHINE, AND PROVIDES ALL SOLAR ELECTRIC POWER CONSUMPTION AND POWERS COMPRESSOR UNDER CONDITIONS OF NO SOLAR POWER.

Table 2. Preliminary Specifications for Solar-Powered Cold Storage and Icemaker Diesels

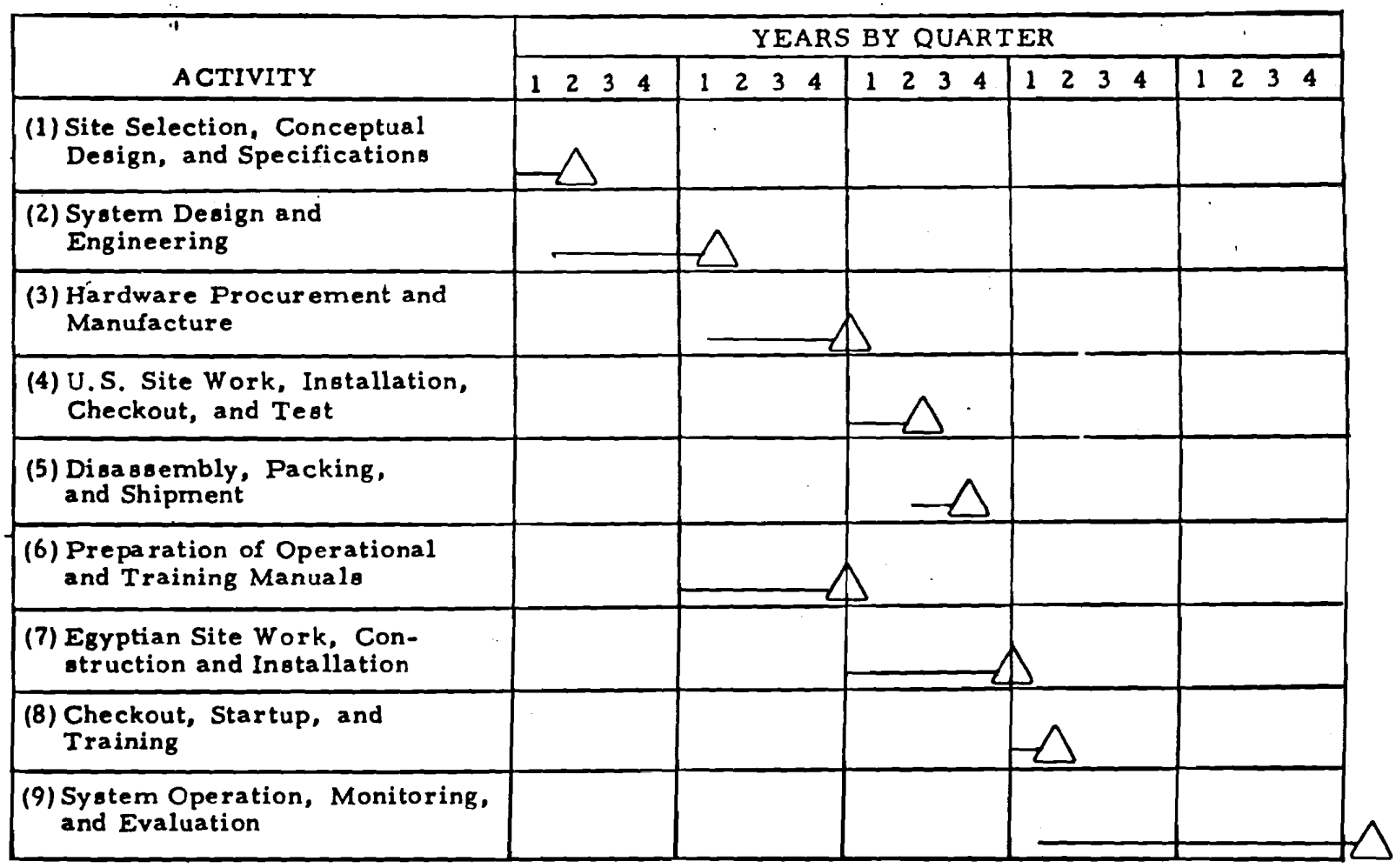

Figure 6. Schedule

contractor the site preparation, construction, and foundation work. The U.S. contractor shall be responsible for the successful check-out and start-up of the system. He shall also train site personnel and staff members of the ministries and the assigned site manager in the operation and maintenance of the system.

The U.S. contractor shall visit the installation periodically during the first two years of operation for the purpose of ensuring that the system is in good operating condition. The contractor and site manager shall perform scheduled maintenance activities and effect system repairs, as required. The GOE site manager shall be responsible for the collection and evaluation of project data. The U.S. Project Manager, Qattara, the site manager and the GOE ministries shall prepare progress reports and the final report. This final report shall present, as a minimum:

(1) An itemized account of all project expenses;

(2) The collected monitoring data;

(3) Statements of equipment failures and/or malfunctions;

(4) A characterization of the site insolation, temperature, and wind regime;

(5) Recommendations as to the suitability of such systems for use in the Egyptian context; and

(6) Recommendations for modifications to the SRCS which might improve the system operation in the Egyptian environment.

11.4 FIELD TEST COST ESTIMATE

The field test cost is estimated to be $2,265,000. The major elements are itemized below:

	COST
System Design and Engineering	$ 200,000
Equipment FOB Manufacturer	735,000
U.S. Site Work, Assembly, Installation, and Test (SRCS testing only)	275,000
Operation and Maintenance Manuals	65,000
Packing and Shipping	125,000
Egyptian Site Work and Installation	325,000
Check-out and Start-up (3 months)	100,000
System Operation, Monitoring and Evaluation (2 years)	440,000
Total	$2,265,000

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ANNEX C

DETAILS OF THE ECONOMIC ANALYSIS

DETAILS OF THE ECONOMIC ANALYSIS

The Net Present Value (NPV) equation

$$NPV = -C_0 + \sum_{i=1}^{n} \frac{(B_i - C_i)}{(1+r)^i} \qquad (1)$$

can be reformulated to

Net Present Value = 0 = Present value revenue - Present value costs (2)

Assume the following:

CP = construction period in years
UL = useful life of project in years
n = CP + UL = total number of years
P_p = price of the "product"
Q_p = quantity of the "product"
P_f = price of input fuel, if any
Q_f = quantity of input fuel, if any
IC = initial capital cost of the system divided by CP
OM = operating and maintenance cost (annual)
r = rate of return
e = annual escalation rate for P_f

Then:

$$0 = \sum_{i=CP+1}^{n} \frac{P_p \cdot Q_p}{(1+r)^i} - \sum_{i=1}^{CP} \frac{IC}{(1+r)^i} - \sum_{i=CP+1}^{n} \frac{OM}{(1+r)^i} - \sum_{i+CP+1}^{n} \frac{P_f \cdot Q_f \cdot (1+e)^i}{(1+r)^i} \qquad (3)$$

To set revenues equal to costs:

$$\sum_{i=CP+1}^{n} \frac{P_p \cdot Q_p}{(1+r)^i} = \sum_{i=1}^{CP} \frac{IC}{(1+r)^i} + \sum_{i=CP+1}^{n} \frac{OM}{(1+r)^i} + \sum_{i=CP+1}^{n} \frac{P_f \cdot Q_f \cdot (1+e)^i}{(1+r)^i} \qquad (4)$$

$$P_p \cdot Q_p \sum_{i=CP+1}^{n} \left(\frac{1}{1+r}\right)^i = IC \cdot \sum_{i=1}^{CP} \left(\frac{1}{1+r}\right)^i + OM \cdot \sum_{i+CP+1}^{n} \left(\frac{1}{1+r}\right)^i + P_f \cdot Q_f \cdot \sum_{i=CP+1}^{n} \frac{(1+e)^i}{(1+r)^i} \qquad (5)$$

The expression, $\sum_{i=1}^{n} \frac{1}{(1+r)^i}$, can be simplified to:

$$\frac{1 - (1+r)^{-n}}{r}$$

This is known as the uniform present worth formula (UPWF). This factor, when multiplied by a period paymnet (A), given the present value of the payment over N periods.

In these applications the construction period is either zero or one year. In order to evaluate a series of costs and benefits which start one or more periods in the future and last over the life of the project, the process can be simplified, using the UPWF factors, as follows:

$$\sum_{i=CP+1}^{n} \left(\frac{1}{1+r}\right)^i = \sum_{i=1}^{n} \left(\frac{1}{1+r}\right)^i - \sum_{i=1}^{CP} \left(\frac{1}{1+r}\right)^i \tag{6}$$

$$= \left(\frac{1}{1+r}\right)^1 + \cdots + \left(\frac{1}{1+r}\right)^{CP} + \sum_{i=CP+1}^{n} \left(\frac{1}{1+r}\right)^i - \left(\frac{1}{1+r}\right)^1 - \cdots - \left(\frac{1}{1+r}\right)^{CP}$$

$$= \sum_{i=CP+1}^{n} \left(\frac{1}{1+r}\right)^i$$

Therefore, ${}_{CP+1}UPWF_n = {}_1UPWF_n - {}_1UPWF_{CP}$

Where, ${}_iUPWF_j$ = the uniform present worth factor from year i to year j.

Substituting these results into equation (6) we have:

$$P_p \cdot Q_p \cdot ({}_{CP+1}UPWF_n) = IC({}_1UPWF_{CP}) + OM\ ({}_{CP+1}UPWF_n) \tag{7}$$

$$+ P_f \cdot Q_f\ ({}_{CP+1}MUPWF_n). \tag{8}$$

Note that $_{CP+1}MUPWF_n$ is the modified UPWF which includes the (i + e), or price escalation, in the formula. The same procedure as that used in equation (6) above applies to the MUPWF in equation (7).

Dividing both sides of equation (7) by ($_{CP+1}UPWF_n$) and Q_p, we have:

$$P_p = IC(_1UPWF_{CP})/(_{CP+1}UPWF_n)(Q_p) + OM/Q_p \qquad (8)$$

$$+P_f \cdot Q_f\ (_{CP+1}MUPWF_n)/(_{CP+1}UPWF_n)(Q_p)$$

Therefore, given the values of the variables on the fight side of equation (8) the "price" of the delivered energy for each specific application can be determined.

This very straight forward system can be applied to renewable energy investments where P_f and Q_f would be zero or to standard energy producing systems, such as a diesel generator or a residual fuel/steam plant for electsricity generation. Although the formula can be made much more complicated, it is quite sufficient for examining, for a given rate of return, what price must be charged for a unit of energy sold. In this manner a series of potential renewable and non-renewable energy producing investments can be compared.

The form used for compiling site data and the computer program used to perform the analysis are included on the next few pages.

DATA REQUIREMENTS FOR ECONOMIC ANALYSIS TO ESTABLISH $/MMBTU, $/KWH, and EXCEPTION REPORT FOR RENEWABLE ENERGY SYSTEMS

Project Identification _____

Location _____

Prepared by _____

RENEWABLE TECHNOLOGY SYSTEM INFORMATION

1. Initial cost or capital cost of system: $ _____
   (disaggregate by capital, freight, ins., etc.
2. Construction period (1 year, 1.5 years, etc.): _____ Years.
3. Lifetime of system: _____ Years.
4. Operating and Maintenance cost per year: _____ $/Year.
   (disaggregate by U.S. and Egyptian)
5. Expected net energy output per year (Total capacity less down time, unused capacity, system losses, etc.):

   _____ KWH/Year

   _____ MMBTU/Year

DISPLACED FUEL INFORMATION

6. Type and volume of fuel displaced:

   _____ BBL mazout

   _____ BBL crude oil

   _____ BBL light oil

   _____ BBL diesel

   _____ KWH electricity from grid

   Other: _____

Note: If steam, hotwater, or other energy is displaced, please convert into one or more of the above fuels for analysis and make footnote conveying this information (e.g., diesel fuel used to generate electricity).

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7. Fuel price paid by user:

_____$/BBL mazout

_____$/BBL crude

_____$/BBL light oil

_____$/BBL diesel

_____$/KWH from grid

Other:_____

O&M MONITORING INFORMATION

8. Please outline primary components and costs necessary to monitor the performance of the proposed technology application (Please disaggregate O&M factors)

ANNEX C - Continued

ECONOMIC ANALYSIS COMPUTER PROGRAM

```
      PROGRAM EGYPT
      CHARACTER* 7 UNIT
      INTEGER Z,Y,N,A
      INTEGER CP,UL,R,CS,NCS
      REAL CAPCOST, OMCOST, FUELUSE, ESC, I, J, RATE
      REAL K, L, M, MUPWF, UPWF, CRF, ACAPCCS, AOMC, AFUELC, TAC, ACU
      REAL UPWFN, UPWFCP, FSUM, FYEAR, FUELADJ
C
C
C           VARIABLE IDENTIFICATION
C
C  CAPCOST        = CAPITAL COST OF SYSTEM
C  OMCOST         = ANNUAL O & M COST OF THE SYSTEM, EXCLUDING FUEL
C  FUELUSE        = ANNUAL FUEL USAGE FOR OPERATION
C  FUELCOS        = INITIAL COST OF FUEL PER UNIT
C  ESC            = ANNUAL REAL RATE OF FUEL ESCALATION
C  RATE           = RATE OF RETURN
C  N              = NUMBER OF YEARS
C  CRF            = CAPITAL RECOVERY FACTOR
C  UPWF           = INVERSE FO CRF AND UNIFORM SERIES PWF
C  MUPWF          = UPWF WITH ESCALATING FUEL PRICE
C  ACU            = ANNUALIZED COST PER DELIVERED UNIT
C  ACAPCOS        = ANNUALIZED CAPITAL COST
C  AOMC           = ANNUALIZED O & M COST
C  AFUEL          = ANNUALIZED FUEL COST
C  TAC            = TOTAL ANNUALIZED COST
C  UL             = USEFUL LIFE OF THE PROJECT IN YEARS
C  CP             = CONSTRUCTION PERIOD ON YEARS
C  CS             = CONSTRUCT START YEAR
C  NCS            = NUMBER OF YEARS FROM FUEL PRICE YEAR TO CS
C  FUELADJ        = FUEL PRICE ADJ FACTOR FOR NON-CURRENT START TIME
C
C           INTERACTIVE DATA INPUT
C
   50 PRINT*, 'WHAT IS THE INITIAL COST OF THE SYSTEM?'
      READ*, CAPCOST
      PRINT*, 'WHAT IS THE ANNUAL O&M COST OF THE SYSTEM?'
      READ*, OMCOST
      PRINT*, 'HOW MUCH NONRENEWABLE FUEL DOES THE SYSTEM USE ANNUALLY?'
      READ*, FUELUSE
      PRINT*, 'HOW MUCH DOES THIS FUEL COST NOW?'
      READ*, FUELCOS
      PRINT*, 'WHAT IS THE CONSTRUCTION PERIOD?'
      READ*, CP
      PRINT*,'IN WHAT YEAR DOES CONSTRUCTION START?'
      READ*,CS
      PRINT*, 'WHAT IS THE USEFUL LIFE OF THE PROJECT?'
      READ*, UL
      PRINT*, 'WHAT IS THE ANNUAL NET ENERGY OUTPUT (M) ?'
      READ*, M
      PRINT*, 'WHAT IS THE UNIT ("UNIT") ?'
      READ*, UNIT
C
53?
```

```
C
C
C           ENERGY PRICE ESCALATION DATA
C
      PRINT*, 'DO YOU WANT THE PRICE ESCALATED FOR ONE VALUE(ANSWER=0)',
     1         ' OF A RANGE OF VALUES(ANSWER=1)?'
      READ*, Z
      IF(Z.EQ.0)THEN
           PRINT*, 'WHAT IS THAT VALUE?'
           READ*, ESC
      ELSE
           PRINT*, 'WHAT ARE THE LOWER AND UPPER LIMITS (I, J)?'
           READ*, I,J
      END IF
C
C
C
C           RATE OF RETURN DATA
C
      PRINT*,'DO YOU WANT ONE RATE OF RETURN(ANSWER=0)'
      PRINT*,'OR A SENSITIVITY ANALYSIS(ANSWER=1)?'
      READ*, Y
      IF(Y.EQ.0)THEN
           PRINT*, 'WHAT IS THAT RATE OF RETURN?'
           READ*, K
           L = K + .01
      ELSE
           PRINT*, 'WHAT ARE THE LOWER AND UPPER LIMITS (K, L)?'
           READ*, K,L
      END IF
C
C
C
85?
```

```
C
C
C
C
C
C          SENSITIVITY ANALYSIS ON RATE OF RETURN AND ESCALATION RATE
C
C
      PRINT*,'RATE            ESC            COST PER ',UNIT
      N = CP + UL
      NCS = CS - 1981
      DO 10 P=K,L,.02
           RATE = P
           DO 20 Q=I,J,.05
                IF(Z.EQ.1) ESC = Q
                IF(RATE.EQ.ESC)THEN
                     MUPWF = N
                ELSE
                     FSUM = 0
                     DO 30 R=CP+1,N,1
                          FYEAR = ((1 + ESC)**R)/((1 + RATE)**R)
                          FSUM = FSUM + FYEAR
 30                           CONTINUE
                     MUPWF = FSUM
                END IF
                UPWFN = (1 -(1 + RATE)**(-N))/RATE
                UPWFCP = (1 -(1 + RATE)**(-CP))/RATE
                UPWF = UPWFN - UPWFCP
                CRF = 1/UPWF
                IF(CP.EQ.0)THEN
                     ACAPCOS = CAPCOST*CRF
                ELSE
                     ACAPCOS = (CAPCOST/CP)*UPWFCP*CRF
                END IF
                AOMC = OMCOST
                FUELADJ = (1 + ESC)**NCS
                AFUELC = MUPWF*FUELUSE*(FUELCOS * FUELADJ)*CRF
                TAC = ACAPCOS + AOMC + AFUELC
                ACU = TAC/M
                PRINT*,RATE,'      ',ESC,'        ',ACU,' PER ',UNIT
 20            CONTINUE
 10         CONTINUE
      PRINT*, 'ANOTHER RUN? (YES=1,NO=0)'
      READ*,A
      IF(A.EQ.1)THEN
           GO TO 50
      ELSE
      END IF
      STOP
      END
132 ?
```

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Project	Location	Initial Cost $	Annual O&M $/year	Construction Period Years	Useful Life Years	Annual Energy Output	Energy Unit
Solar Water Heating for a Milk Products Plant	Cairo	555,000	3,500	1	20	2,250	MMBTU/yr
Solar-Assisted Fruit Dehydration	Cairo	112,000	1,150	1	25	190	MMBTU/yr
Solar Energy and Heat Recovery for Poultry Processing	Cairo	626,000	3,500	1	20	3,700	MMBTU/yr
Solar Energy and Heat Recovery for Textile Dyeing	Sharqiya	540,000	3,500	1	20	13,000	MMBTU/yr
Solar Heating for Metal Processing	Cairo	1,600,000	10,000	1	20	6,000	MMBTU/yr
Photovoltaic-Powered Fisherman Shelter Systems	Aswan	15,000 (per shelter)	200	0	15	830	KWH/yr
Photovoltaic-Powered Irrigation Systems	Assiut; Qena	7,000 (per site)	100	0	15	220	KWH/yr
Village Wind Power System	Marsa Matruh; Red Sea	166,000	3,000	1	20	18,000	KWH/yr
Solar Rankine Cycle Cold Storage System	Faiyum	275,000	2,750	1	20	17,580	KWH/yr
Wind Powered Reverse Osmosis Desalination System	Red Sea	662,000	5,100	1	20	273,000	KWH/yr
Photovoltaic Powered Reverse Osmosis Desalination System	Marsa Matruh	545,000	5,300	1	20	76,000	KWH/yr

Input Data for Renewable Energy Technology Applications in 1981

TABLE IV B-1

Project	Unit Energy Cost for Renewable Energy Technology ROR - .04	ROR - .10	ROR - .16	Conventional Technology Replaced	Annual Fuel Displacement
Solar Water Heating for a Milk Products Plant	$19.08/MMBTU	$30.53/MMBTU	$ 43.16/MMBTU	Steam Boiler	490 bbl Diesel
Solar-Assisted Fruit Dehydration	$43.79/MMBTU	$71.00/MMBTU	$102.73/MMBTU	Steam Boiler	48 bbl Diesel
Solar Energy and Heat Recovery for Poultry Processing	$13.40/MMBTU	$20.82/MMBTU	$ 29.48/MMBTU	Steam Boiler	1075 bbl Diesel
Solar Energy and Heat Recovery for Textile Dyeing	$ 3.33/MMBTU	$ 5.15/MMBTU	$ 7.28/MMBTU	Steam Boiler	2900 bbl Mazout
Solar Heating for Metal Processing	$21.29/MMBTU	$33.00/MMBTU	$ 46.64/MMBTU	Steam Boiler	1200 bbl No. 2 fuel oil
Photovoltaic-Powered Fisherman Shelter System	$ 1.87/KWH	$ 2.62/KWH	$ 3.48/KWH	Gas Engine/ Generator	250 gallons gasoline (per site)
Photovoltaic-Powered Irrigation Systems	$ 3.32/KWH	$ 4.64/KWH	$ 6.16/KWH	Gas Engine/ Generator	66 gallons gasoline (per site)
Village Wind Power System	$ .85/KWH	$ 1.25/KWH	$ 1.72/KWH	Diesel Generator	92 bbl Diesel
Solar Rankine Cycle Cold Storage System	$ 1.31/KWH	$ 1.99/KWH	$ 2.79/KWH	Diesel Generator	49 bbl Diesel
Wind Powered Reverse Osmosis Desalination System	$ .20/KWH	$ .30/KWH	$ .43/KWH	Diesel Generator	683 bbl Diesel
Photovoltaic Powered Reverse Osmosis Desalination System	$ .60/KWH	$ .91/KWH	$ 1.28/KWH	Diesel Generator	181 bbl Diesel

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Results of Economic Analyses for Renewable Energy Technologies in 1981

TABLE IV B-2

Conventional Technology	Fuel Escalation %/year	Unit Energy Cost of Conventional Technology ROR = .04	ROR = .10	ROR = .16
		$/MMBtu	$/MMBtu	$/MMBtu
Boiler:				
(1 boiler horsepower basis) Initial Cost: $300 Annual O&M Cost: $30 Annual Fuel Usage: 2900 gals Fuel Cost: $1.10/gallon Construction Period: 1 yr Useful Life: 20 years Annual Net Energy Output: 273 MMBtu	0	11.88	11.92	11.98
	5	20.19	18.57	17.36
	10	36.09	31.94	26.30
Diesel Engine/Generator:		$/kWh	$/kWh	$/kWh
(for 1 kW capacity) Initial Cost: $350 Annual O&M Cost: $175 Annual Fuel Usage: 424 gals (No. 2 diesel) Fuel Cost: $1.10/gallon Useful Life: 5 years Annual Net Energy Output: 3600 kWh	0	.200	.204	.208
	5	.220	.223	.226
	10	.243	.245	.247
Gasoline Engine/Generator:				
(for 1 kW capacity) Initial Cost: $1,000 Annual O&M Cost: $322 Annual Fuel Usage: 300 gals Fuel Cost: $1.20 Useful Life: 3 years	0	1.042	1.084	1.127
	5	1.079	1.120	1.163
	10	1.118	1.158	1.200

RESULTS OF ECONOMIC ANALYSES FOR CONVENTIONAL TECHNOLOGIES IN 1981

TABLE IV B-3

Project	Location	Initial Cost $	Annual O&M $/year	Construction Period Years	Useful Life Years	Annual Energy Output	Energy Unit
Solar Water Heating for a Milk Products Plant	Cairo	434,000	3,500	1	20	2,250	MMBTU/yr
Solar-Assisted Fruit Dehydration	Cairo	67,000	1,150	1	25	190	MMBTU/yr
Solar Energy and Heat Recovery for Poultry Processing	Cairo	491,000	3,500	1	20	3,700	MMBTU/yr
Solar Energy and Heat Recovery for Textile Dyeing	Sharqiya	436,000	3,500	1	20	13,000	MMBTU/yr
Solar Heating for Metal Processing	Cairo	1,310,000	10,000	1	20	6,000	MMBTU/yr
Photovoltaic-Powered Fisherman Shelter Systems	Aswan	4,350 (per shelter)	100	0	15	830	KWH/yr
Photovoltaic-Powered Irrigation Systems	Assiut; Qena	1,225 (per site)	50	0	15	220	KWH/yr
Village Wind Power System	Marsa Matruh; Red Sea	86,000	1,800	1	20	18,000	KWH/yr
Solar Rankine Cycle Cold Storage System	Faiyum	245,000	2,750	1	20	17,580	KWH/yr
Wind Powered Reverse Osmosis Desalination System	Red Sea	575,000	5,100	1	20	273,000	KWH/yr
Photovoltaic Powered Reverse Osmosis Desalination System	Marsa Matruh	185,000	3,700	1	20	76,000	KWH/yr

Input Data for Renewable Energy Technology Applications in 1990

Table IV B-4

Project	Unit Energy Cost for Renewable Energy Technology			Conventional Technology Replaced	Annual Fuel Displacement
	ROR - .04	ROR - .10	ROR - .16		
Solar Water Heating for a Milk Products Plant	$15.75/MMBTU	$24.21/MMBTU	$34.09/MMBTU	Steam Boiler	490 bbl Diesel
Solar-Assisted Fruit Dehydration	$28.63/MMBTU	$44.90/MMBTU	$63.89/MMBTU	Steam Boiler	48 bbl Diesel
Solar Energy and Heat Recovery for Poultry Processing	$10.71/MMBTU	$16.53/MMBTU	$23.33/MMBTU	Steam Boiler	1075 bbl Diesel
Solar Energy and Heat Recovery for Textile Dyeing	$ 2.74/MMBTU	$ 4.21/MMBTU	$ 5.93/MMBTU	Steam Boiler	2900 bbl Mazout
Solar Heating for Metal Processing	$17.73/MMBTU	$27.31/MMBTU	$38.49/MMBTU	Steam Boiler	1200 bbl No. 2 fuel oil
Photovoltaic-Powered Fisherman Shelter System	$ .59/KWH	$ .81/KWH	$ 1.06/KWH	Gas Engine/ Generator	250 gallons gasoline (per site)
Photovoltaic-Powered Irrigation Systems	$ .73/KWH	$ .96/KWH	$ 1.23/KWH	Gas Engine/ Generator	66 gallons gasoline (per site)
Village Wind Power System	$ .45/KWH	$ .66/KWH	$ .91/KWH	Diesel Generator	92 bbl Diesel
Solar Rankine Cycle Cold Storage System	$ 1.18/KWH	$ 1.79/KWH	$ 2.51/KWH	Diesel Generator	49 bbl Diesel
Wind Powered Reverse Osmosis Desalination System	$ .17/KWH	$ .27/KWH	$ .37/KWH	Diesel Generator	683 bbl Diesel
Photovoltaic Powered Reverse Osmosis Desalination System	$ .23/KWH	$ .33/KWH	$ .46/KWH	Diesel Generator	181 bbl Diesel

Results of Economic Analyses for Renewable Energy Technologies in 1990

Table IV B-5

Conventional Technology	Fuel Escalation %/year	Unit Energy Cost of Conventional Technology ROR = .04	ROR = .10	ROR = .16
		$/MMBtu	$/MMBtu	$/MMBtu
Boiler:				
(1 boiler horsepower basis) Initial Cost: $300 Annual O&M Cost: $30 Annual Fuel Usage: 2900 gals Fuel Cost: $1.10/gallon (1981) Construction Period: 1 yr Useful Life: 20 years Annual Net Energy Output: 273 MMBtu	0	11.88	11.92	11.98
	5	31.21	28.67	26.76
	10	84.84	75.00	61.62
Diesel Engine/Generator:		$/kWh	$/kWh	$/kWh
(for 1 kW capacity) Initial Cost: $350 Annual O&M Cost: $175 Annual Fuel Usage: 424 gals (No. 2 diesel) Fuel Cost: $1.10/gallon (1981) Useful Life: 5 years Annual Net Energy Output: 3600 kWh	0	.200	.204	.208
	5	.303	.305	.308
	10	.478	.477	.477
Gasoline Engine/Generator:				
(for 1 kW capacity) Initial Cost: $1,000 Annual O&M Cost: $322 Annual Fuel Usage: 300 gals Fuel Cost: $1.20 (1981) Useful Life: 3 years	0	1.042	1.084	1.127
	5	1.298	1.338	1.381
	10	1.710	1.748	1.788

Results of Economic Analyses for Conventional Technologies in 1990

Table IV B-6

ANNEX D

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Honeywell, R. Aspen

Hydranautics, R. R. Weiss

McDonald Equipment Co.-Cleveland Ohio
Distributors for ONAN Diesel
Electric Generators

National Drying Machinery Co.

Samakura Engineering Co. Int., J. P. Gaylor

ONAN Electric Power Systems, Minneapolis, MN, USA.

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Annex E

Detailed Financial Tables

FIELD TEST ELEMENT COST ESTIMATES*

Rate Assumptions

U.S. Contractor	=	$100K/Man Year (Burdened including Overhead)
U.S. Travel	=	$1.5K Air + $100/Day (per person)
GOE		
Professional/Engineering	=	$10K/Man Year (Burdened including Overhead)
Support/Technician	=	$ 5K/Man Year (Burdened including Overhead)

No real or nominal escalation used.

Project Year	1	2	3	4	5

GOE Contribution Assumed

Approximately 50% installation costs + GOE manpower in Operations and Maintenance support.

K = $1,000

*Does not include U.S. or GOE Project Management.

IELD TEST ELEMENT COST ESTIMATES

1. Solar Water Heating for Milk Products Plant

				Data for Economic Analysis
Design & Engineering		YR 2	50K	
Equipment		YR 2	440K	
Collectors	$300K			300K
Mounting Structure	45K			45K
Piping, Valves & Pumps	20K			20K
Central Clean-up System	35K			
Instruments & Controls	20K			20K
Hot Water Storage Tank	20K			20K
	$440K			
Manual Development		YR 3	30K	
Shipping		YR 3	65K	25K
Installation & Construction		YR 3	135K	125K
Check-out & Start-up & Training		YR 3	50K	535K
Operations & Maintenance Support		YR 4-5	140K	
U.S. Contractor - 1/6 MY/YR YR 4-5 17K + 17K	34K			
U.S. Contractor Travel Split YR 4-5 5 man trips @ 3K/trip	15K			
GOE Engineer 1/2MY/YR 5K + 5K	10K			
GOE Technician 1/2/MY/MY 2.5K + 2.5K	5K			
O & M Expenses 5K/YR 5K + 5K	10K			
15% Spare Equipment, Modifications, Extra Expenses YR 3	66K			
	140K			

Total Cost	$910K	
GOE Contribution	$ 73K	
U.S Contribution	$837K	(152K LC)

Disbursement Schedule: YR	1	2	3	4	5
	0	490K	280K	103K	37K

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FIELD TEST ELEMENT COST ESTIMATES 3

2. Solar-Assisted Fruit Dehydration

			Data for Economic Analysis
Design & Engineering		40K	
Equipment		210K	
Collectors	30K		30K
Mounting	6K		6K
Ducts, Fans, Dampers, etc.	6K		5K
Controls & Operation Monitoring	18K		18K
Tunnel Dryer (50' long)	150K		
	210K		
Manual Development		30K	
Shipping		50K	18K
Construction & Installation		45K	35K
Start-up/Check-out/Training		50K	112K
Operations & Maintenance Support		90K	
U.S. Contractor - 1/8 MY YR 12.5 + 12.5K	25K		
U.S. Contractor Travel 4 man trips @ 3K/trip	12K		
GOE Engineer 1/4 MY/YR 2.5K + 2.5K	5K		
GOE Technician 1 MY/YR 5K + 5K	10K		
O & M Expenses 2.5K + 2.5K	5K		
15% Spare equipment, etc.	33K		
	90K		

Total Cost	$ 515K	
GOE Contribution	38K	
U.S. Contribution	$ 477K	($84K LC)

Disbursement Schedule: YR	1	2	3	4	5
	0	250K	175K	62K	28K

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FIELD TEST ELEMENT COST ESTIMATES 4

			Data for Economic Analysis
3. Solar Energy & Heat Recovery for Poultry Processing			
Design & Engineering		50K	
Equipment		455K	455K
Collectors	320K		
Mounting	48K		
Piping, etc.	20K		
Hot water tank	12K		
Heat recovery	35K		
Instruments & Controls	20K		
	455K		
Manual Development		30K	30K
Shipping		30K	
Construction & Installation		140K	140K
Start-up/Check-out/Training		50K	625K
Operations & Maintenance Support		185K	
U.S. Contractor - 1/4 MY/YR 25K + 25K	50K		
U.S. Contractor Travel 6 man trips @ 3K/trip	18K		
GOE Engineer - 1 MY/YR 10K + 10K	20K		
GOE Technician - 2 MY/YR 10K + 10K	20K		
O & M Expenses 5K + 5K	10K		
20% Spare Equipment, etc.	67K		
	185K		

Total Cost	$940K	
GOE Contribution	110K	
U.S. Contribution	$830K	($148 LC)

Disbursement Schedule: YR	1	2	3	4	5
	0	505K	250K	126K	59K

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FIELD TEST ELEMENT COST ESTIMATES

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			Data for Economic Analysis
4. Solar Energy & Heat Recovery for Textile Dyeing			
Design & Engineering		$ 50K	
Equipment		424K	410K
Collectors	$ 280K		
Mounting	42K		
Waste Heat Recovery	25K		
Lint Removal/Water Storage	20K		
Modifications to Process Equip.	20K		
Pumps, etc.	12K		
Hot Water Storage	10K		
Auxiliary Water Heater	10K		
Controls	5K		
	424K		
Manual Development		30K	
Shipping		30K	30K
Construction & Installation		100K	100K
Start-up/Check-out/Training		50K	540K
Operations & Maintenance Support		206K	
U.S. Contractor 1/4 MY/YR 25K + 25K	50K		
U.S. Contractor Travel 6 man trips @ 3K/trip	18K		
GOE Engineer 1 MY/YR 10K + 10K	20K		
GOE Technician 2MY/YR 10K + 10K	20K		
O & M	10K		
20% Spare Equipment, etc.	88K		
	206K		

Total Cost	$ 890K	
GOE Contribution	90K	
U.S. Contribution	800K	($ 128K LC)

Disbursement Schedule: YR	1	2	3	4	5
	0	474K	210K	147K	59K

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FIELD TEST ELEMENT COST ESTIMATES 6

			Data for Economic Analysis
5. Solar Water Heating for Metal Processing			
Design & Engineering		$ 50K	
Equipment		1,245K	1,245K
Collectors	$1,000K		
Mounting	150K		
Piping, etc.	50K		
Hot Water Storage	30K		
Controls & Instruments	15K		
	1,245K		
Manual Development		30K	
Shipping		75K	75K
Construction & Installation		325K	280K
Start-up/Check-out/Training		50K	1,600K
Operations & Maintenance		260K	
U.S. Contractor 1/6 MY/YR 17 K + 17K	34K		
U.S. Contractor Travel 5 man trips	15K		
GOE Engineer 1/2 MY/YR 5K + 5K	10K		
GOE Technician 2 MY/YR 10K + 10K	20K		
O & M 15K + 15K	30K		
15% Spare Equipment	151K		
	$ 260K		

Total Cost	$ 2,035K	
GOE Contribution	193K	
U.S. Contribution	1,842K	($257K LC)

Disbursement Schedule: YR	1	2	3	4	5
	0	1295K	480K	206K	54K

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FIELD TEST ELEMENT COST ESTIMATES

				Data for Economic Analysis
6. Photovoltaic - Powered Fishermen Shelter Systems				
Design & Engineering			50K	
Equipment			100K	12.5K
Per Site:				
PV Array		$14,250		
Batteries		700		
Pumping/Irrigation System		7,000		
Water Purifier		800		
R/F		1,700		
Wiring, etc.		1,400		
Lights		300		
Controls & Instruments		6,500		
		$32,650 - $33,000		
Manuals			15K	
Shipping			9K	2.5K
Construction & Installation			35K	15 K
Start-up/Check-out/Training			8K	
Operations Support			58 K	
U.S. Contractor	1/8 MY/YR			
12.5K + 12.5K		25K		
U.S. Contractor Travel				
3 trips @ 4K/trip		12K		
GOE Engineer	1/8 MY/YR			
1.25K + 1.25K		2.5K		
GOE Technician	1/4 MY/YR			
1.25K + 1.25K		2.5K		
GOE Travel 2.5K + 2.5K		5K		
O & M .5K + .5K		1K		
10% Spare Equipment		10K		
		58 K		

Total Cost	$ 275K	
GOE Contribution	28K	
U.S. Contribution	247K	($38K LC)

Disbursement Schedule: YR	1	2	3	4	5
	50K	125K	50K	35K	15K

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FIELD TEST ELEMENT COST ESTIMATES

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			Data for Economic Analysis
7. Photovoltaic - Powered Irrigation Systems			
3 Sites:			
Design & Engineering		10K	
Equipment		52K	5K Equip/costs installed/ site
Per Site:			
PV Arrays	$ 4300		
Controls	660		
Pump & Motor	2000		
Irrigation	9400		
Instrumentation	1000		
	$17,360		
Manuals		1K	
Shipping		4K	2K / site
Installation/Check-out/Training		30K	7K / site
Operations Support		25K	14K / site
U.S. Contractor 1/24 MY/YR 5K + 5K	10K		
U.S. Contractor Travel 2 man trips @ 3K/trip	6K		
GOE Engineer 1/10 MY/YR 1K + 1K	2K		
GOE Technician 1/5 MY/YR 1k + 1K	2K		
GOE Travel	2K		
O & M	0		
Spare Equipment	3K		
	25K		

+

Total Cost	$ 132K		
GOE Contribution	17K		
U.S. Contribution	115K	($35K	LC)

Disbursement Schedule: YR	1	2	3	4	5
	10K	87K	25K	10K	0

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FIELD TEST ELEMENT COST ESTIMATES

8. Photovoltaic - Powered Reverse Osmosis Desalination System

			Data for Economic Analysis
Design & Engineering		300K	
Equipment		675K	531K
PV Array	260K		
Electrical Controls	130K		
PV B.O.S.	130K		
Instrumentation	25K		
R.O. Unit	30K		
Intake/Outfall System	25K		
Other	48K		
Equipment Building	27K		
	675K		
U.S. Site Work & Test		50K	
Manual Development		50K	
Shipping		85K	14K
Construction & Installation		410K	545K
Start-up/Check-out/Training		100K	
Operation Support		300K	
U.S. Contractor 1/3 MY/YR 33K + 33K	66K		
U.S. Contractor Travel 6 man trips @ 3K/trip	18K		
GOE Engineer 1 MY/YR 10K + 10K	20K		
Support 4 MY/YR 20K + 20K	40K		
GOE Travel	5K		
O & M	15K		
20% Equipment Spares	135K		
	299 - 300K		

Total Cost	$1,970K	
GOE Contribution	270K	
U.S. Contribution	1,700K	($338K LC)

Disbursement Schedule: YR	1	2	3	4	5
	0	925K	745K	220K	80K

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FIELD TEST ELEMENT COST ESTIMATES 10

			Data for Economic Analysis
9. Village Wind Power System			
Design & Engineering		50K	
Equipment		120K	101K
Wind Turbine Generator	40K		
Inverter	20K		
Diesel Back-up	10K		
Instrumentation & Controls	7K		
Battery System	12K		
Tower System	7K		
MSC Electrical Load Dist.	24K		
	120K		
Manual Development		30K	
Shipping		20K	20K
Site Preparation & Installation		50K	45K
Start-up/Training		20K	166K
Operations & Maintenance		112K	
U.S. Contractor 1/6 MY/YR			
17K + 17K	34K		
U.S. Contractor Travel			
5 man trips @ 3K/trip	15K		
GOE Engineer 3/4 MY/YR			
7.5K + 7.5K	15K		
Support 1 MY/YR			
5K + 5K	10K		
GOE Travel	2K		
O & M 5K + 5K	10K		
20% Spare Equipment	26K		
	112K		

Total Cost	$ 407K				
GOE Contribution	52K				
U.S. Contribution	355K	($70K LC)			
Disbursement Schedule: YR	1	2	3	4	5
	0	170K	125K	70K	42K

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FIELD TEST ELEMENT COST ESTIMATES

10. Wind - Powered Reverse Osmosis Desalination System

			Data for Economic Analysis
Design & Engineering		325K	
Equipment		775K	510K
Wind Turbines	500K		
Equipment Building	45K		
R.O. System	106K		
Intake/Outfall System	25K		
Electrical	30K		10K
Instrumentation	25K		
MSC	44K		
	775K		
U.S. Site Work & Test		50K	
Manual Development		50K	
Shipping		110K	42K
Site Work & Installation		400K	100K
Start-up/Check-out/Training		100K	
Operations		320K	
U.S. Contractor 1/3 MY/YR			
33K + 33K	66K		
U.S. Travel			
6 man trips @ 3K/trip	18K		
GOE Engineer 1 MY/YR			
10K + 10K	30K		
Support 4 MY/YR			
20K + 20K	40K		
GOE Travel	5K		
O & M	15K		
20% Spare Equipment	151K		
	320K		

Total Cost	$ 2,130K	
GOE Contribution	265K	
U.S. Contribution	1,865K	($333K LC)

Disbursement Schedule: YR	1	2	3	4	5
	0	1,055K	710K	287K	79K

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FIELD TEST ELEMENT COST ESTIMATES

			Data for Economic Analysis
11. Solar Rankine Cycle Cold Storage System			
Design & Engineering		200K	
Equipment		735K	245K
Rankine Unit	200K		
Collectors	150K		
Pipes/Pumps/Tanks	75K		
Controls	100K		
Cold Storage Locker	70K		
Ice Machine	90K		
Diesel Units	50K		
	735K		
U.S. Site Work & Test		275K	
Manual Development		65K	
Shipping		125K	30K
Installation/Construction		325K	275K
Start-up/Check-out/Training		100K	
Operation		440K	
U.S. Contractor 1/2 MY/YR 50K + 50K	100K		
U.S. Contractor Travel 6 man trips @ 4.5K/trip	27K		
GOE Engineer 3 MY/YR 30K + 30K	60K		
Support 6 MY/YR 30K + 30K	60K		
O & M	10K		
25% Spare and Critical Parts	183K		
	440K		

Total Cost	$2,265K
GOE Contribution	282K
U.S. Contribution	1,983K ($350K LC includes transient quarters)

Disbursement Schedule: YR	1	2	3	4	5
	0	935K	800K	407K	123K

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Field Test Cost Estimates
Summary Table ($ 000's)

Fields Tests	AID(FX)	AID(LC)	TOTAL AID	GOE(LC)	TOTAL
1. Milk Plant	685	152	837	73	910
2. Fruit Dehydration	388	89	477	38	515
3. Poultry	635	195	830	110	940
4. Textile	672	128	800	90	890
5. Metal	1585	257	1842	193	2035
6. Fishermen	209	38	247	28	275
7. Irrigation	80	35	115	17	132
8. PV-Desalination	1362	338	1700	270	1970
9. Village Wind	285	70	355	52	407
10. Wind Desalination	1533	333	1866	265	2131
11. Cold Storage	1683	300	1983	282	2265
TOTAL	9117	1935	11052	1418	12470

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PROJECTED DISBURSEMENTS
($ 000's)

Field Tests	FY 82			FY 83			FY 84			FY 85			FY 86			Total
AID	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	
1. Milk Plant	-	-	-	490	-	490	95	127	222	83	12.5	95.5	17	12.5	29.5	837
2. Fruit Dehydration	-	-	-	250	-	250	80	72	152	46	8.5	54.5	12	8.5	20.5	477
3. Poultry	-	-	-	455	50	505	130	50	180	25	81	106	25	14	39	830
4. Textile	-	-	-	474	-	474	148	12	160	25	102	127	25	14	39	800
5. Metal	-	-	-	1295	-	1295	256	61	317	17	174	191	17	22	39	1842
6. Fishermen	50	-	50	125	-	125	9	28	37	12.5	9.5	22	12.5	.5	13	247
7. Irrigation	10	-	10	57	15	72	8	16	24	5	4	9	-	-	-	115
8. PV-Desalination	-	-	-	925	-	925	371	169	540	35	152.5	187.5	31	16.5	47.5	1700
9. Village Wind	-	-	-	170	-	170	81	19	100	18	38.5	56.5	16	12.5	28.5	355
10. Wind Desalination	-	-	-	1055	-	1055	210	300	510	235	19.5	254.5	33	13.5	46.5	1866
11. Cold Storage	-	-	-	935	-	935	475	163	638	173	174	347	50	13	63	1983
Subtotal	60	0	60	6231	65	6296	1863	1017	2880	674.5	776	1450.5	238.5	127	365.5	11052

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PROJECTED DISBURSEMENTS
($ 000's)

Field Tests	FY 82			FY 83			FY 84			FY 85			FY 86			Total
GOE	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	
1. Milk Plant	-	-	-	-	-	-	-	58	58	-	7.5	7.5	-	7.5	7.5	73
2. Fruit Dehydration	-	-	-	-	-	-	-	23	23	-	7.5	7.5	-	7.5	7.5	38
3. Poultry	-	-	-	-	-	-	-	70	70	-	20	20	-	20	20	110
4. Textile	-	-	-	-	-	-	-	50	50	-	20	20	-	20	20	90
5. Metal	-	-	-	-	-	-	-	163	163	-	15	15	-	15	15	193
6. Fishermen	-	-	-	-	-	-	-	13	13	-	13	13	-	2	2	28
7. Irrigation	-	-	-	-	15	15	-	1	1	-	1	1	-	-	-	17
8. PV-Desalination	-	-	-	-	-	-	-	205	205	-	32.5	32.5	-	32.5	32.5	270
9. Village Wind	-	-	-	-	-	-	-	25	25	-	13.5	13.5	-	13.5	13.5	52
10. Wind Desalination	-	-	-	-	-	-	-	200	200	-	32.5	32.5	-	32.5	32.5	265
11. Cold Storage	-	-	-	-	-	-	-	162	162	-	60	60	-	60	60	282
Subtotal	0	0	0	0	15	15	0	970	970	0	222.5	222.5	0	210.5	210.5	1418
Total Project Element	60	0	60	6231	80	6311	1863	1987	3850	674.5	998.5	1673	238.5	337.5	576	12,470

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SUPPORTING ANALYSES ELEMENT COST ESTIMATES

TASK I APPLICATION STUDY

U.S. Contractor 3½ MY @ $100K/MY =			$350K
Travel (U.S. Contractor)			28K
2 people, 2 trips, 3 weeks each			
Per Person Air		3. K	
Per Diem		4.2K	
		7.2K	
2 Persons Total		14.4K	
1 person, 2 trips, 4 weeks each			
Air		3 K	
Per diem		5.6K	
Total		8.6K	
Local Travel Expenses		5 K	
GOE Support 2 MY/YR ENG @ 10K/MY =			$ 20K
2 MY/YR Support @ 5K/MY =			10K
Local Travel			10K

Total Task I	$418,000	
GOE Contribution	40,000	
U.S. Contribution	378,000	(28,000 LC)

Disbursement Schedule: YR	1	2	3
	350K	68K	--

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SUPPORTING ANALYSES ELEMENT COST ESTIMATES

Task II FIELD TEST DATA ACQUISITION AND ANALYSIS

U.S. Consultant Support/Design Specs, Data Acquitision, Analyses

Industrial	YR 1	1	MY	@	100K/MY	=	100K
	2	1/2	MY			=	50K
	3	1/6	MY			=	17K
	4	1/12	MY			=	8K
	5	1/12	MY			=	8K
Wind	YR 1	1	MY	@	100K/MY	=	100K
	2	1/4	MY			=	25K
	3	1/12	MY			=	8K
Desalination	YR 1	1	MY	@	100K/MY	=	100K
	2	1/12	MY			=	8K
	3	1/12	MY			=	8K
	4	1/12	MY			=	8K
Solar Thermal	YR 1	1/2	MY	@	100K/MY	=	50K
	2	1/12	MY			=	8K
	3	1/12	MY			=	8K
	4	1/12	MY			=	8K
Balance Field Test	YR 1	1/2	MY	@	100K/MY	=	50K
	2	1/12	MY			=	8K
	3	1/12	MY			=	8K
	4	1/12	MY			=	8K
New Initiatives	YR 2	1/6	MY	@	100K/MY	=	17K
	3	1/2	MY			=	50K
	4	1/2	MY			=	50K
Travel (U.S. Contractors)	YR 1	(31 man months)				=	175K
	2					=	40K
	3					=	30K
	4					=	20K
Equipment: Data Instrumentation System							
Current Field Tests	YR 1					=	200K
New Initiatives	YR 2-3					=	200K
O & M Per Year					2K	=	7K
GOE - Engineer		1 MY/YR		@	10K	=	50K
Technician		2 MY/YR		@	5K	=	50K
Local Travel						=	10K
					Total		$1487K

Total Task II $1487
GOE Contribution $110K
U.S. Contribution $1,377K (272,000 LC)

Disbursement Schedule: YR	1	2	3	4	5
	795K	279K	211K	182K	20K

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SUPPORTING ANALYSES ELEMENT COST ESTIMATES

TASK III ECONOMIC ANALYSIS

U.S. Economist	1/4 MY/YR	@	100K/YR	=	125K
Travel Expenses - 1 trip/YR					15K
Air	1.5 K				
Per Diem	1.4 K				
Local	.1 K				
	3.0 K				
GOE Economist	1 MY/YR	@	10K/YR	=	50K
Local Travel					5K

Total Task III 195K
GOE Contribution 55K
U.S. Contribution 140K (15,000 LC)

Disbursement Schedule: YR	1	2	3	4	5
	39K	39K	39K	39K	39K

TOTAL SUPPORTING ANALYSES

Task I	418 K
Task II	1487 K
Task III	195 K
	$2100 K
GOE Contribution	205 K
U.S. Contribution	$1895 K (315,000 LC)

Disbursement Schedule: YR	1	2	3	4	5
	1184	386	250	221	59

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PROJECTED DISBURSEMENTS
($000's)

Supporting Analyses	FY 82			FY 83			FY 84			FY 85			FY 86			Total
AID	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	
TASK I	310	20	330	40	8	48	-	-	-	-	-	-	-	-	-	378
TASK II	600	175	775	219	40	259	156	30	186	130	27	157	-	-	-	1377
TASK III	25	3	28	25	3	28	25	3	28	25	3	28	25	3	28	140
SUBTOTAL	935	198	1133	284	51	335	181	33	214	155	30	185	25	3	28	1895
GOE																
TASK I	-	20	20	-	20	20	-	-	-	-	-	-	-	-	-	40
TASK II	-	20	20	—	20	20	-	25	25	-	25	25	-	20	20	110
TASK III	-	11	11	-	11	11	-	11	11	-	11	11	-	11	11	55
SUBTOTAL	-	51	51	-	51	51	-	36	36	-	36	36		31	31	205
TOTAL	935	249	1184	284	102	386	181	69	250	155	66	221	25	34	59	2100

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TRAINING

	AID(FX)	AID(LC)	AID(Total)	GOE(LC)	TOTAL
U.S. Training					
1. Tech. Training 12 persons/yrs., 2 mo/ea @ $4.K/mo. 120 p.m.	480		480		480
Int'l Travel= 60 persons trips @ $1.5K/each		90	90		90
2. Mgmt. Support Training Contract/project mgmt. 4 persons/yr., 1 mo/ea. @ $4K/mo 20 p. mo.	80		80		80
Int'l Travel - 20 trips @ $1.5/each		30	30		30
Subtotal			680	0	680
Egyptian Training					
1. 2 Seminars/yr. 3 U.S. Consultants Seminar for 10 days/each= 2 p.m. (a) 100K/yr for 5 yrs $83K	83		83		83
6 trips/yr @ 1.5K= 45K		45	45		45
stopovers @ $150/each 1	4.5		4.5		4.5
Per Diem - $74/day, 60 da/yrs.		21.9	21.9		21.9
Facility rental, 20-50 persons/ session $1k/session = 10 sessions L.O.P.				10	10
Translations materials, comms. field visits @ 1k/session - 10 L.O.P.				10	10
Subtotal			154.4	20	174.4
2. University Courses 2 courses for 5 persons/yr. LE 300/course = LE 3000/yr.				15	15
Subtotal			0	15	15

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	AID(FX)	AID(LC)	AID(Total)	GOE(LC)	TOTAL
3. QHREA Seminars Tech seminars for 20-50 persons 2 seminars/yrs. 4 lectures/da for 1 wk = LE 6000/yr.				30	30
		Subtotal	10	30	30
4. Information Dissemination Brochures, info. on solar energy in general & field testing in specific LE 2,000/yr				10	10
		Subtotal	0	10	10
TOTAL	647.5	186.9	835	75	910

Disbursement	Yr (1)	Yr(2)	Yr(3)	Yr(4)	Yr(5)
*U.S.	167	167	167	167	167
GOE	15	15	15	15	15

* 835 rounded

PROJECTED DISBURSEMENTS
($ 000's)

TRAINING	FY 82			FY 83			FY 84			FY 85			FY 86			TOTAL
AID	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	
1. Tech Training-US																
Training	96	-	96	96	-	96	96	-	96	96	-	96	96	-	96	480
Travel	-	18	18	-	18	18	-	18	18	-	18	18	-	18	18	90
2. Mgmt. Training-US																
Training	16	-	16	16	-	16	16	-	16	16	-	16	16	-	16	80
Travel	-	6	6	-	6	6	-	6	6	-	6	6	-	6	6	30
3. Seminars in Egypt																
Consultants' Sal.	17	-	17	17	-	17	17	-	17	17	-	17	17	-	17	85
Travel	-	9	9	-	9	9	-	9	9	-	9	9	-	9	9	45
P.D.	-	4	4	-	4	4	-	4	4	-	4	4	-	4	4	20
Stopovers	1	-	1	1	-	1	1	-	1	1	-	1	1	-	1	5
Subtotal	130	37	167	130	37	167	130	37	167	130	37	167	130	37	167	835
GOE																
1. Seminars in Egypt																
Facility Rental	-	2	2	-	2	2	-	2	2	-	2	2	-	2	2	10
Materials, etc.	-	2	2	-	2	2	-	2	2	-	2	2	-	2	2	10
2. University Egypt	-	3	3	-	3	3	-	3	3	-	3	3	-	3	3	15
3. QHREA Seminars Egypt	-	6	6	-	6	6	-	6	6	-	6	6	-	6	6	30
4. Info. Dessemination	-	2	2	-	2	2	-	2	2	-	2	2	-	2	2	10
Subtotal	-	15	15	-	15	15	-	15	15	-	15	15	-	15	15	75
TOTAL	130	52	182	130	52	182	130	52	182	130	52	182	130	52	182	910

220

PROJECTED DISBURSEMENTS
($000's)

*New Initiatives	FY 82			FY 83			FY 84			FY 85			FY 86			Total
	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	
AID Subtotal	-	-	-	500	100	600	500	100	600	500	100	600	165	35	200	2000
GOE Subtotal	-	-	-		100	100	-	200	200	-	150	150	-	100	100	550
Total	-	-	-	500	200	700	500	300	800	500	250	750	165	135	300	2550

*Estimates based upon figures of currently-proposed field tests.

PROJECT MANAGEMENT

		(000's)	
PID			
Salaries (Burdened)		$	LE
YR 1 - 8 MY @ $50K/YR		400	
YR 2 - 9 MY @ $50K/YR		450	
YR 3 - 7 MY @ $50K/YR		350	
YR 4 - 4 MY @ $50K/YR		200	
YR 5 - 4 MY @ $50K/YR		100	
*Travel & Per Diem			
YR 1 - 40 man trips average 14/days/each			102
YR 2 - 27 man trips average 14 days/each			68.85
YR 3 - 28 man trips average 14 days/each			71.9
YR 4 - 16 man trips average 14 days/each			48
YR 5 - 16 man trips average 14 days/each			48
	Subtotal	1600	340***
**Allowances			
Differential - 15%		37.5	
Education - 2 children @ 4400/yr each			44
Housing - Average LE 1200/mo			72
Relocation Travel - 8 man trips @ LE 1500/ea			12
Temporary Lodging - LE 30/da for 30 days for 8 people			7.2
R & R - 1 x/tour @ $200 each			1.6
Storage - $6000/yr		30	
Freight - est. $25K per shipment for 2 families		25	25
	Subtotal	92.5	161.8
Car		9	
O&M, ins. for 5 yrs ave. LE 4000/yr			20
Secretary			20
Equipment, Supplies, Communications			30
	Subtotal	9	70

*Assumes per diem rate of $75/day and travel at LE 1500/trip.

**Assumes change of NASA resident advisor one time during life of project.

***Rounded.

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AID Contributions to GOE Management Costs

		(000's)	
		$	LE
Travel			
*International - 25 man trips average 13 days each			37.5
Per Diem		16.25	
Vehicles			
1 Station Wagon		11	
1 Van		18	
1 Pick-up		13	
Transient Quarters Fayoum			50
1 Trailer, equipped			
	Subtotal	58.25	87.5
	Total	1759.75	659.3

*2 man trips - Pre-proposal Conference average 9 days;
10 man trips - Bid Review average 17 days;
4 man trips - Design Review average 7 days;
4 man trips - U.S. Testing Observations average 10 days;
1 man trip - Applications Study average 10 days.

PROJECT MANAGEMENT

GOE

Salaries (Burdened)				GOE (000) & US Equiv.
Project Manager	5 man/yrs	-	$12,000/yr	60,000
Assistant Project Manager	5 man/yrs	-	10,000/yr	50,000
Administrative Director	5 man/yrs	-	8,000/yr	40,000
Administrative Assistant (2)	10 man/yrs	-	5,000/yr	50,000
Financial Analyst	5 man/yrs	-	5,000/yr	25,000
Secretaries (2)	10 man/yrs	-	3,000/yr	30,000
Drivers (3)	15 man/yrs	-	3,000/yr	45,000
Customs/Expeditors (5)	2.5 man/yrs	-	4,000/yr	10,000
Site Managers- YR 1 - 5; YR 2 - 6; YRS 3-5 - 7		-	8,000/yr	256,000
Translator (1)	5 man/yrs	-	6,000/yr	30,000
		Subtotal		596,000
Facilities, Supplies, Communications, etc.		$1800/mo x 5 yrs		108,000
		Subtotal		108,000

*Travel - In-Country

a. Field Tests — 64.2
1 man trip, bi-weekly visits average 2 da @ $40/da
3.5 yrs, 6 sites (3 by plane)

b. Supporting Analyses

1. Applications Study 3 m/1 mo ea/6 sites (3 by plane) @ $40/da — 22.3

2. Design Specs, - 3 m/6 sites (3 by plane) 3 wks ea @ $40/da — 15.8

3. Equipment Design - 2 m/6 sites (3 by plane) 1 wk ea @ $40/da — 3.8

c. New Initiatives - 1 m/trip, bi-wkly visits - 3 sites - 78 trips; average 2da/3yrs @ $40/da, assuming 1 site requiring plane travel — 24.6

Subtotal — 131**

Vehicles O&M Costs — Subtotal — 5

Total — 840

*Assumes- 6 sites to travel;(as 5 Process Heat sites in Cairo vicinity and no travel funds necessary); assumes flight costs average $75/ea .

**Rounded.

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PROJECTED DISBURSEMENTS
($000's)

PROJECT MANAGEMENT	FY 82			FY 83			FY 84			FY 85			FY 86			Total
AID	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	
Salaries	400	-	400	450	-	450	350	-	350	200	-	200	200	-	200	1600
Travel & Per Diem	-	102	102	-	68.85	68.85	-	71.9	71.9	-	48	48	-	48	48	340*
Differential	7.5	-	7.5	7.5	-	7.5	7.5	-	7.5	7.5	-	7.5	7.5	-	7.5	37.5
Housing	-	14.4	14.4	-	14.4	14.4	-	14.4	14.4	-	14.4	14.4	-	14.4	14.4	72
Relocation Travel	-	6	6	-	-	-	-	6	6	-	-	-	-	-	-	12
Temporary Lodging	-	3.6	3.6	-	-	-	-	3.6	3.6	-	-	-	-	-	-	7.2
R & R Travel	-	-	-	-	.8	.8	-	-	-	-	.8	.8	-	-	-	1.6
Storage	6	-	6	6	-	6	6	-	6	6	-	6	6	-	6	30
Freight	12.5	-	12.5	-	12.5	12.5	12.5	-	12.5	-	-	-	-	12.5	12.5	50
Education Allow.	-	8.8	8.8	-	8.8	8.8	-	8.8	8.8	-	8.8	8.8	-	8.8	8.8	44
Car, O&M, Ins, etc	9	4	13	-	4	4	-	4	4	-	4	4	-	4	4	29
Secretary	-	4	4	-	4	4	-	4	4	-	4	4	-	4	4	20
Equipment, Supplies	-	6	6	-	6	6	-	6	6	-	6	6	-	6	6	30
Project Vehicles	42	-	42	-	-	-	-	-	-	-	-	-	-	-	-	42
Transient Qtrs-Fayoum	-	8	8	-	42	42	-	-	-	-	-	-	-	-	-	50
Travel-P.D., GOE, Managemt Reviews	13.5	31.5	45	2.75	6	8.75	-	-	-	-	-	-	-	-	-	53.75
	490.5	188.3	679*	466.25	167.35	633.6*	376	118.7	495*	213.5	86	300*	213.5	97.7	311*	2419*

*Rounded

PROJECTED DISBURSEMENTS
($000's)

PROJECT MANAGEMENT	FY 82			FY 83			FY 84			FY 85			FY 86			Total
GOE	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	FX	LC	T	
Salaries	-	108	108	-	116	116	-	124	124	-	124	124	-	124	124	596
Facility, Supplies, Communications, etc	-	21.6	21.6	-	21.6	21.6	-	21.6	21.6	-	21.6	21.6	-	21.6	21.6	108
Travel																
Field Tests	-	-	-	-	18.3	18.3	-	18.3	18.3	-	18.3	18.3	-	9.2	9.2	64.1*
Supporting Analyses	-	27.4	27.4	-	7.5	7.5	-	2.8	2.8	-	2.8	2.8	-	1.6	1.6	42.1*
New Initiatives	-	-	-	-	-	-	-	8.2	8.2	-	8.2	8.2	-	8.2	8.2	24.6*
Transportation-O&M	-	1	1	-	1	1	-	1	1	-	1	1	-	1	1 -	5
Subtotal	-	158	158	-	164.4	164.4*	-	175.9	176*	-	175.9	176*	-	165.6	166*	840*
Total	490.5	346.3	837*	466.75	331.75	798	376	294.6	671*	213.5	261.9	476	213.5	263	477	3259

*Rounded

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Annex F

[illegible] 7/71 14-1219
[illegible]
[illegible] 291117Z MAY 81
FM SECSTATE WASHDC
TO AMEMBASSY CAIRO [illegible]
BT
UNCLAS STATE 139667

29 MAY 81
TOR: 1267
CN: [illegible]
CHRGE: AID
ACTION AIDS
INFO AMB DCM EC ICA SCI CHRN12JP

AIDAC

E.O. 12065: N/A

TAGS:

SUBJECT: PID FOR EGYPT ENERGY POLICY, UTILITY MANAGEMENT AND RENEWABLES DEMONSTRATION (0123) NEAC.

1. THE NEAC REVIEWED AND APPROVED ENERGY POLICY AND RENEWABLES DEMONSTRATION SUB-PROJECTS OF SUBJECT PID ON 7 MAY 1981. THE FOLLOWING ARE THE NEAC'S SUGGESTIONS FOR PP PREPARATION.

2. THE PID INDICATES A ROLE FOR DOE AND POSSIBLY NASA/LRC IN THE PROJECT IMPLEMENTATION. NEAC SUGGESTS THAT THE MISSION CONSIDER AID'S POLICY OF GIVING PREFERENCE TO PRIVATE SECTOR CONTRACTS, SET FORTH IN AID HANDBOOK 12, CHAPTERS 1-A5 AND 1-F. IF A USG AGENCY IS NEVERTHELESS CONSIDERED REQUIRED THE PP SHOULD MAKE SPECIFIC RECOMMENDATION REGARDING THE ROLE OF THAT AGENCY, STATING EXPLICIT REASONS FOR ITS INVOLVEMENT CONSISTENT WITH HANDBOOK 12.

3. THE NEAC WAS CONCERNED THAT SOME OF PROPOSED PRE-PROJECT ACTIVITIES ARE LOGICALLY PART OF A PHASE 1 OF THE PROJECT. A PREMATURE BEGINNING MAY INHIBIT COMPETITION FOR FOLLOW ON CONTRACTS (OTHER THAN DOE) FOR THE PLANNING SUB-PROJECT. ALSO, THE FREEDOM FOR CONCEPTUALIZATION BY THE FUTURE CONTRACTOR MAY BE IMPARED BY PRE-PROJECT DECISIONS.

NEAC QUESTIONS THE URGENCY OF SOME OF THE PRE-PROJECT ACTIVITIES SINCE THESE ACTIVITIES WILL NOT BE COMPLETED IN THE NEAR FUTURE AND, THEREFORE, HAVE LITTLE IMMEDIATE IMPACT ON EGYPTIAN PLANNING CAPABILITIES. GIVEN THESE CONCERNS THE NEAC SUGGESTS THE MISSION CAREFULLY RECONSIDER THE NECESSITY OF THE VARIOUS PRE-PROJECT ACTIVITIES (PAGE 19 OF PID).

4. MOST OF THE INITIAL DATA COLLECTION ACTIVITIES, IDENTIFICATION OF APPROACHES FOR DATA COLLECTION AND EVALUATION, AND IDENTIFICATION OF MANAGEMENT OPTIONS APPEAR TO BE ACTIVITIES WHICH COULD WAIT UNTIL STARTED BY THE PROJECT CONTRACTOR. THE PP DEVELOPMENT TEAM WILL HAVE TO DETERMINE ONLY THE MAGNITUDE OF THE DATA PROBLEMS. TASK 1 AND 2, IDENTIFICATION OF ANALYTICAL FUNCTIONS AND THE SELECTION OF APPROPRIATE ANALYTIC METHODOLOGIES ARE A FOLLOW-ON TO THE 1978 ASSESSMENT AND IN ALL PROBABILITY COULD BE STARTED NOW BY DOE/ANL WITHOUT AFFECTING ON FUTURE CONTRACT

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ARRANGEMENTS. THE OTHER ACTIVITIES, EXCLUDING TASK 8, PROVIDE MATERIALS FOR THE PP. TASK 8, SPECIALIZED CONSULTATIVE SERVICES, SHOULD BE DEFINED DURING THE PERIOD OF THE PP DEVELOPMENT BASED ON THE ACTIVITY URGENCY AND PRIORITY. THESE COULD BE IMPLEMENTED BY DOE OR OTHER ORGANIZATIONS BEFORE THE PROJECT IMPLEMENTATION IS STARTED. NEAC IS SUPPORTIVE OF THE SUGGESTED NEAC APPROACH TO THE "PRE-PROJECT" ACTIVITIES.

5. THREE OTHER ISSUES TO BE CONSIDERED IN THE ENERGY POLICY AND PLANNING SUB-PROJECT ARE: (A) THE IMPLICATION ON MISSION STAFFING FOR BACKSTOPPING THE NUMEROUS SHORT-TERM U.S. PERSONNEL. GIVEN PRESENT STAFF, WE BELIEVE MISSION SHOULD CONSIDER THE POSSIBILITY OF A FIELD COORDINATOR; (B) THE NEAC SUGGESTS THAT THE ENERGY POLICY AND PLANNING SUB-PROJECT INCLUDE PROVISIONS FOR THE INSTITUTIONAL DEVELOPMENT WITHIN THE COOPERATING GOE ORGANIZATION FOR PROGRAMATIC ANALYSIS OF ENVIRONMENTAL AND SOCIOLOGICAL IMPACTS OF ENERGY SECTOR DEVELOPMENTS AND FACILITY SITE SELECTION CRITERIA AND REVIEW PROCEDURES; (C) GOE STAFFING IMPLICATIONS FOR THE PLANNING SUB-PROJECT IS ALSO A NEAC CONCERN. PRESENTLY, THE SUPREME COUNCIL ON ENERGY IS STAFFED WITH PART-TIME PERSONNEL. THE IMPLICATIONS FROM THE PID ARE THAT A COMMITMENT MUST BE MADE FOR FULL-TIME STAFFING OF APPROPRIATE PERSONNEL. THE ADMINISTRATIVE ANALYSIS IN THE PP SHOULD CAREFULLY DESCRIBE GOE COUNTERPART REQUIREMENTS AND THEIR INSTITUTIONAL INVOLVEMENT. WILL THE GOE BE CAPABLE AND WILLING TO PROVIDE THE REQUIRED STAFF? THE MISSION SHOULD CONSIDER SATISFACTORILY GOE STAFFING LEVEL AS A CONDITIONS PRECEDENT TO DISBURSEMENT IN THE PRO AG.

6. IN DESIGN OF THE RENEWABLES SUB-PROJECT, THE NEAC WAS CONCERNED ABOUT THE NUMBER OF DEMONSTRATION SITES, WHICH SEEMS EXCESSIVE FOR DEMONSTRATION PURPOSES AND EASE OF MANAGEMENT. REQUEST MISSION RE-EXAMINE NUMBER OF SITES SELECTED AND CONSIDER REDUCING THIS NUMBER TO DELETE DUPLICATIVE DEMONSTRATION. THIS DOES NOT IMPLY HAVING ONLY ONE DEMONSTRATION OF EACH TECHNOLOGY BUT EACH SITE DEMONSTRATION SHOULD BE BASED ON SOME UNIQUE ELEMENT OF TECHNOLOGY APPLICATION. THE NUMBER OF SITES SHOULD NOT EXCEED THAT NECESSARY FOR DECISIONS REGARDING REPLICABILITY.

7. THE NEAC QUESTIONED APPROPRIATENESS OF THE ECONOMIC CRITERIA LISTED ON PAGE 42 OF THE PID. IT IS UNCLEAR WHY ANY SINGLE-POINT PROJECTED REAL PRICE OF OIL NEEDS TO BE SPECIFIED, GIVEN THE VARIABILITY OF PRICES. HOW WAS THE DOLS. 25.00 PER BARREL PRICE FOR FUEL OIL IN 1985 SELECTED? WITH REGARD TO ITEM 2, WHAT IS THE SPECIAL MERIT OF RENEWABLES THAT NECESSITATES A SPECIAL DISCOUNT RATE AND WHY.

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SHOULD RENEWABLES RECEIVE A SPECIAL SUBSIDY IN THE COMPARATIVE ECONOMIC ANALYSES? THE NEAC RECOMMENDED DELETING THE SPECIAL DISCOUNT RATE. FURTHER, CAN CRITERIA THREE BE REASONABLY JUSTIFIED? FINALLY, THERE IS NO OBJECTION TO CRITERIA FOUR, BUT IF IT IS EXCLUDED, THESE COSTS ARE ASSUMED TO BE RELATIVELY MINOR IN ECONOMIC ANALYSES. THE NEAC RECOMMENDS: (A) THAT PRICE OF FUEL OIL AND PROJECT IMPACTS BE THE SUBJECT OF A SENSITIVITY ANALYSIS IN THE PP; (B) THAT THE DISCOUNT RATE BE THE TRADITIONAL ONE USED IN EGYPTIAN PROJECT ANALYSIS BY USAID/CAIRO, (12 PERCENT); AND (C) THAT THE PP BE EXTREMELY CAREFUL IN PROJECTING COST REDUCTIONS RELATED TO TECHNOLOGICAL DEVELOPMENTS. IN ADDITION, MANY OF THE ILLUSTRATIVE FIELD TESTS PROPOSED ARE IN PRODUCTION ORIENTED AREAS, AND THE NEAC AGREES WITH THIS DESIGN RAIONALIZATION.

9. THE NEAC AND DS/RD NOTED THAT RENEWABLES TECHNOLOGY SELECTION SHOULD FOCUS ON TECHNOLOGIES WITH LOW MAINTENANCE AND PROVEN RELIABILITY. FOR THESE REASONS NEAC DOES NOT RECOMMEND DEMONSTRATIONS WITH SOLAR THERMAL PUMPING. THIS TECHNOLOGY HAS A HISTORY OF HIGH FAILURE RATE AND COSTLY MAINTENANCE. LARGE SOLAR DISTILLATION SYSTEMS ALSO HAVE HAD LIMITED RESULTS, HOWEVER THIS TECHNOLOGY HAS SEEN RAPID DEVELOPMENT OVER THE LAST FEW YEARS AND SHOULD BE CONSIDERED WITH CAUTION. THE OTHER RENEWABLE ENERGY DEMONSTRATIONS ARE SIMPLE, STRAIGHT FORWARD, AND PROVEN

TECHNOLOGY APPLICATIONS WHICH SHOULD PROVIDE RELIABLE DEMONSTRATIONS FOR EGYPTIAN ADAPTATION. GIVEN THE PRESENT COST OF PV SYSTEMS, THE NEAC ALSO QUESTIONED THE NUMBER AND SIZE OF THE PHOTOVOLTAIC (PV) APPLICATIONS. FOR EXAMPLE, WITH REGARD TO WATER LIFTING, THE MISSION SHOULD CONSIDER PV PUMPING SYSTEMS FOR LOWER HEAD AND SMALLER VOLUME. THESE SYSTEMS WOULD DEMONSTRATE THE TECHNOLOGY APPLICATION AS WELL AS THE MUCH LARGER AND EXPENSIVE SYSTEM. HAIG
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ANNEX G

LOGICAL FRAMEWORK

ANNEX G

PROJECT DESIGN SUMMARY

LOGICAL FRAMEWORK

Life of Project:

From FY 82 to FY 85

Total U.S. Funding 24.1 Million

Date Prepared: 1 March 1982

Project Title & Number Renewable Energy Field Testing Sub-Project 263-0123

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: Effective development and utilization of indigenous and imported energy resources in a manner consistent with and in support of overall national economic and social development plans.	Measures of Goal Achievement: GOE policies evolve to reflect better economic realities of energy pricing and give more realistic investment decision-making signals.	. Relevant sector and/or subsector analyses from Egyptian (e.g. SCE) or foreign (e.g. IBRD) sources; . Review of Sector data from GOE agencies and; . Integration of renewable energy resources into sector where proven appropriate	Assumptions for achieving goal targets: 1. Energy Resource issues retain dominance in national economy with oil exports a key factor. 2. Policy commitment to development of renewable energy resources continues. 3. All GOE agencies willing to collaborate to reach this goal.
Project Purpose: Collect data and conduct field tests on selected renewable energy technologies which will permit a judgement as to the technical economic and social feasibility of their widespread replication in a five - ten year timeframe.	Conditions that will indicate purpose has been achieved: End of project status. 1. Body of data has been collected, analyzed and disseminated to those responsible for making decisions concerning the role of renewables in Egyptian environment. 2. Information system in place which will provide for collection of data on Egyptian and other renewables projects and state of the art developments on a continuing basis.	Performance data from field tests. Economic, technical and social reports from information system established under Supporting Analyses Section of project. AID independent evaluation studies Sector data from GOE agencies	Assumptions for achieving purpose: 1. Shown economically, technically and socially feasible, decision makers will determine to invest in system replication. 2. Results of field tests are effectively disseminated throughout the industrial and service sectors. 3. Individuals and organizations in the community willing and able to support field gests and the dissemination and utilization of the results. 4. Companies/users willing and able to pay for the energy system.
Outputs: 1. Data collected and analyzed on selected field tests of renewable energy applications. 2. Egyptians trained and information system in place allowing for dissemination of information and judgement on feasibility of system replication. 3. Technical, economic and social analyses on current applications and new initiatives as means to evaluate information for future energy planning in renewables	Magnitude of Outputs: 1. Field tests....11 2. Training of at least 16 GOE Site Managers, approximately 40-100 policy/decision makers, and approx. 40-100 engineers and technical spec 3. Information system in place to provide technical, economic and social analyses on applications and technology state of the art. 4. New initiatives studies....6 and 1-2 implemented.	. Reports and Reviews . Site visits . Progress Assessments . Interim and Final Project Evaluations . Contractor, GOE and AID records	Assumptions for achieving outputs: 1. Suitable applications and sites were chosen 2. Field test participants/users will be cooperative and motivated toward project goals for life of Project 3. Analyses and field tests have potential to show technical, social and economic feasibility of systems
Inputs: 1. Field tests 2. Supporting Analyses 3. Training 4. New Initiatives 5. Project Management 6. Other	Implementation Target (Type and Quantity) Estimated Level of Effort for each Input ($000)	. Vouchers . Letters of commitment . Management Reports . Cost Proposals and Financial Reports from Contractors . Discussions with participating agencies	Assumptions for providing inputs: 1. A suitable American institution or firm is available to provide for implementation of the project within time and budgetary constraints 2. GOE provides adequate personnel, material and administrative support to the project

Input	AID	GOE	TOTAL
Field Tests	11052	1418	12470
Supp. Anal.	1895	205	2100
Training	835	75	910
New Init.	2000	550	2550
Proj. Mgmt.	2419	840	3259
Other	5917	1273	7190
Total	24118	4361	28479

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ANNEX H

QATTARA HYDRO AND RENEWABLE
ENERGY PROJECTS AUTHORITY
18 Hoda Shaarawy St.
Bab El-Look - CAIRO

وزارة الكهرباء
هيئة مشروعات القطارة والطاقة
المائية والمتجددة
١٨ شارع هدى شعراوى
باب اللوق - القاهرة

Mr. Donald S. Brown
Director, Agency of International Development,
U.S. Embassy Cairo,
Latin America Str.,

Dear Mr. Brown

As you know, over the last two years we have been working together on a renewable energy project. It is my understanding that we are now in the final stages of the AID project development process. The Government of Egypt intends to contribute the Egyptian Pound equivalent of $4.4 million to the $28.5 million project over the next five years.

In this regard, I would much like to reiterate our desire for the involvement of NASA Lewis Research Center as the U.S. project management entity. Having worked with NASA for over a year on this project, we believe they could provide both excellent technical expertise and project management skills which are to be transferred to those working on this project.

This area of renewable energy is one in which the Government of Egypt places great importance. We look forward to cooperating with USAID and NASA on this project in the very near future.

Sincerely,

Eng. I. El Sioufy
Chairman 7. 3. 82

Phone : 740405 - Telex : 92694 QTARA UN
P. O. Box 146 - Cairo

ت : ٧٤٠٤٠٥ - ص.ب ١٤٦ القاهرة

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ANNEX I

PROJECT AUTHORIZATON

Name of Country: Arab Republic of Egypt

Name of Project: Energy Policy and Planning

Number of Project: 263-0123

1. Pursuant to Section 531 of the Foreign Assistance Act of 1961, as amended (the "Act"), I hereby authorize the Energy Policy and Planning Project (the "Project") for the Arab Republic of Egypt ("Cooperating Country") involving planned obligations not to exceed Eight Million Five Hundred Thousand United States Dollars ($8,500,000) in grant funds over a four-year period from the date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB/allotment process, to help in financing the foreign exchange and local currency costs of goods and services required for the Project.

2. The Project will assist the Grantee to strengthen its energy planning and analytical capability by establishing an institutional capacity to perform integrated energy and economic analysis and to undertake national and sectoral energy and economic planning.

3. The Project Agreement, which may be negotiated and executed by the officer to whom such authority is delegated in accordance with A.I.D. regulations and delegations of authority, shall be subject to the following essential terms and covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

a. Source and Origin of Goods and Services

Goods and services, except for ocean shipping, financed by A.I.D. under the Project shall have their source and origin in the Cooperating Country or in the United States, except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the Project shall, except A.I.D. may otherwise agree in writing, be financed on flag vessels of the United States.

b. Conditions Precedent to Disbursement

(1) First Disbursement

Prior to any disbursement or to the issuance of any commitment documents under the Grant, the Cooperating Country shall, except as the parties may otherwise agree in writing, furnish to A.I.D. in form and substance satisfactory to A.I.D.:

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(a) A statement of the names and titles, of the persons who will act as the representatives of the Cooperating Country, together with a specimen signature of each person specified in such statement;

(b) Such other information and documentation as A.I.D. may reasonably request.

(2) Additional Disbursement

Prior to any disbursement or to the issuance of any commitment documents under the Grant for the long-term technical assistance contractor, the Cooperating Country shall, except as the parties may otherwise agree in writing, furnish to A.I.D. in form and substance satisfactory to A.I.D., evidence that OEPA has operating procedures, office space, training facilities and computer facilities necessary for project implementation.

c. Covenants

(1) The Cooperating Country shall establish the organizational and communication links necessary to coordinate Project activities and to exchange information among the OEPA and the concerned ministries.

(2) The Cooperating Country shall take appropriate action to establish and fund a mechanism by which OEPA may procure consulting services for each year of Project activities following July 1982.

4. Based upon the justification set forth in the Project Paper, I hereby determine, in accordance with Section 612(b) of the Act, that the expenditure of United States Dollars for the procurement of goods and services in Egypt is required to fulfill the purposes of this Project; the purposes of this Project cannot be met effectively through the expenditure of U.S.-owned local currencies for such procurement; and the administrative official approving local cost vouchers may use this determination as the basis for the certification required by Section 612(b) of the Act.

Acting

M. Peter McPherson
Administrator

May 13, 1982
Date

Clearances:

AA/NE:WAFord BL Date 4/20
PPC:JRBolton Date
for GC:KCKammerer Date 4/22/82

ACTION MEMORANDUM FOR THE ADMINISTRATOR

20 APR 1982

THRU : ES

THRU : AA/PPC, John Bolton John R Bolton

FROM : AA/NE, W. Antoinette Ford

SUBJECT: Authorization of Project: Energy Policy Planning (263-0123) for Egypt

Problem: Your authorization is requested for the subject project in the Life-of-Project amount of $8.5 million.

Discussion: Having almost a half billion dollars of USAID funds invested in the electric power sector, the Mission collaborates very closely with the GOE agencies involved in all aspects of the Egyptian energy situation, ranging from policy planning and technical training to power generation and distribution. The Mission's work in the sector, as well as the 1978 U.S. Department of Energy-sponsored Joint Egypt-U.S. Cooperative Energy Assessment have provided us with a large amount of information on Egypt's energy resources as well as on the government's ability to put these resources to use.

This project is part of an overall project concept entitled Energy Policy, Renewables Demonstration, Utility Management. The overall project, when finally authorized, will contain three related activities, each of which is fully separable which are considered critical to the efficient utilization of Egypt's energy resources. The first, and the one for which authorization is now being sought, is development of an institutional capability in energy policy planning to serve the GOE Supreme Council for Energy (SCE). The second is the demonstration of renewable energy technologies in order to prepare Egyptian policy makers, planners and the private sector for the time when energy prices make renewables economic. The third is upgrading the management of the utility agencies to promote both efficiency and decentralization of the energy sector. These activities are:

- Energy Policy Planning -

  Strengthening Egypt's overall national energy, economic and technical planning, as well as management capability, will enable the GOE to analyze various energy supply options, develop a sound program to identify energy demand and the capability to implement it in a more efficient manner. Basic to the project is the reinforcement of the Egyptian Office for Energy Planning and Analysis (OEPA), the staff arm of the Supreme Council for Energy, and of other Egyptian energy related agencies. This will be accomplished through technical assistance, on-the-job and selected long-term training and provision for appropriate hardware. The intent is to upgrade Egyptian capabilities in energy economics, analysis, technology and conservation, and in information systems management and systems analysis.

Renewables Demonstration -

It is expected that the energy analyses will also result in a better understanding of the technical/economic characteristics of renewable energy resource systems. Renewables are not economically attractive at the present to the end-user in Egypt because of heavy subsidies on fossil fuel based energy. It is felt, however, that Egypt is showing signs regarding movement in the direction of adjusting selected energy prices upward. In the meanwhile, field testing of proven renewable technologies is timely in order to evaluate their appropriateness from a technical, cultural and economic (based on world energy prices) point of view. Then, as Egypt moves toward realistic energy prices, the GOE can move confidently in the renewables area.

- Utility Management -

In order to respond to the GOE request for assistance in the utility management area, it is initially necessary to define the management issues to be addressed. A joint detailed review and assessment of the current and planned management development program efforts of both the Egyptian Electrification Authority (EEA) and the Rural Electrification Authority (REA), will be undertaken. Recommendations will then be translated into an appropriate subproject.

The overall project concept developed from the interest of the GOE based on the 1978 National Energy Assessment. The request came from the Minister of Energy, who is Deputy Chairman of the Supreme Council for Energy (SCE). The Supreme Council for Energy was established by Decree as a partial result of the Assessment. The Project Identification Document (PID) for Energy Planning and Renewables Demonstration was approved by the Near East Advisory Committee (NEAC) in May, 1981. The Project Paper (PP) for Energy Planning was approved by the NEAC in December, 1981 ($2.5 million FY 1982, $6.0 million FY 1983) (see attachment). This forms the basis for the requested Project Authorization.

A separate Project Paper has been submitted, but not yet approved, for Renewables Demonstration ($4.0 million FY 1982, $20.1 million FY 1983). Documentation for Utility Management sub-project will be prepared during FY 1983 and is projected at $15.4 million.

The initial, FY 1982, obligation for the $8.5 million Energy Planning Project will be $2.5 million. Because the total aggregation of related projects, when finally authorized, will exceed $20 million, we are requesting your authorization of this initial, separable project activity. As the related, but separable, sub project activities are developed by USAID and approved by NEAC as Project Paper amendments, we will be submitting each to you for your authorization. The total estimated cost of all of the sub-projects is $48 million.

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UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON D.C. 20523

FIRST AMENDMENT

TO

PROJECT AUTHORIZATION

Name of Country: Arab Republic of Egypt

Name of Project: Energy Policy and Renewable Energy Field Testing

Number of Project: 263-0123

1. Pursuant to Section 531 of the Foreign Assistance Act of 1961, as amended, the Energy Policy and Planning Project ("Project") for the Arab Republic of Egypt ("Cooperating Country") was authorized on May 13, 1982. That authorization is hereby amended as follows:

a. The Project is hereby renamed "Energy Policy and Renewable Energy Field Testing."

b. Paragraph 1 is revised to read as follows:

"1. Pursuant to Section 531 of the Foreign Assistance Act of 1961, as amended (the "Act"), I hereby authorize the Energy Policy and Renewable Energy Field Testing Project (the "Project") for the Arab Republic of Egypt ("Cooperating Country") involving planned obligations not to exceed Thirty-two Million Six Hundred Thousand United States dollars ($32,600,000) in grant funds over a five-year period from the date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB/allotment process, to help in financing the foreign exchange and local currency costs of goods and services required for the Project."

c. Paragraph 2 is revised to read as follows:

"2. The Project will assist the Grantee to strengthen its energy planning and analytic capacity by establishing an institutional capacity to perform integrated energy and economic analysis and to undertake national and sectoral energy and economic planning and to establish the technical, economic and cultural feasibility of utilizing renewable energy technologies in Egypt."

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2. The Project Grant Agreement Amendment, which may be negotiated and executed by the officer to whom such authority is delegated in accordance with A.I.D. regulations and delegations of authority, shall be subject to the following essential terms and covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

a. Source and Origin of Goods and Services

Goods and services, except for ocean shipping, financed by A.I.D. under the Project shall have their source and origin in the Cooperating Country or in the United States, except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the Project shall, except as A.I.D. may otherwise agree in writing be financed on flag vessels of the United States.

3. Based upon the justification set forth in the Project Paper, I hereby determine, in accordance with Section 612(b) of the Act, that the expenditure of United States dollars for the procurement of goods and services in Egypt is required to fulfill the purposes of this Project; the purposes of this Project cannot be met effectively through the expenditure of U.S.-owned local currencies for such procurement; and the administrative official approving local cost vouchers may use this determination as the basis for the certification required by Section 612(b) of the Act.

4. The authorization cited above remains in force except as hereby amended.

M. Peter McPherson

JUL 29 1982
Date

Clearances:

AA/NE:WAFord _____ Date 21 JUL 1982
GC:CLvanOrman _____ Date _____
AA/PPC:JRBolton _____ Date _____

See attached memo.
JRB

21 JUL 1982

ACTION MEMORANDUM FOR THE ADMINISTRATOR

THRU : ES

THRU : AA/PPC, John Bolton

FROM : AA/NE, W. Antoinette Ford

SUBJECT: Egypt - Energy Policy Planning and Renewable Energy Field Testing (263-0123) - Amendment to Project Authorization

Problem: Your authorization is requested (attachment # 1) for amendment of the Energy Policy Planning Project (263-0123) for Egypt to include Renewable Energy Field Testing in the additional Life-of-Project amount of $24.1 million.

Discussion: The first sub-project, Energy Policy Planning (263-0123.1) was authorized on May 13, 1982. The accompanying Action Memorandum (attachment #2) described the three activities which make up the overall project concept. The description remains valid for the Renewable Energy Field Testing (Renewables Demonstration) sub-project which is the subject of this requested amendment.

A separate sub-Project Paper has now been reviewed and approved for the Renewables Demonstration activity, now titled Renewable Energy Field Testing (attachment #3). This is for the amount of $4.0 million in FY 1982, and $20.1 million in FY 1983. When added to the $8.5 million for Energy Policy Planning, already authorized, this brings the project total to $32.6 million. Still remaining to be presented, in FY 1983, is the sub-project activity for Utility Management, planned in the amount of $15.4 million. The total estimated cost of the three sub-project activities remains at $48.0 million.

The Renewable Energy Field Test sub-Project Paper was approved by the Near East Bureau on May 20, 1982. At that time the Near East Advisory Committee requested responses from the Mission on four issues. Briefly, they were: (1) that the selection of National Aeronautics and Space Administration, Lewis Research Center (NASA/Lewis) as the project management entity be fully justified, (2) that plans be clarified for the institutional development of the Government of Egypt (GOE) implementing agency, the Qattara Hydro and Renewable Energy Authority (QHREA), (3) that the project should include further provision for development of the information system integral to the project and (4) that the Mission discuss the relationship of this project to the AID/GOE energy sector policy dialogue and address feasibility of alternatives to government leadership in the area of renewable energy resources (attachment #4).

USAID/Cairo has replied (attachment #5 a, b) to the issues above to the satisfaction of the Near East Bureau. The Mission indicated that (1) use of NASA/Lewis has met the standards of OMB Circular A-76 and Section 621(a) of the F.A.A., in that NASA/Lewis is particularly suited to the functions of the management entity and is not in competition with the private sector in that

regard. Some of the functions that NASA/Lewis would perform are "governmental functions" concerning program oversight that AID would otherwise perform in-house, and under OMB A-76 is not permitted to delegate to a non-U.S. government entity. While much of the management contract does not include these functions, they are inextricably intertwined with the other management tasks, and cannot be separated into several separate management contracts without losing the benefit of one overall project manager. The Mission has elaborated upon this and other points in support of NASA/Lewis in attachment 5a. NASA/Lewis is already successfully performing a function similar to the one proposed herein in Tunisia for a smaller scale renewable energy project. The decision on the use of NASA/Lewis has not yet been made and is not required for project authorization. Of the $20.0 million planned for the PASA, 92% or $18.4 million will be used for sub-contracts with U.S. private sector firms.

The Mission has also indicated that (2) the QHREA analysis and plans will be complete before the grant agreement is signed, or included as a Condition Precedent prior to first disbursement; (3) the project information system will be designed and in place during the first project year; and (4) the Mission has had lengthy discussions with the GOE on energy pricing, the GOE understands our position and some adjustments have been made in electricity rates and others are in the offing. The energy pricing situation is also elaborated further in attachment #5 b. Further to item (4) above, the Near East Bureau recommended as part of our comprehensive energy policy for Egypt that we proceed to develop and implement this project. You agreed with our recommendation during March 5 meeting on energy policy.

An Advice of Program Change for the total project was sent to the Congress on March 11, 1982 and the 15 day waiting period expired without objection on March 26, 1982.

There are no current human rights issues under section 502 b of the F.A.A. which would preclude provision of this assistance to Egypt.

Recommendation: That you indicate your approval of this sub-project by signing the attached Project Authorization.

Attachments:

1. Project Authorization (263-0123.2)
2. Action Memo to the Administrator dated April 20, 1982
3. Project Paper (253-0123.3)
4. NEAC cable State 151267
5. Mission reply to NEAC cable, Cairo (a) 14823, (b) 14212

Clearances:

GC, C. Van Orman _____ Date _____
PPC/PDPR, J. Eriksson _____ Date 7-27-82
NE/TECH/HRST, B. Heyman (draft) Date 6/18/82
NE/TECH, K. Sherper _____ Date 7/15/82
NE/E, G. Gower _____ Date 7/15/82
GC/NE, G. Davidson _____ Date _____
NE/PD, S. Taubenblatt (draft) Date 6/28/82
NE/DP, C. Johnson _____ Date 7/15/82
DAA/NE, B. Langmaid _____ Date _____

SECOND AMENDMENT

TO

PROJECT AUTHORIZATION

Name of Country: Arab Republic of Egypt

Name of Project: Energy Policy and Renewable Energy Field Testing

Number of Project: 263-0123

1. Pursuant to Section 531 of the Foreign Assistance Act of 1961, as amended, the Energy Policy and Renewable Energy Field Testing Project (the "Project") for the Arab Republic of Egypt ("Cooperating Country") was authorized on May 13, 1982, and that authorization was amended on July 29, 1982. That authorization is hereby further amended as follows:

a. Paragraph 2 of the First Amendment to Project Authorization is deleted and replaced with the following:

The Project Grant Agreement, or the Project Grant Agreement Amendment, as the case may be, covering the grant funds and activities added by this First Amendment to Project Authorization, which may be negotiated and executed by the officer to whom such authority is delegated in accordance with A.I.D. regulations and delegations of authority, shall be subject to the following essential terms and covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

(1) Source and Origin of Goods and Services

Goods and services, except for ocean shipping, financed by A.I.D. under the Project shall have their source and origin in the Cooperating Country or in the United States, except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the Project shall, except as A.I.D. may otherwise agree in writing be financed on flag vessels of the United States.

2. The authorization cited above remains in force except as hereby amended.

W. Antoinette Ford
Assistant Administrator
Bureau for Near East

10 AUG 1982
Date

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Clearances:
DAA/NE:BLangmaid _____ Date _____
NE/DP:CJohnson _____ Date 8/4/82
NE/TECH:KSherper _____ Date 8/6/82
NE/TECH/HRST:BHeyman _____ Date 8/5/82
NE/PD:STaubenblatt _____ Date 8/6/82
NE/E:GGower _____ Date 8/6/82
GC/NE:GDavidson _____ Date _____

Drafted by:GC/NE:MAKlenjan:paj:8/4/82

AUG - 6 1982

ACTION MEMORANDUM FOR THE ASSISTANT ADMINISTRATOR, BUREAU FOR NEAR EAST

FROM: NE/TECH, Kenneth Sherper BV for

SUBJECT: Egypt - Energy Policy Planning and Renewable Energy Field Testing Project (263-0123)-Amendment to Project Authorization

Problem: Your approval is required to amend the Project Authorization for the above project to permit the funds and activities authorized for the Renewable Energy Field Testing Component to be obligated by a separate grant from the funds and activities authorized for the Energy Policy Planning component.

Discussion: The Project was originally authorized in the amount of $8.5 million, on May 13, 1982, as the Energy Policy and Planning Project. A Renewable Energy Field Testing component, in the additional amount of $24.1 million, was authorized by the AID Administrator on July 29, 1982, by the First Amendment to the Project Authorization. That First Amendment authorized obligation of the Renewable Energy Field Testing funds by an amendment to the original grant. Subsequently, the Mission has stated that it wishes the flexibility to obligate the Renewable Energy Field Testing component by means of a separate grant agreement. Each component will have a different implementing agency, and the responsibilities of each agency will be more clearly delineated if there are separate grants. The existence of separate grant agreements means that project funds will be available only for the purposes of the applicable grant agreement. However, we have suggested to the Mission that it draft the purposes of each separate agreement broadly, to encompass the purpose of the entire project, so as to retain maximum availability of all funds for the total project.

You have authority to approve this amendment to the authorization under Delegation of Authority 133, Section 4(2), even though the total amount of the project now authorized is $32.6 million, since this amendment does not add funds, does not involve a significant policy issue, and does not involve a waiver that only the Administrator may approve.

Recommendation: That you approve the attached Second Amendment to Project Authorization for the Energy Policy Planning and Renewable Energy Field Testing Project, permitting the funds and activities authorized for the Renewable Energy component to be obligated by a separate grant agreement.

Attachments:
1. Second Amendment to Project Authorization
2. First Amendment to Project Authorization
3. Project Authorization
4. Cairo 18719

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An Advice of Program Change for the total project was sent to the Congress on March 11, 1982, and the 15 day waiting period expired without objection on March 26, 1982.

There are no current human rights issues under Section 502b of the F.A.A. which would preclude provision of this assistance to Egypt.

Recommendation: That you indicate your approval of this Project Paper by signing the attached Project Authorization.

Attachments: Project Authorization
Project Paper

Clearance:

GC: Kelly Kammerer _____ Date 4/22/82

PPC/PDPR:JEriksson _____ Date _____

5C(2) - PROJECT CHECKLIST

Listed below are statutory criteria applicable generally to projects with FAA funds and project criteria applicable to individual funding sources: Development Assistance (with a subcategory for criteria applicable only to loans); and Economic Support Fund.

CROSS REFERENCES:	IS COUNTRY CHECKLIST UP TO DATE?	Yes
	HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT?	Yes

A. GENERAL CRITERIA FOR PROJECT

1. Continuing Resolution Unnumbered; FAA Sec. 634A; Sec. 653(b).

(a) Describe how authorizing and appropriations Committees of Senate and House have been or will be notified concerning the project;	Congress shall be notified in accordance with regular agency procedures.
(b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than $1 million over that figure)? .	The intended obligation is within the level of funds appropriate for Egypt.

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,000, will there be (a) engineering, financial and other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?

(a)	Yes
(b)	Yes

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3.	FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?	N.A.
4.	FAA Sec 611(b); Continuing Resolution Sec. 501. If for water or water-related land resource construction, has project met the standards and criteria as set forth in the Principles and Standards for Planning Water and Related Land Resources, dated October 25, 1973?	N.A.
5.	FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project?	N.A
6.	FAA Sec 209. Is project susceptible of execution as part of regional or multilateral project? If so why is project not so executed? Information and conclusion whether assistance will encourage regional development programs.	N.A.
7.	FAA Sec. 601(a). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of	Project, through the demonstration of renewable energy technologies will encourage the flow of international trade in this area initially. It is anticipated that private initiative and competition will also be fostered for local manufacture of such technologies. Training will also be given in these technologies so that the potential for improvement in energy efficiency in all sectors can be realized.

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	international trade; (b) foster private initiative and competition; and (c) encourage development and use of cooperatives, and credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.	
8.	FAA Sec. 601(b). Information and conclusion on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).	This project will utilize U.S. private companies for all field tests, providing those companies experience in the Egyptian environment and knowledge on the local marketplace.
9.	FAA Sec. 612(b), 636(h); Continuing Resolution Sec. 508. Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars.	See attached next page
10.	FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release?	All U.S. owned local currency has been programmed. None is available for this project.
11.	FAA Sec. 601(e). Will the project utilize competitive selection procedures for the	Yes

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9. Continued

The Government of Egypt is providing financing for approximately 15% of total estimated costs ($4.4 million); the Egyptian Government contribution will be for local currency costs to cover salaries and services for Egyptian participants. An estimated 17% of the AID grant will require local currency expenditures for travel; related project support costs, project promotion and in-country training. It is recommended that Egyptian currency for this purpose be purchased with U.S. dollars since U.S.-owned local currency has already been programmed. 612(b) determination attached.

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awarding of contracts, except where applicable procurement rules allow otherwise?

12. Continuing Resolution Sec. 522. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competiting commodity? N.A.

E. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a. FAA Sec. 102(b), 111, 113, 281(a). Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural

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and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries?

b. FAA Sec. 103, 103A, 104, 105, 106, 107. Is assistance being made available: (include only applicable paragraph which corresponds to source of funds used. If more than one fund source is used for project, include relevant paragraph for each fund source.)

(1) [103] for agriculture, rural development; if so (a) extent to which activity is specifically designed to increase productivity and income of rural poor; 103A if for agriculture research; full account shall be taken of the needs of small farmers, and extensive use of field testing to adapt basic research to local conditions shall be made; (b) extent to which assistance is used in coordination with

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programs carried out under Sec. 104 to help improve nutrition of the people of developing countries through encouragement of increased production of crops with greater nutritional value, improvement of planning, research, and education with respect to nutrition, particularly with reference to improvement and expanded use of indigenously produced foodstuffs; and the undertaking of pilot or demonstration of programs explicitly addressing the problem of malnutrition of poor and vulnerable people; and (c) extent to which activity increases national food security by improving food policies and management and by strengthening national food reserves, with particular concern for the needs of the poor, through measures encouraging domestic production, building national food reserves, expanding available storage facilities, reducing post harvest food losses, and improving food distribution.

(2) [104] for population planning under sec. 104(b) or health under sec. 104(c); if so, (i) extent to which activity emphasizes low-cost, integrated delivery systems for health, nutrition and family planning for the poorest people, with particular attention to the needs of mothers and young children, using paramedical and auxiliary medical personnel, clinics and

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health posts, commercial distribution systems and other modes of community research.

(4) [105] for education, public administration, or human resources development; if so, extent to which activity strengthens nonformal education, makes formal education more relevant, especially for rural families and urban poor, or strengthens management capability of institutions enabling the poor to participate in development; and (ii) extent to which assistance provides advanced education and training of people in developing countries in such disciplines as are required for planning and implementation of public and private development activities.

(5) [106; ISDCA of 1980, Sec. 304] for energy, private voluntary organizations, and selected development activities; if so, extent to which activity is: (i) (a) concerned with data collection and analysis, the training of skilled personnel, research on and development of suitable energy sources, and pilot projects to test of suitable energy sources, and pilot projects to test new methods of energy production; (b) facilitative of geological and geophysical survey work to locate potential oil, natural gas, and coal reserves and to encourage exploration for

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potential oil, natural gas, and coal reserves; and (c) a cooperative program in energy production and conservation through research and development and use of small scale, decentralized renewable energy sources for rural areas;

(ii) technical cooperation and development, especially with U.S. private and voluntary or regional and international development, organizations;

(iii) research into, and evaluation of, economic development process and techniques;

(iv) reconstruction after natural or manmade disaster;

(v) for special development problems, and to enable proper utilization of earlier U.S. infrastructure, etc., assistance;

(vi) for programs of urban development, especially small labor-intensive enterprises, marketing systems, and financial or other institutions to help urban poor participate in economic and social development.

c. [107] is appropriate effort place on use of appropriate technology? (relatively smaller, cost-saving, labor using technologies that are generally most appropriate for the small farms, small businesses, and small incomes of the poor.)

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d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or has latter cost-sharing requirement been waived for a "relatively least developed" country)?

e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing, or is the recipient country "relatively least developed"?

f. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective participation in governmental processes essential to self-government.

g. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase of productive capacities and self-sustaining economic growth?

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2. Devlopment Assistance Project Criteria (Loans Only)

a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan, at a reasonable rate of interest.

b. FAA Sec. 620(d). If assistance is for any productive enterprise which will complete with U.S. enterprises, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?

3. Project Criteria Solely for Economic Support Fund

a. FAA Sec. 531(a). Will this assistance promote economic or political stability? To the extent possible, does it reflect the policy directions of FAA Section 102?	It will contribute to economic and political stability and reflects section 102 policy directions.
b. FA Sec. 531(c). Will assistance under this chapter be used for military, or paramilitary activities?	No.

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5C(3) - STANDARD ITEM CHECKLIST

Listed below are the statutory items which normally will be covered routinely in those provisions of an assistance agreement dealing with its implementation, or covered in the agreement by imposing limits on certain uses of funds.

These items are arranged under the general headings of (A) Procurement, (B) Construction, and (C) Other Restrictions.

A. Procurement

1.	FAA Sec. 602. Are there arrangements to permit U.S. small business to participate equitably in the furnishing of commodities and services financed?	Yes
2.	FAA Sec. 604(a). Will all procurement be from the U.S. except as otherwise determined by the President or under delegation from him?	Yes
3.	FAA Sec. 604(d). If the cooperating country discriminates against U.S. marine insurance companies, will commodities be insured in the United States against marine risk with a company or companies authorized to do a marine insurance business in the U.S.?	N.A.
4.	FAA Sec. 604(e); ISDCA of 1980 Sec. 705(a). If offshore procurement of agricultural commodity or product is to be financed, is there provision	N.A.

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against such procurement when the domestic price of such commodity is less than parity? (Exception where commodity financed could not reasonably be procured in U.S.)

5. FAA Sec. 603. Is the shipping excluded from compliance with requirement in section 901(b) of the Merchant Marine Act of 1936, as amended, that at least 50 per centum of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S-flag commercial vessels to the extent that such vessels are available at fair and reasonable rates?

No

6. FAA Sec. 621. If technical assistance is financed, to the fullest extent practicable will such assistance, goods and professional and other services be furnished from private enterprise on a contract basis? If the facilities of other Federal agencies will be utilized, are they particularly suitable, not competitive with private enterprise, and made available without undue interference with domestic programs?

7. International Air Transport. Fair Competitive Practices Act, 1974. If air transportation of persons or property is financed on grant basis, will provision be made that U.S. carriers will be utilized to the extent such service is available?

Yes

NASA Lewis Research Center will be utilized in a project management mode, however, their technical assistance can be made available without undue interference with domestic programs. The overwhelming majority of project activities will be furnished by private enterprise on a contract basis.

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8. Continuing Resolution Sec. 505. If the U.S. Government is a party to a contract for procurement, does the contract contain a provision authorizing termination of such contract for the convenience of the United States? — Yes

B. Construction

1. FAA Sec. 601(d). If capital (e.g., construction) project, are engineering and professional services of U.S. firms and their affiliates to be used to the maximum extent consistent with the national interests? — N.A.

2. FAA Sec. 611(c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable? — N.A.

3. FAA Sec. 620(k). If for construction of productive enterprise, will aggregate value of assistance to be furnished by the U.S. not exceed $100 million? — N.A.

C. Other Restrictions.

1. FAA Sec. 122(b). If development loan, is interest rate at least 2% per annum during grace period and at least 3% per annum thereafter? — N.A.

2. FAA Sec. 301(d). If fund is established solely by U.S. contributions and administered by an international organization, does Comptroller General have audit rights? — N.A.

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3.	FAA Sec. 620(h). Do arrangements exist to insure that United States foreign aid is not used in manner which, contrary to the best interests of the United States, promotes or assists the foreign aid projects or activities of the Communist-bloc countries?	Yes
4.	Continuing Resolution Sec. 514. If participants will be trained in the United States with funds obligated in FY 1981, has it been determined either (a) that such participants will be selected otherwise than by their home governments, or (b) that at least 20% of the FY 1981 fiscal year's funds appropriated for participant training will be participants selected otherwise than by their home government?	Yes
5.	Will arrangements preclude use of financing:	
	a. FAA Sec. 104(f). To pay for performance of abortions as a method of family planning or to, motivate or coerce persons to practice abortions; to pay for performance of involuntary sterilization as a method of family planning, or to coerce or provide financial incentive to any person to undergo sterilization?	Yes
	b. FAA Sec. 620(g). To compensate owners for expropriated nationalized property?	Yes

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c. FAA Sec. 660. To provide training or advice or provide any financial support for the police, prisons, or other law enforcement forces, except for narcotics programs?	Yes
d. FAA Sec. 662. For CIA activities?	Yes
e. FAA Sec. 636(i). For purchase, sale, long-term lease, exchange or guaranty of the sale of motor vehicles manufactured outside U.S., unles a waiver is obtained.	Yes
f. Continuing Resolution Sec. 504. To pay pensions, annuities retirement pay, or adjusted service compensation for military personnel?	Yes
g. Continuing Resolution Sec. 506. To pay U.S. assessments, arrearages or dues.	Yes
h. Continuing Resolution Sec. 507. To carry out provisions of FAA section 209(d) (Transfer of FAA funds to multilateral organizations for lending.)	Yes
i. Continuing Resolution Sec. 509. To finance the export of nuclear equipment fuel, or technology or to train foreign nationals in nuclear fields?	Yes
j. Continuing Resolution Sec. 510. For the purpose of aiding the efforts of the government of	Yes

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such country to repress the legitimate rights of the population of such country contrary to the Universal Declaration of Human Rights?	
k. Continuing Resolution Sec. 516. For publicity or propaganda purposes within U.S. not authorized by Congress?	Yes

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Annex K

السيد المهندس / اعلى
للمتابعة
رجاء فتح ملف تحت عنوان "مواقع المشروعات الخاصة بـ "AID" وتضمين هذا الكتاب وفهرسته على ان يتضمن كافة المعلومات الخاصة بهذا الشأن واطلاع الوزارة على ما هو جديد حتى تتسنى المتابعة بعد ذلك
مشكراً

الشركة العامة للدواجن

مكتب رئيس مجلس الادارة

السيد المهندس / عبد اللطيف بيروت

نائب رئيس هيئة مشروعات القطارة

والطاقة المائية والتجددة

تحية طيبة وبعد

ايماء الى كتاب سيادتكم رقم ٦٢٨٣ في ١٩٨٢/٢/٣

بخصوص اعداد الاتفاق النهائي مع هيئة التنمية الدولية الامريكية

لتنفيذ مشروع Solar energy and heat recovery for Poultry Processing Plant.

بمجزر مصر الجديدة التابع للشركة العامة للدواجن والذي تم ادراجه ضمن المشروعات المتوقع تنفيذها وبالاشارة الى الاجتماع الذي تم بمكتب رئاسة سيادتكم في يوم الاثنين الموافق ١٩٨٢/٢/١ بين المختصين عن هيئة التنمية الدولية الامريكية وحضور كل من السيد الدكتور / عزت عبد الحميد والمهندس سيد الامام من الشركة العامة للدواجن .

وبناء على طلب الهيئة أتشرف بافادة سيادتكم بأن السيد الدكتور / عزت عبد الحميد اسماعيل مدير عام الادارة العامة للمجازر قد عين مندوبا عن الشركة العامة للدواجن فيما يخص هذا المشروع .

برجاء التكرم بالعلم والامر باتخاذ اللازم .

وتفضلوا بقبول تحياتنا .

نائب
وزير الزراعة ورئيس مجلس الادارة
" المهندس / صلاح الدين المهدي "

تحريرا في ١٩٨٢/٢/١١

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ANNEX K

(Unofficial Translation)

With reference to the letter dated February 3, 1982, concerning the final agreement with USAID for implementation of the project Solar Energy and Heat Recovery for Poultry Processing Plant and the Heliopolis Slaughterhouse that was held amongst projects agreed upon and with reference to the meeting that took place in your office and under your leadership on February 1, 1982, and that was attended by Dr. Ezzat Abd El Hamid and Engineer Sayed Al Emam for the Chicken Industry.

And based upon the Association's request, it gives me pleasure to inform you that Dr. Ezzat Abd El Hamid, General Manager of Slaughter Houses, has been appointed the representative of the General Poultry Company in that which concerns this project.

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ANNEX L
(Unofficial Translation)

Excerpts from a Report Presented to the
Ministerial Committee for Production
Concerning the Ministry of Electricity and Energy Activities
in the Field of New and Renewable Energy

Following is a submission of agreements made by the Ministry, the governorates and the different foreign organizations:

1. French-Egyptian Agreement:
This agreement was signed for the first time during 1977. It included the following projects that have been implemented during 1981.

A. The construction of an Information and Documentation Center related to renewable energy:

Imported equipment for the Documentation Center and the library have arrived and the Center will be supplied with more than 300 books in the field, in addition to 33 scientific circulars received regularly by the Center. The Ministry will guarantee receipt of new publications in the field so that researchers and students might easily find the necessary books.

B. The construction of essential network for solar energy:

Construction and operation of an important solar measurement station took place near the Pyramids, in addition to six mobile stations for solar measurements. The Ministry changes the locations yearly to get the necessary data easily on the Republic-wide level.

These stations have been working for more than 18 months and the results that were obtained are being analyzed to fix the solar map of the A.R.E. so that different projects can be easily evaluated.

C. The construction of an examination and measurement lab for the different solar groups:

- This lab has been formed and a number of the solar stations have been chosen since November 1979. This kind of lab meets the essential need of the evaluation of local production of solar systems.

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- Manufacture of an experimental apparatus has taken place for examination and evaluation of night cooling for the solar systems and making use of that in the cooling field.

D. Importation and placement of a number of different solar heaters:

This project includes locating and operation of the following heaters:

- A heater with a capacity of 150 litres/day and a heater with a capacity of 1500 litres/day in the Wafaa Wal Amal city.

- A heater with a capacity of 5000 litres/day of hot water for the cobalt building in the Armed Forces Hospital in Maadi.

E. Water desalination in El Hamrawein:

A study and construction of a desalination station with a productivity of ($60m^3$/day) of water working with solar energy at the Misr Phosphate Company at Hamrawein on the Red Sea took place at the end of 1981.

F. The solar refrigerator project on the High Dam Lake:

The application program of the Egyptian-French agreement in the field of renewable energy includes the construction of a cooling and freezing facility with a capacity of 10 kilowatts and a freezing capacity of 14 tons on the High Dam Lake for freezing fish until it is transported. In addition, the project, which has been completed, includes the capability of irrigating and cultivating the surrounding area.

G. In the field of training and spreading awareness:

Scientific and technical training for Egyptian engineers in the field of solar energy will take place in France, especially in the experimental stations previously cited.

The educational tour took place for the basics of solar energy with the cooperation of scientists in the two countries. The Egyptian-French solar week took place during March-April 1980, including a scientific seminar and a solar energy equipment fair in France.

H. In the field of manufacturing solar energy equipment:

In addition to the previous projects, as a result of French cooperation in this field, and because the Ministry of Electricity and Energy desires to manufacture the solar energy

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equipment in Egypt, during 1981 an agreement was signed for the construction of the French-Egyptian Company for New Energy (RITCO) between the French Sofretes Company and the Nasr Company for Transformer Manufacture (ALMACO) under the Ministry. The solar heaters will be collected in the company during the year 1982 and the factory is to be completed at the beginning of 1983.

The Egyptian-French Agreement in the Field of Renewable Energy (November 1981):

The Egyptian-French Agreement for Renewable Energy was signed in Cairo during the month of November 1981. It included some application projects in addition to support of scientific and technical cooperation between the two counterparts and the continuation of the fields of cooperation to include other resources of renewable energy like wind energy, biomass and geothermal. Following is a brief summary of the components of this agreement:

In the field of solar energy:

1. Joint seminars for development took place in the period of 19-21 December 1981.

   Another two seminars will take place during 1982, one is in the field of solar building, the other is in the field of development of the substances used for new energy equipment.

2. Importation of one of the solar centers with equivalent circular cut to be chosen for Egyptian circumstances with the cooperation of the French counterpart and the Ministry of Electricity and Cairo University. It is expected that this kind would be suitable for the uses of industrial heating at high temperatures.

3. A desalination project in the Red Sea working with combined solar and wind energy.

4. A study of a solar system to provide one of the textile factories with industrial heating needs by means of solar energy.

5. Cooperation with the National Research Center in the field of study of the new photovoltaic cells and means of applying it.

6. Importation, placement and examination of a low-head irrigation pump working with photovoltaic cells.

7. Supplying Elwan village in Assiut with its different needs, utilizing solar energy with the cooperation of the Ministry of Electricity, Assiut University and the French counterpart.

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8. Cooperation between the Agriculture Research Center and the French Research Center in the field of biomass to produce biogas and impact upon the urban waste problem.

9. A study of the domestic heater models that were examined in France and selection of 3 suitable models for Egyptian circumstances, building it in one of the new settlements in order to select the best one.

10. The cooperation of France in financing and in exporting the equipment related to the Egyptian Renewable Energy Development Organization.

11. Training Egyptian engineers and technicians in all fields of implementation of the previous projects.

2. Egyptian-German Agreement:

This agreement was signed at the end of 1978, including the following projects:

A. In the field of electricity production by using photovoltaic cells:

The agreement included the importation and placement of ten solar stations working with photovoltaic cells for operation of different equipment. A number of them have been finalized, the rest are expected to be finished during 1982. These are:

1. A naval warning apparatus placed on the High Dam lake which has been successfully working since the start of 1980.

2. A system for the microphones of Mit Aboul Kom mosque has been working since August 1979.

3. A refrigerator (2 KW) for keeping medicine has been placed in the Health Unit in Mit Aboul Kom village.

4. A photovoltaic station for supplying electrical batteries for cultivators and insecticide and irrigation equipment has been working in the irrigation development project in Mansoura since March 1981.

5. Solar pump for irrigating the cultivated lands (2 KW) was installed during December, 1981 and experiments are being done now.

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6. A complete system containing three stations for water desalination for producing water from a potable well for the use of the workers in the lab will be implemented under the auspices of the Ministry of Electricity.

7. Units for colored television sets.

B. Examining the solar systems:

Importation of a station for comparison of the solar systems, to evaluate their role.

C. Planning between the Egyptian and German counterparts to finalize the study of the capability of using renewable energy resources in El Owainat South of the Valley.

D. In the field of training and spreading awareness:

The Egyptian-German seminar for solar energy took place in January 1981.

3. Cooperation with the United States of America:

The Ministry of Electricity in the last few years has completed some studies in the field of new and renewable energy with the cooperation of scientific organizations in the U.S.A. The cooperation agreement between the Ministry and USAID is expected to be signed during the first quarter of 1982 and will last 5 years. Following are the cooperation fields with the U.S.A.:

A. Assessment of Egyptian Resources from Wind Energy:

The Ministry of Electricity contracted the University of Oklahoma in 1978 to do an overall study on wind energy in Egypt where a complete survey was being done. A map has been made to make a complete image of the most suitable regions to construct wind energy projects on the Northwest Coast and the Red Sea Shore.

Based on the results of these studies, the cooperation project with USAID includes some projects for wind energy in both regions.

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B. In the field of producing electricity thermally:

The Ministry has finalized a study for the feasibility of constructing solar studies to produce electricity by using the central complex system with the cooperation of McDonnell Douglas. This study includes three phases:

Phase I: Collecting data and selecting projects according to needs until the year 2000.

Phase II: Studying and analyzing the results and specifying the size, kind and location of the stations and the implementation programs, specifying the industrial needs and manner of implementation.

Phase III: An industrial survey is to take place to learn the potential of Egyptian industrialization and the study of the maintenance of solar energy stations and the economic aims of the different projects.

C. A study of the evaluation of renewable energy resources and the fields of utilization:

In 1979 the Ministry and AID, contracting MITRE, finalized an overall study of new and renewable energy resources in A.R.E., including the current activities and the local capabilities. The results of the study specified six main priority fields in A.R.E.

D. Cooperation agreement between the Ministry and AID:

Based on the previous study, AID has sent a large group of American experts to study the details of the possible cooperation between the two countries with the cooperation of

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the Qattara Hydro Renewable Energy Authority (QHREA). The studies will result in a cooperation agreement which will include four main aspects. Implementation will last five years.

1. Thirteen experimental projects in the following fields:

   a. Utilization of solar energy in industrial heating operations.

   b. Producing electricity by means of photovoltaic cells.

   c. Use of wind energy.

   d. Producing electricity by using thermal solar stations.

2. Training of engineers and technicians in different fields related to the previous projects.

3. Detailed studies and designs related to the implementation of these projects.

4. Studies of some projects which are of great importance to Egypt and which could be put forward for consideration in the future.

4. Cooperation with UNDP:

A study of several projects for cooperation with UNDP is taking place and includes the following:

Selection of Egypt as a location for a solar pump project financed by the World Bank in which eight solar pumps will be fixed in different locations in Egypt, in addition to three projects for desalination and drying, with total expenditures of $300,000.

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5. Cooperation with the Italian government:

Four years ago, cooperation started with the Italian government and concentrates on the following:

1. The Italian government yearly gives training courses for Egyptians nominated by the Ministry of Electricity and Energy and are being sent to Italy to study in the International School for Solar Energy (SOGITA). During these four years the ministry has sent more than 100 students representing different universities and organizations in Egypt. In January 1981 a Memorandum of Understanding was signed between Italy and the Ministry which includes the following:

- Cooperation in studying and planning projects to supply remote settlements with their energy needs.

- Cooperation in the field of solar architecture by means of seminars and field tests.

- Cooperation in the field of applying renewable energy to industries.

- The Egyptian-Italian Week for Renewable Energy.

- Cooperation in manufacturing solar energy equipment.

The Ministry has asked the Italian Embassy and the Ministry of Economy to supply the necessary funds for various projects which were previously approved under the Financial Protocol signed by both counterparts.

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6. Other activities of the Ministry of Electricity and Energy in the field of renewable energy:

A. In the field of solar energy:

The Ministry of Electricity submitted an international tender for importing 1000 solar water heaters with various qualifications. The tender was analyzed and the heaters were bought from five international companies. The Ministry has finished the following:

1. Making the tender available to get acquainted with the international technologies in the field of heating water by means of solar energy.

2. Thirty-five heaters were placed with various qualifications in experimental locations in Alexandria, Damanhour, Cairo and Assiut for doing experiments in the Egyptian environment.

3. Fifty heaters were specially placed, without any fees, in locations useful for the general national interest like schools, universities and hospitals. This has been done in about ten locations.

- These heaters were rented to citizens for very little money to support the spread of awareness with the benefits of using it by means of companies which are distributing electricity in Cairo, Alexandria and elsewhere.

- The Ministry will put the measuring qualifications for the solar heating apparatus under the supervision of the Supreme Council of Renewable Energy with the cooperation of the Ministry of Industry and Organization for Standardization.

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B. In the field of spreading awareness:

A committee has been formed to spread awareness between the pupils in schools as a test of the educational division of the Minist y of Education, universities and the Ministry of Electricity. Some of the education inspectors in the Ministry of Education and a large number of training divisions in universities were sent on training courses abroad and Egypt in the field of solar energy. The Ministry intends to place a number of solar heaters in schools, in addition to the Ministry of Education's supply of a number of books dealing with renewable energies. Also, some of the solar heaters were placed in Faculties of Engineering in different universities, in addition to the seminars done by the Ministry for the previously-mentioned purpose.

C. In the field of desert settlement development and renewable energy:

The Ministry, the American University in Cairo, and the Ministry of Reconstruction are constructing a new settlement on 200 feddans in Sadat City to represent the first experiment for the development of renewable energy resources used in the development of the Egyptian desert. The project contains the following examples for the new desert settlements:

1. Three farms, each of ten feddans occupied by one family. Each Farm has its individual source of energy to easily identify the most suitable.

2. One farm (30 feddans) occupied by three families. Their needs are centrally supplied as the result of the first experiment.

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3. An agro-industry (90 feddans) is a sample of the farms under the agro-industrial companies, contains the regular settlements, the animal food factories, dairy factories and automatic slaughterhouses. It supplies the other farms with their needs of meat and dairy products.

4. A farm for producing and storing vegetables.

All means of renewable energy are used on these farms.

Conclusion:

Based on the aforementioned, the Ministry has given priority to new and renewable energy resources and much effort is being made through the Supreme Council of New and Renewable Energy, supporting local and international cooperation in order to supply Egypt with her energy needs.

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Objectives of EREDO

1. To define national energy needs, patterns and resources, with emphasis on the contribution of renewable energy resources potential to assist development of policies and strategies.

2. Introduction of new technology development and acceleration of the rate of its progress to the field.

3. Adaption of technologies and prototypes through field testing as well as laboratory analysis.

4. R&D solutions to problems limiting the practical use of the existing technologies and for solving application problems.

5. Market and economic evaluation studies, with concern to the problems of new techniques, are to be conducted.

6. Demonstration of components and systems to provide evidence to the potential users of which systems are feasible to identify technical problems and possible implementation barriers.

7. To identify and monitor the main barriers to the use of renewable energy sources, such as standards, building codes, testing and sun rights.

8. Introduction of the systems to industry.

9. Commercialization of the products by moving the technology from the status of technical and economic feasibility to the status of market-phase.

10. Educational courses and training for engineers and industry to improve their technical capabilities so that they can continue the implementation and use of appropriate systems.

11. To give assistance for:

    Policy-Makers: With program and legislation with recommendations.

    Manufacturers: Specifying and developing of better designs and solutions to the application problems.

    The Users: In identifying economical uses of renewable energy resources and other energy conserving techniques.

Relevant Experience with Similar Projects

NASA was delegated by the DOE, beginning in the mid 1970's, with responsibility for the U.S. national programs involving design, development, field test and evaluation of photovoltaic stand-alone systems, large horizontal-axis wind electric machines and solar heating and cooling projects.

In this period the following photovoltaic systems experience has been developed by the NASA Lewis Research Center (NASA-LeRC):

- Twenty systems have been placed in successful operation (See Annex 5)

- Over one dozen applications have been demonstrated at users' sites, ranging from insect traps (agricultural) to village power (Schuchuli, Arizona, operational Dec. 1978 and Tangaye, Upper Volta, operational March 1979) for lighting, water pumping, refrigeration, and grain grinding

- Photovoltaic powered vaccine refrigerator systems are now being procured, in support of the U.S. Center for Disease Control and the World Health Organization, to be deployed this year in India, Maldive Islands, Gambia, Ivory Coast, Peru and Colombia

- Standardized power systems for remote medical units are now being procured in support of AID/DS/EY for deployment in Kenya, Zimbabwe, Guyana, and Ecuador

- Village Community Service Systems (for health unit, school, water supply, and area lighting) are under design for a joint U.S./GOG project for four villages in Gabon

Concurrently, NASA Marshall Space Flight Center assisted in the preparation of the National Commercial Demonstration Program for the installation of solar heating and cooling systems, including industrial process heat, in commercial establishments in the U.S. These sites included factories, hospitals, schools, warehouses, hotels and multiple family dwellings. Two hundred and eighty seven projects were implemented, with NASA responsible for the management of 118. In addition, forty-two new systems were developed and installed in test buildings for both heating and cooling demonstrations. The DOE National Collector Test program was planned and executed by NASA. This program resulted in the ranking of 158 collector type manufactured in the U.S. according to thermal efficiency. An outgrowth of this test program is an effort, currently underway, to upgrade the performance specification (ASHRAE 93.77) to reflect all-day efficiency. A program, to be completed in 1984, was recently undertaken to install heating and cooling equipment in 840 federal buildings in all 50 states.

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NASA, long instrumental in aerodynamics and aircraft profession, has addressed its experience to the development of aerodynamically efficient wind power generation machines. NASA-LeRC has completed development of large wind power machines, i.e. 200 kW-2.5 MW, and is now well into the demonstration phase of these machines interfaced with the utility grid in the U.S. Eight of these machines have been installed over the last two years. The largest single installation is a wind farm of three machines, generating a total of 7.5 MW. Machines have been sited in Hawaii, Puerto Rico, Block Island, North Carolina, New Mexico and Washington. Several of the sites are remote, such as on the Island of Cuelebra, Puerto Rico, and have posed installation problems which would be common to many areas in developing countries.

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ANNEX N

Project 263-0123

2(b) RECOMMENDATION TO AUTHORIZE PURCHASE OF EGYPTIAN POUNDS WITH U.S. DOLLARS

Over the life of the Renewable Energy Field Testing Subproject approximately $4.8 million will be used to support local currency costs of the project. Dollar funds will be used in association with GOE disbursement of Egyptian pounds for the costs of the travel, per diem, and shipment of household effects of project consultant; related project support costs such as the travel and U.S. per diem of Egyptian participants, procurement of secretarial services, project promotion, in-country training and such local procurement commodities as is authorized. The Mission will purchase Egyptian pounds with U.S. dollars provided by the Project. The Egyptian pounds will, in turn, be made available to the various appropriate entities responsible for project implementation for disbursement in accordance with the agreements reached between USAID and the GOE in the Project Agreement.

JUSTIFICATION: Dollar funds used in conjunction with Egyptian pound costs represent an additional real resource to the Egyptian economy and provide means for speedy implementation of studies and offers some incentive for the Egyptian Government to implement new initiatives that it might otherwise not be able to undertake. U.S.-owned local currency is fully programmed and is not available for use in this project.

However, if U.S.-owned local currency were available, it is doubtful that the various Egyptian entities could enter into agreements since they would have to sustain budgetary cutbacks in other areas. Even if the various Egyptian entities were to obtain budgetary funds to provide its full portion of project costs, it is doubtful that it could commit them to this project unless the added fill in of dollar funding for local currency costs were assured. Given the above considerations and the fact the Energy Policy and Planning Subproject supports the U.S. Foreign policy ojbectives and the Country Development Strategy Statement of Egypt, we have concluded that local currency costs should be funded with dollar-purchased Egyptian pounds.

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ANNEX O

ANNUAL COST FOR FUEL UTILIZED IN INDUSTRIAL HEATING

AND THE SIZE OF GOVERNMENT SUBSIDIES

MINISTRY/SECTOR		Fuel Consumption in 1000 tons Petroleum Equivalent					Cost in LE 1 M		
		Electricity	Mazout*	Solar*	Gas	Other	International	Subsidized	Difference
Min. of Petroleum		-	142,200	-	48,400	-	32,402	1,429	30,972
Min. of Military Production		3,160	6,330	1,280	22	180	2,205	241	1,964
Min. of Electricity and Energy		-	74,000	-	-	-	12,580	555	12,025
Min. of Industry		439	1,546,827	50,620	-	-	275,619	13,455	262,164
Min. of Agriculture		-	-	12,950	-	-	3,212	469	2,743
Total Production Sector Excluding Fertilizers		3,599	1,769,357	64,850	48,422	180	326,018	16,149	309,868 13% of Subsidy
Cost in LE 1 M for Production Sector	Intl	863	300,790	160,828	8,236	47			
	Sub.	158	13,270	2,350	364	7			
	Diff	705.	287,520	13,732	7,872	40			
Total National in 1000 tons of Petrol. Equiv.		8,997.5	4,423,392	162,125	121,055	450			774,675 32.34%
Costs in LE 1 M on the National Level	Intl	2,158	751,975	40,207	20,590	117.5	815,045	40,370	Total Subsidy 774,675
	Sub.	395	33,175	5,875	910	17.5			
	Diff	1,703	718,800	34,330	19,680	100			

*Grade of Oil

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TABLE 1

ANNEX O

CONSUMPTION OF INDUSTRIAL HEATING AT
DIFFERENT TEMPERATURE LEVELS CALCULATED IN
TONS OF PETROLEUM FOR THE YEAR 1980-81

MINISTRY/SECTORS	TEMPERATURE LEVELS ≤80	≤ 150	≤ 300	> 300	TOTAL
1) Ministry of Petroleum	28,738	24,622	40,040	97,560	190,600
2) Ministry of Industry					
Spinning & Weaving	25,304	288,000	30,000	18,000	361,304
Metallic Products	3,765	17,240	-	506,500	529,505
Chemical Products Excluding Fertilizers	130,281	394,563	2,826	-	527,670
Nutritional Products	27,300	74,287	18,900	-	120,487
Metallurgy & Refractory Materials	24,780	24,780	1,200	8,160	58,920
Total Industry	211,430	798,870	52,926	534,660	1,597,886
3) Ministry Military Production	6,244	2,411	1,110	1,210	10,975
4) Ministry Electricity and Energy	74,000	-	-	-	74,000
5) Ministry of Agriculture	9,000	3,950	-	-	12,950
TOTAL PRODUCTION SECTOR	329,052	829,853	94,076	623,430	1,886,411
Items 2-7	246,790	622,390	70,557	475,072	1,414,809
4 Largest Industries and Power Stations	80,000	20,000	202,960	1,051,840	1,414,808
NATIONAL TOTAL	655,842	1,472,240	427,953	2,160,342	4,716,027
RATIO TO NATIONAL TOTAL %	13.92	31.22	9.06	65.8	100.00
RATIO TO CONSUMPTION OF PRODUCTION SECTOR	17.44	5.00	44.00	33.6	100.00

TABLE 2

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MINISTRY OF ELECTRICITY AND ENERGY

FOR PRESENTATION TO :

THE SUPREME COUNCIL OF NEW AND RENEWABLE SOURCES OF ENERGY

RECOMMENDATION FOR A NATIONAL STRATEGY OF UTILIZATION OF NRSE

LIST OF PRIORITIES

TABLE 3:LOW PRIORITY PROJECTS

TITLE/SITE	SOURCE OF ENERGY	APPLIC. END-USE	ORIGIN OF TECH	FUNDING AGENCY	EXECUT. AGENCY	START DATE	BUDGET REQ.	BUDGET AVAIL.	REQ. ANNUAL ALLOCATION FUND(L/F) Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	STA-TUS DURAT
THERMO-MECHANICT SOLAR CELLS	SOLAR-THERI	POWER GEN.			H. A/HARI UNIV.		L: .044 F: .001	.000 .000	.018 .002	.013 .002	.013 .001	.000 .000	.000 .000	PROPOSE 13 YEARS
									ANN ENERGY SAVING(BTU):				.000	

N.B:LOCAL FUNDS IN MILLION EGYPTIAN POUNDS

N.B:FOREIGN FUNDS IN MILLION AMERICAN DOLLARS

N.B:ANNUAL ENERGY SAVING IN 10**9 OF B.T.U.

*** THIS PRIORITIZATION IS INDICATIVE OF HOW THE ***
*** MODEL WORKS AND IS NOT A JUDJEMENT ON THE ***
*** LISTED PROJECTS ***

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FOR PRESENTATION TO :

THE SUPREME COUNCIL OF NEW AND RENEWABLE SOURCES OF ENERGY

RECOMMENDATION FOR A NATIONAL STRATEGY OF UTILIZATION OF NRSE

LIST OF PRIORITIES

TABLE 1 : HIGH PRIORITY PROJECTS

TITLE/SITE	SOURCE OF ENERGY	APPLIC. END-USE	ORIGIN OF TECH	FUNDING AGENCY	EXCUT. AGENCY	START DATE	BUDGET REQ.	BUDGET AVAIL.	REQ. ANNUAL ALLOCATION FUNDS(E) Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	STG. DUR.
SOLAR INDUST. DRYER	SOLAR-THER	DRAYING	EGYPT		SEE/NRC.		L: .020	.000	.012	.000	.000	.000	.000	10/10 YRS
							F: .011	.000	.000	.007	.000	.000	.000	10 YEARS
NRC.									ANN ENERGY SAVING(BTU): .000					
SOLAR ENERGY MAPPING OF EGYPT	SOLAR	RES. ASSEM		GOL/OTHER	EEA		L: .250	.000	.100	.000	.000	.000	.000	10/10 YRS
							F: .525	.000	.175	.000	.000	.000	.000	10 YEARS
OVER THE COUNTR									ANN ENERGY SAVING(BTU): .000					
SOLAR ASSISTED FRUIT DEHYDRA.	SOLAR-THER	DRAYING	U.S.A.	US"AID"	IQ.P.A/MOE	MAR.011	L: .045	.045	.020	.010	.010	.005	.000	10/10 YR
							F: .605	.605	.250	.175	.100	.000	.000	10 YEARS
GIZA.G.P.AUTH									ANN ENERGY SAVING(BTU): .120					
SOLAR HEATING FOR MEAT PROCESSING	SOLAR-THER	HEATING	U.S.A.	US AID	IQ.P.A/MOE	MAR.011	L: .225	.225	.150	.050	.050	.000	.000	10/10 YR
							F: 2.175	2.175	1.450	.500	.200	.000	.000	10 YEARS
GIZA-KOLDAIR CO									ANN ENERGY SAVING(BTU): 6.000					
SOLAR ENERGY AND HEAT RECOV. FOR POULTRY PROCESSING CAIRO	SOLAR-THER	HEATING	U.S.A.	US AID	IQ.P.A/MOE	MAR.011	L: .115	.115	.075	.025	.015	.000	.000	10/10 YR
							F: .955	.955	.550	.250	.150	.000	.000	10 YEARS
									ANN ENERGY SAVING(BTU): 3.200					
SOLAR WATER HEATING FOR MILK PRODUCTS PLANTS CAIRO.M.P.CO.	SOLAR-THER	PR.HEATING	U.S.A.	US AID	IQ.P.A/MOE	MAR.011	L: .020	.020	.010	.010	.010	.010	.000	10/10 YR
							F: .970	.970	.250	.150	.100	.000	.000	10 YEARS
									ANN ENERGY SAVING(BTU): 2.250					

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TABLE 1 "CONT."

ENERGY	SOLAR-THER	HEATING	U.S.A.	US AID	Q.P.A/MOE	MAR.81	L:	.100	.070	.070	.015	.015	.000	.000	DEFINE
AT RECOV.							F:	.930	.930	.570	.230	.130	.000	.000	3 YEAR
XTILE															
ARGIYA										ANN ENERGY SAVING(BTU):				6.000	
PROCESS	SOLAR-THER	HEATING	FRANCE		EEA		L:	.700	.000	.200	.000	.000	.000	.000	PROPOS
ENARATION							F:	.050	.000	.420	.000	.000	.000	.000	3 YEAR
										ANN ENERGY SAVING(BTU):				.000	
POWER	WIND	POWER GEN.			CAIRO UNI		L:	.325	.000	.042	.000	.000	.000	.000	PROPOS
STATION					IV.+EEA		F:	.096	.000	.024	.000	.000	.000	.000	3 YEAR
D ZONE															
-COAST										ANN ENERGY SAVING(BTU):				.000	
E	WIND	POWER GEN.	U.S.A.	US AID	Q.P.A/MOE	MAR.81	L:	.300	.300	.000	.100	.140	.030	.030	DEFINE
							F:	.395	.395	.050	.120	.085	.000	.060	5 YEAR
ATRUH										ANN ENERGY SAVING(BTU):				.061	

A: LOCAL FUNDS IN MILLION EGYPTIAN POUNDS

B: FOREIGN FUNDS IN MILLION AMERICAN DOLLARS

B: ANNUAL ENERGY SAVING IN 10**9 OF B.T.U.

*** THIS PRIORITIZATION IS INDICATIVE OF HOW THE ***
*** MODEL WORKS AND IS NOT A JUDJEMENT ON THE ***
*** LISTED PROJECTS ***

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FOR PRESENTATION TO :

THE SUPREME COUNCIL OF NEW AND RENEWABLE SOURCES OF ENERGY

RECOMMENDATION FOR A NATIONAL STRATEGY OF UTILIZATION OF NRGE

LIST OF PRIORITIES

TABLE 2:INTERMEDIATE PRIORITY PROJECT

TITLE/SITE	SOURCE OF ENERGY	APPLIC. END-USE	ORIGIN OF TECH	FUNDING AGENCY	EXCUT. AGENCY	START DATE	BUDGET REQ.	BUDGET AVAIL.	REQ. ANNUAL ALLOCATION FUND(L/F) Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	STATUS DURAT
A 0.5MW PROTO -TYPE DEMON. PLANT	SOLAR-THER	POWER GEN.	SRAIEL		DPW/GOF1/1 AND OTHER		L:1.360 F:1.360	.000 .000	.700 .700	1.400 1.400	.620 .620	.000 .000	.000 .000	PROPOSL 13 YEARS
FAYOUM									ANN ENERGY SAVING(BTU): .000					
SOLAR HEAT. OF POULTY BROODER HOUSES	SOLAR-THER	RP.HEATING	U.S.A.	US AID	IG.P.A/MOE	MAR.011	L: .050 F: .540	.050 .540	.030 .030	.010 .010	.010 .010	.000 .000	.000 .000	DEFINED 13 YEARS
FAIYUM									ANN ENERGY SAVING(BTU): .550					
PHOTOVOLTIC-POWERED REV.OSF OSMOSIS DESAL. SYSTEM MARSA MATRUH	SOLAR-PHOT	DESALINAT.	U.S.A.	US AID	IG.P.A/MOE	MAR.011	L: .140 F:1.040	.140 1.040	.030 .150	.040 .775	.030 .595	.010 .200	.010 .120	DEFINED 15 YEARS
									ANN ENERGY SAVING(BTU): .750					
ELECTROMECH. CONV. AND STO. OF SOLAR ENERGY	SOLAR	STORAGE	U.S.A.		CAIRO UNI IIV.		L: .000 F: .000	.000 .000	.025 .000	.000 .000	.000 .000	.000 .000	.000 .000	ONGOING 13 YEARS
									ANN ENERGY SAVING(BTU): .000					
PHOTOVOLTAIC POWERED IRRIG. SYSTEMS UPPER EGYPT.	SOLAR-PHOT	POWER GEN.	U.S.A.	US AID	IG.P.A/MOE	MAR.011	L: .030 F: .112	.030 .112	.020 .060	.010 .030	.010 .022	.000 .000	.000 .000	DEFINED 13 YEARS
									ANN ENERGY SAVING(BTU): .000					

N.B:LOCAL FUNDS IN MILLION EGYPTIAN POUNDS

N.B:FOREIGN FUNDS IN MILLION AMERICAN DOLLARS

N.B:ANNUAL ENERGY SAVING IN 10**9 OF B.T.U.

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ANNEX P

Unofficial Translation
Ministerial Decree No. 272 for the
Year 1979 Issued June 26, 1979 for QDA

The Minister of Electricity and Energy, after reviewing:

- Law 14 for the year 1974 for the establishment of the Qattara Depression Authority (QDA)

- The Prime Minister Decree No. 917 for the year 1979 for the establishment of the Supreme Council for New Energy and its amendment by a Prime Minister Decree No. 276 for the year 1979.

- The Ministerial Decree No. 181 for 1979 for the formation of a committee to identify an authority that will be responsible for the New Energy projects.

- Minutes of the aforementioned committee meeting on May 14, 1979.

Hereby decrees

Article 1: The Qattara Depression Authority (QDA) is responsible for the execution of renewable energy projects in the field of electricity.

Article 2: Funds for the renewable energy projects allocated in the Ministerial budget for the year 1979 are to be transferred to QDA in several installments according to the instructions of the First Secretary of State of the Ministry of Electricity and authorized by the Minister and after taking into consideration the agreed distribution of funds with the Minister of Planning.

Article 3: The QDA will assign the research and studies of renewable energy to the Division of Research, Studies and Development of the Egyptian Electrical Authority (EEA) and to any other entity in the light of the possibilities offered by the aforementioned division.

Article 4: In assuming its activity in the field of renewable energy, the QDA is considered one of the integrated entities for planning, coordinating and responding to the directives of the Supreme Council for New Energy and it is supposed to provide the technical secretariat of the Council with all information concerning renewable energy to be presented to the Supreme Council.

Article 5: The QDA will intensify its activity in the field of renewable energy under its different forms in compliance with public opinion, supreme national interest, and will accelerate implementation to obtain tangible results in order to follow the nations that have surpassed us in this field.

Article 6: The decree is to be published for execution by all concerned.

Eng. Moustafa Kamal Sabry
Minister of Electricity and
Energy

LAW NO. 87 OF 1980

FOR

THE AMENDMENT OF SOME PROVISIONS

FOR THE ESTABLISHMENT OF THE QATTARA DEPRESSION

EXECUTIVE PROJECT AUTHORITY

In the name of the People

The President of the Republic

The People's Assembly has ratified the following law and it is promulgated

Article 1

The texts of the two clauses 1 and 2 of the Law No. 14 for the establishment of the Qattara Depression Executive project Authority shall be substituted by the following texts:

Clause 1 A Public Authority to be named, "QATTARA HYDRO AND RENEWABLE ENERGY PROJECTS AUTHORITY", shall be established. It shall have a juristic personality, be affiliated with the Minister of Electricity and have its head office in the city of Cairo.

The Authority shall be subject to the provisions of this Law

Clause 2 The Authority will carry out the execution of the Qattara Depression Project and all works related to it and Hydro Electric Power generation Projects in the Republic and renewable energy projects, as well as all projects related to the activity of the Authority subject to the approval of the Board of Directors upon a proposal from the Minister of Electricity.

The Authority is exclusively assigned the following:

(1) Carrying out of studies, technical and economical research for the Authority's Projects as well as the Projects related to it, branching from it, or consequent upon, either individually, or participating with other local or foreign bodies.

(2) Executing all contractual agreements which have been contracted with foreign governments, as well

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as local, and foreign Authorities pertaining to its projects.

(3) Contracting with consulting bodies for setting designs and approval of the projects.

(4) Planning and setting up of a program for execution of the projects.

(5) Study and approving methods of execution of the Projects and the works related to it.

(6) Preparing the basic specification for the projects and its emplementation for execution.

(7) Carrying out the execution of the Projects individually or participating with other bodies or assigning the whole or part of the project to Authorities or specialized companies.

(8) Executing the works related to the Authority's projects, or branches of it or consequent upon, as pointed out in sub clause (7).

(9) Preparing the projects for its operation and management either by itself or sublating same totaly or partialy to specilized Authorities or companies.

(10) Undertaking Expertise and execution of projects falling within the specialization of the Authority either locally or abroad, and which are consistent with the Authorities compality available by or through it.

Article 2

This law shall be published in the official Gazette and shall be valid as from the next day after the date of its publication.

This law shall be embossed with the Stat's seal and shall be implermented as one of its law.

Best Available Document

Excerpt from Uniform Data Collection and Information Systems for Renewable Energy Projects 1/

Finely detailed or specific data categories can only be developed with a particular project in mind. For example, the socio/cultural factors relevant to use of a solar cooker will be different than those of a village wood lot. Below is a discussion of a set of data categories and their sub-elements that are non-specific in terms of particular renewable technologies but which can be adapted to the specific technology and local setting of the project.

A. Data Categories

Technical

--Adequate physical data (amount of biomass, wind, solar, etc.) should be gathered to verify the original assumptions or estimates made during project design.

--Complete records of component acquisition in person hours, costs, and skill requirements.

--Complete records of technology installations in person hours, costs, and skill requirements.

--Complete records of system output.

--Complete records of system performance, down time, maintenance activities and costs.

--Records on environmental impacts.

--Changes that could be made, for example, in:

- overall system design
- component acquisition
- local manufacture of technology

1/ George Burrill, A paper prepared for the SERI Workshop on Evaluation Systems for Renewable Energy Systems, Boulder, Colorado, February, 1980.

- system maintenance

Information can then be assembled on the potential technical effects of such changes on the system.

Social/Cultural

--Relationship of the energy project and technology to the users or to village daily and seasonal life patterns. Also, data on behavior changes required by the technology, and on villagers' traditional habits or ways of doing things which are affected by the project, although not necessarily required to change by the technology (i.e., behavioral side effects).

--People's attitudes towards the technology and the project.

--Behavior of organizations in the project.

--Other cultural constraints discovered during the project that were not identified by the project planners.

--Data on performance of the project's ownership strategy and maintenance strategy from a social/cultural standpoint.

--Equity results of the project as implemented:

- impact on male and female roles
- impact on local income level groups
- impact on ethnic sub-groups and castes
- related to individual vs. family vs. community

Economic and Financial

David French has suggested the following elements:*

*French, David, "The Economics of Renewable Energy Systems for Developing Countries", US/AID, Washington, D.C., January 1979.

--Value of a system's output (if measurable in market prices).

--Alternative employment opportunities (to measure benefits if the system chiefly releases labor from former tasks).

--Costs of site preparation and installation of the system.

--Direct operating costs.

--Degree of local unemployment (to find shadow wages).

--Existing uses of raw materials (to find their shadow price).

--Extension costs of introducing the system.

--Market interest rates for local borrowing (to estimate investors' discount rates).

--Characteristic local investments (to suggest willingness to take financial risks).

I would add two more elements. The investor's point of view is extremely important for the long-term success of any project, whether it be government, community, individual, or a combination of these. The extent to which the project is testing economic or financial acceptability to potential investors should depend upon the extent of proven technology development. Less developed technologies will generally have higher subsidies, and project results are therefore less of an indicator of future investor behavior than unsubsidized technologies. Moreover, investors very often do not act in a financially or economically

rational manner. Economic and financial positive or negative analysis results may not correlate with investor decisions experienced in the project. Therefore, a reasonable estimate as to what can be determined about potential investor behavior based on project data should be clarified before any conclusions are reached. To do this, data should be gathered during the project on the additional elements of:

--investor perception of financial or economic cost/ benefit, and

--investor opinion as to competing investment choices. (I am not referring to cost effectiveness analysis here, but to the fact that monies may be invested in items for completely different purposes.)

AGENCY FOR INTERNATIONAL DEVELOPMENT
ADVICE OF PROGRAM CHANGE

DATE: March 11, 1982

Country: Egypt No. 121

Project Title: Energy Policy, Renewables Demonstration, Utility Management

Project Number: 263-0123

FY 1982 CP Reference: Amended Main Volume, page 373

Appropriation Category: Economic Support Fund

Life of Project Funding: $48,000,000 (Grant)

Intended FY 1982 Obligation: $33,000,000

This is to advise that AID intends to obligate $33 million of FY 1982 grant funds and $48 million in total for this project. This project consists of three activities dealing with: effective and efficient national policy planning and decision-making; demonstration of the place of renewable energy options in national energy decisions; and strengthening the management capability of utility organizations.

This project was not obligated in FY 1981, as planned, because project dimensions were not sufficiently developed at that time. Project activities have since been expanded to include additional assistance in renewables technology and in management of utility agencies, resulting in an increase to $33 million in initial obligation and to $48 million in life of project costs.

Attachment: Activity Data Sheet

PROGRAM: EGYPT

ACTIVITY DATA SHEET

TITLE	FUNDS	PROPOSED OBLIGATION (In thousands of dollars)	
Energy Policy, Renewables Demonstration, Utility Management	Economic Support Fund	FY 82 $33,000	LIFE OF PROJECT $48,000
NUMBER 263-0123 GRANT [X] LOAN [ ] NEW [X] CONTINUING [ ]	PRIOR REFERENCE FY 82 CP, Amended Main Volume, Page 373	INITIAL OBLIGATION FY 82 / ESTIMATED FINAL OBLIGATION FY 85	ESTIMATED COMPLETION DATE OF PROJECT FY 86

Purpose: To improve the efficiency of energy resource utilization in Egypt by: strengthening GOE institutional capabilities in national energy planning and policy making; demonstrating feasibility of renewable energy technologies; and improving utility management in the Egyptian Electricity Authority and the Rural Electrification Authority.

Background: The GOE is undertaking a major program in the electric power sector. This involves all aspects of the Egyptian energy situation, ranging from policy planning and technical training to power generation and distribution. In recent years social and economic conditions have become increasingly sensitive to the supply of and demand for energy. In 1978 the US Department of Energy sponsored a Joint Egypt-US Cooperative Energy Assessment which has provided a large amount of information on Egypt's energy resources and utilization capabilities. Key elements have been identified as national policy planning, the potential for renewable energy substitution, and management of utility agencies.

Project Description: This project consists of three groups of activities: 1) institutionalizing the capability within the GOE to collect and analyze data necessary for national energy policy planning, 2) the demonstration of renewable energy technologies which may be economically competitive with conventional energy and 3) improving management capabilities in the Egyptian Electrification Authority (EEA) and the Rural Electrification Authority (REA). These activities will be supported through technical assistance, on-the-job and long-term training and with appropriate hardware necessary to upgrade Egyptian capabilities. Each activity will contribute to the common goal of efficient utilization of Egypt's energy resources.

Relation to AID Country Strategy: By providing Egyptian policy makers and operational personnel with information and skills which can lead to realistic energy pricing and more efficient energy use, this project addresses a key impediment to increasing the productivity of the Egyptian economy.

Host Country and Other Donors: The GOE is funding initial and recurrent costs for salaries and support and for special activities necessary to the project ($12,500,000 equivalent).

Beneficiaries: Direct beneficiaries will be the twelve GOE agencies dealing with energy and approximately six hundred individuals receiving training and technical assistance. More important, private consumers and business throughout Egypt will benefit through the more rational and efficient use of energy resources.

Major Outputs:
1. More effective policy and decision making regarding use of energy resources.
2. Realistic set of options for use of renewable energy resources based on practical field tests in Egypt.
3. Improved organization and efficiency in utility management agencies.

AID Financed Inputs:	Life of Project ($Thousands)
Technical Assistance (930 PY)	$13,000
Training (35 PY Long-term) (10 PY Short-term) (1200 PM Seminar/Workshop)	19,000
Commodities (Renewables technology, office support and construction)	4,000
Other Costs (Evaluations, contingency, inflation, etc.)	12,000
	$48,000 Total

U.S. FINANCING (In thousands of dollars)	Obligations	Expenditures	Unliquidated
Through September 30, 1980	-	-	-
Estimated Fiscal Year 1981	-	-	-
Estimated through September 30, 1981	-	-	-
		Future Year Obligations	Estimated Total Cost
Proposed Fiscal Year 1982	33,000	15,000	48,000

PRINCIPAL CONTRACTORS OR AGENCIES

Argonne National Laboratory for preliminary work and sub-contract. Prime contractors to be selected.

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ANNEX S

UNITED STATES GOVERNMENT

memorandum

DATE: May 15, 1981

REPLY TO ATTN OF: NE/PD/PDS, Stephen F. Lintner, Bureau Environmental Coordinator

SUBJECT: EGYPT - (A) Energy Policy and Planning Subproject - Project Identification Document (263-0123) - Environmental Clearance

TO: NE/TECH/HRST, George Self, Project Chairperson

I have reviewed the environmental documentation prepared for the proposed subproject and concur with the recommendation of the Mission that it be given a "Negative Determination" in compliance with the requirements of 22 CFR 216, "A.I.D. Environmental Procedures".

It is recommended that the Policy and Planning subproject include in its design provisions for the institutional development within the GOE for (1) programmatic analysis of environmental impacts of energy sector developments and (2) facility site selection criteria and review procedures.

cc: GC/NE, T. Carter
AID/Cairo, W. McAleer, Mission Environmental Officer
AID/Cairo, L. M. Hager, Senior Legal Advisor
AID/Cairo, J. Weber, Mission Project Officer

JULY 1973 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

ANNEX T
NEAC PACKAGE

TO : See Distribution

DATE: May 13, 1982

THRU : NE/TECH, Kenneth Sherper KS

FROM : NE/TECH/HRST, Ross Thomas RT

SUBJECT: PRC Issues Paper - Egypt Renewable Energy Field Testing (263.0123.2)

The Project Review Committee met and reviewed this project on April 1, 7, 15 and May 6, 1982. As a result of an initial set of issues and recommendations made by the PRC the Mission Project Officer has made substantial revisions in the original PP, with Mission approval. The revised PP (Attachment A) was reviewed by the PRC at the May 6 meeting.

The PRC recommends NEAC approval of the project subject to consideration of the following issues:

Issue 1. Economic feasibility

Discussion - The original economic analysis presented the case from a current cost (1981) standpoint and was felt to be unsatisfactory by the PRC. The revised economic analysis (which now appears in the PP) is based on a projection of relative costs in 1990, comparing renewable energy applications with off-grid (diesel and gasoline engines, generators and boilers) using conceptual designs. Eight of eleven computations result in economically viable applications. While there are concerns with the methodology and the theoretical renewable cost projections the PRC notes that the additional testing of economic feasibility in both the engineering design process and during implementation is one aspect of the information system to be undertaken.

Recommendation - That the NEAC accept the preliminary economic feasibility as described in the PP permitting the Mission to make final selection based on further analysis. The PRC suggests that the following parameters be used in further economic analysis: (a) the five percent annual escalation of real fuel costs, as the maximum upper range; (b) a ten percent internal rate of return and (c) inclusion of an estimate of the cost of grid connection as an alternative conventional energy source.

Issue 2. Technical feasibility

Discussion - The field tests chosen are generally mid-sized and industrial/agricultural/commercial in nature. They were selected in cooperation with the GOE. The criteria in the PP which were used to propose these specific applications and to eliminate others appear to cover any and all applications. The Mission does indicate that the proposed applications will be subject to rigorous preliminary and final engineering design analyses before selection is final. This will include the study of alternative technologies which might satisfy the same problem statements.

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

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Recommendation - That the NEAC approve the overall character of the field tests permitting the Mission to make final selection based on further analyses. Further, that the Mission give consideration to a Condition Precedent prior to first disbursement for any field testing activity requiring the GOE to furnish a statement of the criteria which would govern selection of renewable energy applications, describing both engineering and economic qualifications.

Issue 3. Egyptian organizations

Discussion - The PP does not present a clear and coherent description of the renewable energy responsibilities of the Qattara Hydro and Renewable Energy Authority as it is presently structured or as it is to become. Without these it is difficult to judge whether Qattara has or can readily recruit the staff to conduct the project and to achieve the project purpose.

Recommendation - That Mission give consideration to inclusion of a Condition Precedent prior to first disbursement which requires the GOE to provide USAID/Cairo with an analysis of Qattara's current capability and plans to increase staff resources necessary to successfully undertake and implement this project.

Issue 4. Information utilization

Discussion - It does not appear that the emphasis on dissemination in the PP is adequate to achieve the project purpose. Since the intent of the project is to prepare for replication of the renewable technologies active and full dissemination of results of the field tests is a vital implementation activity.

Recommendation - That the Mission incorporate the broad outlines of an information dissemination approach in the PP and include provision for further developing and implementing that approach.

Issue 5. Field tests, Private vs. Public Sector

Discussion - The proposed Field Tests, as listed, are scheduled to be conducted with public sector organizations. The New Initiatives are anticipated to be conducted with private companies. In either case the PP proposes the principle of cost sharing of field test costs with the immediate beneficiaries. The PRC commends this approach. The PP does not fully justify conducting all Field Tests with the public sector particularly in that it does not demonstrate the lack of interest or capability of private sector companies in the installations. It is not clear to the PRC whether the Field Tests could not be arranged with the private sector without causing substantial delay in project implementation.

Recommendation - That the Mission be authorized to proceed in the selection process but give additional consideration to including private companies in the Field Test component.

Observation 1. Use of PASA/Contractor - The Mission recommends in the PP the use (under PASA) of NASA/Lewis Research Center Laboratory as project management contractor due to its unique stature, experience and inherent lack of bias in development of renewable energy technology. It appears that NASA would be prepared to accept such a role. The use of NASA as Project Manager guarantees the availability of comprehensive management services across the broad spectrum of this activity. NASA is particularly well adapted to conduct the complex procurement required by this activity which will involve complicated, perhaps two-step type, procedures to first draft specifications for each renewable technology and then hold competition for the supply, installation and operation of each application. In this regard the PP indicates that NASA would use AID procurement procedures in implementing the project. We would recommend that the Mission consider whether it would not be more advantageous, and in the best interests of smooth project implementation, for NASA to use its own highly developed contracting procedures since they will be more familiar with those procedures.

Observation 2. Mission staffing - Since there will be a continuing series of technical and contractual matters to be addressed in the project the PRC expressed some concern that the proposed Mission staffing may be insufficient to monitor the project. We suggest that the NEAC approve conveying this concern to the Mission for their consideration.

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Department of State

OUTGOING TELEGRAM

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NEE-03 OOE-01 RELO-01 MAST-01 3V-08 /033 A0

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DRAFTED BY AID/NE/TECH/HRST:ROSS THOMAS:ES
APPROVED BY AA/NE:W.ANTOINETTE FORD
AID
NE/TECH/HRST:BARRY HEYMAN(DRJ AID/N
AID/GC/NE:JUDD KESSLER
AID/NE/E:GERALD GOWER
AID/PPC/EY:STEPHEN KLEIN
AID/ST/EY:WILLIAM EILERS
AID/NE/PO:SELIG TAUBENBLATT
AID/NE/DP:CHARLES JOHNSON

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E.O. 12065: N/A
TAGS:
SUBJECT: EGYPT RENEWABLE ENERGY FIELD TESTING (263-0123.2)

REF: (A) CAIRO 10940 (B) STATE 142537

1. THE NEAC REVIEWED AND APPROVED THE SUBJECT PROJECT PAPER ON MAY 18, 1982. THE FOLLOWING ISSUES WERE DISCUSSED. MISSION RESPONSE TO ITEMS 1A, 1B, 1C AND PARA 2 IS REQUESTED FOR ATTACHMENT TO AUTHORIZATION MEMO TO BE SUBMITTED TO ADMINISTRATOR ASAP.

--A. NEAC IS CONCERNED THAT THE SELECTION OF NASA AS PROJECT MANAGEMENT ENTITY BE FULLY JUSTIFIED. NOTE MISSION WILL NEED TO ADDRESS ANOTHER ASPECT OF PRIVATE SECTOR ROLE PER PARA 2 BELOW. IF MISSION WISHES NE BUREAU TO RECOMMEND USG SERVICES UNDER PASA FOR THIS ACTIVITY, DETAILED RATIONALE WILL BE NEEDED WHICH FOLLOWS CLOSELY THE POLICY SET FORTH IN AID H.B. 12 CH. 1.B.2. THIS WILL REQUIRE AN EXPANSION OF POINTS MADE IN PAGES 59 AND 60 OF PP. DISCUSSION SHOULD INDICATE TO WHAT EXTENT USE OF PRIVATE SECTOR CONTRACTORS HAVE BEEN CONSIDERED.

--B. QATTARA HYDRO AND RENEWABLE ENERGY AUTHORITY - THE NEAC VIEWED INSTITUTIONAL DEVELOPMENT AS CRITICAL, EVEN VITAL, TO PROJECT SUCCESS. CONCERN WAS EXPRESSED AS TO QHREA'S CAPABILITY TO CARRY OUT THIS PROJECT AND IT IS NOT CLEAR FROM THE PP WHETHER QHREA HAS THE INSTITUTIONAL CAPABILITY NECESSARY TO PARTICIPATE ACTIVELY SO AS TO ACHIEVE PROJECT PURPOSE, OR HOW IT PLANS TO ORGANIZE AND STAFF TO IMPLEMENT THE PROJECT, INCLUDING AN INTERFACE WITH OTHER RESPONSIBLE GOE ORGANIZATIONS DURING DESIGN AND FIELD TESTING. MISSION SHOULD ENGAGE IN A DIALOGUE ASAP WITH QHREA TO CLARIFY PLANS FOR INSTITUTIONAL DEVELOPMENT AND IMPLEMENTATION CAPABILITY OVER THE LIFE-OF-PROJECT. WE BELIEVE THE PROJECT AGREEMENT SHOULD INCLUDE AS A CONDITION PRECEDENT PRIOR TO FIRST DISBURSEMENT THE REQUIREMENT THAT THE GOE PROVIDE USAID/CAIRO WITH AN ANALYSIS OF QHREA'S CURRENT CAPABILITY AND PLANS TO SUPPLY INSTITUTIONAL AND STAFF RESOURCES APPROPRIATE TO THE PROJECT PURPOSE. IN VIEW OF NEAC CONCERN THE NE BUREAU WOULD LIKE TO BE INFORMED OF GOE CAPACITY AND PLANS TO DEVELOP INSTITUTIONAL CAPABILITY AND IMPLEMENTATION CAPACITY FOR THIS PROJECT.

--C. INFORMATION DISSEMINATION - MISSION SHOULD MAKE PROVISION FOR EARLY DEVELOPMENT OF THE BROAD OUTLINES OF AN INFORMATION DISSEMINATION SYSTEM AND FOR ON-GOING DEVELOPMENT OF THAT SYSTEM. AA/NE NOTED THE IMPORTANCE, AND THE DIFFICULTY AND COMPLEXITY, OF CONSTRUCTING A SYSTEM WHICH CAN WIDELY DISSEMINATE EXPERIENTIAL INFORMATION TO THOSE PEOPLE AND INSTITUTIONS WHICH SHOULD RECEIVE IT.

--D. ECONOMIC FEASIBILITY - THE NEAC AGREES THAT FURTHER ECONOMIC ANALYSIS SHOULD BE PERFORMED DURING THE FINAL SELECTION OF TECHNOLOGIES AND SITE APPLICATIONS AND DURING THE COURSE OF THE FIELD TESTING, AS OUTLINED IN THE SUPPORTING ANALYSIS DISCUSSION IN THE PP. FOR THE PRESENT, IN FURTHER ECONOMIC ANALYSIS THE FOLLOWING PARAMETERS ARE SUGGESTED: (A) THE FIVE PERCENT ANNUAL ESCALATION OF REAL FUEL COSTS, AS THE MAXIMUM UPPER RANGE; (B) A TEN PERCENT INTERNAL RATE OF RETURN (CUSTOMARY IN AID PROJECTS IN EGYPT) AND (C) INCLUSION OF THE COST OF ELECTRIC POWER CENTRAL GRID CONNECTION, OR OTHER SOURCES SUCH AS NATURAL GAS, AS ALTERNATIVE CONVENTIONAL ENERGY SOURCES. IN OTHER WORDS, ALTERNATIVE CONVENTIONAL ENERGY SOURCES EXPLORED SHOULD BE AS COMPREHENSIVE AS FEASIBLE.

--E. TECHNICAL FEASIBILITY - THE TECHNICAL CRITERIA WHICH WILL GOVERN SELECTION SHOULD BE STATED IN THE PROJECT DESCRIPTION ANNEX TO THE PROAG.

--F. FIELD TEST SELECTION - MISSION SHOULD CONTINUE TO GIVE CONSIDERATION TO PRIVATE COMPANIES IN PRESENT FIELD TEST SITES AS WELL AS THE NEW INITIATIVES. CONSIDERATION SHOULD ALSO BE GIVEN TO POSSIBLE WAYS OF UTILIZING EGYPTIAN PRIVATE COMPANIES IN THE TOTAL PROJECT.

--G. MISSION STAFFING-GIVEN THE NUMBER AND COMPLEXITY OF TECHNICAL AND CONTRACTIONAL MATTERS TO BE MONITORED BY THE MISSION UNDER THIS PROJECT THE NEAC EXPRESSED CONCERN WHETHER MISSION PROJECT OVERSIGHT CAPABILITY IS ADEQUATE AND REQUESTED THE MISSION TO GIVE THOUGHT AS TO HOW THIS CAPABILITY MIGHT BE REINFORCED.

--H. PACD - ASSUMING OBLIGATION OF FUNDS LATE IN FY 1982 PACD SHOULD BE CHANGED TO 1987 TO REFLECT 60 MONTH PROJECT LIFE. AA/NE EMPHASIZED THAT THESE DATES SHOULD REFLECT OUR MOST REALISTIC ASSESSMENT OF PROJECT LIFE.

2. PRIOR TO AID/W AUTHORIZATION MISSION WILL NEED TO RESPOND TO REF (B) TO PROVIDE DISCUSSION OF THE RELATIONSHIP OF THIS PROJECT TO OUR ENERGY SECTOR POLICY DIALOGUE AND TO ADDRESS THE FEASIBILITY OF ALTERNATIVES TO GOVERNMENT LEADERSHIP IN THE AREA OF RENEWABLE ENERGY RESOURCES. THIS ISSUE WILL BE ESPECIALLY RELEVANT TO PARA. 1.A. ABOVE BECAUSE BURDEN OF ARGUMENT WILL BE ON MISSION TO EXPLAIN WHY A GOVERNMENT AGENCY, NOT A PRIVATE FIRM, SHOULD BE USED AS THE PROJECT MANAGEMENT ENTITY FOR TA. STOESSEL

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AIDAC

E.O. 12065:N/A
SUBJECT: RENEWABLE ENERGY FIELD TESTING, PROJECT
263-0123.2

REF: A) CAIRO 10948, B) STATE 142537, C) STATE 151267
D) CAIRO 14212

1. THE FOLLOWING ARE MISSION RESPONSES TO NEAC ISSUES STATED IN CORRESPONDING PARAS REFTEL C:

A. RE NASA AS PROJECT MANAGEMENT ENTITY, THE MISSION HAS DETERMINED THAT THE NATURE OF THE FUNCTIONS WHICH THE MANAGEMENT ENTITY WILL BE ASKED TO PERFORM ARE "GOVERNMENT FUNCTIONS." NASA LEWIS IS PARTICULARLY SUITED TO THESE FUNCTIONS AND IS NOT IN COMPETITION WITH THE PRIVATE SECTOR IN THAT REGARD. IN ADDITION, NASA HAS BEEN SPECIFICALLY REQUESTED BY THE GOE FOR THIS MANAGEMENT ROLE AS AN ENTITY WHICH WILL PROVIDE UNBIASED, QUALITY TECHNICAL ASSISTANCE. AS STATED IN HANDBOOK 17 CHAPTER 45A3, AID WILL BE MONITORING NASA AND WILL REQUEST IT TO "...MANAGE PROGRAMS REQUIRING VALUE JUDGMENTS, REVIEW AND APPROVAL OF PROGRAMS....., COORDINATING WITH RECIPIENT GOVERNMENTS, INSTITUTIONS, CONTRACTING AND THE OVERSIGHT OF CONTRACTOR OPERATIONS..." THESE FUNCTIONS WILL EXIST THROUGHOUT PROJECT IMPLEMENTATION. HOWEVER, PARTICULARLY WITH REGARD TO SELECTION OF FIELD TESTS IN COLLABORATION WITH THE GOVERNMENT INSTITUTIONS, USAID BELIEVES A USG AGENCY SHOULD BE PROVIDING THE TECHNICAL OVERSIGHT.

THE MISSION AND NASA FULLY INTEND THAT THE OVERWHELMING MAJORITY OF THE PROJECT TECHNICAL SERVICES BE SUBCONTRACTED TO THE PRIVATE SECTOR (APPROXIMATELY 92 PERCENT). INDEED, DISCUSSIONS WITH PRIVATE SECTOR FIRMS SUCH AS BATELLE, EDI, AND ARTHUR D. LITTLE RESULTED IN THOSE FIRMS STATING THAT THEY PREFER THE ROLE OF SUB-CONTRACTOR TO A GOVERNMENT AGENCY SUCH AS NASA AND WOULD WELCOME THE OPPORTUNITY TO WORK WITH NASA. THE U.S. NATIONAL LABORATORIES WERE CONSIDERED AS WELL - ARGONNE, IDAHO ENGINEERING, BROOKHAVEN, JET PROPULSION - AND IT WAS DETERMINED THAT THEY DID NOT HAVE THE OVERALL TECHNICAL AND MANAGERIAL EXPERIENCE IN REVEWABLES AND WOULD MORE APPROPRIATELY PARTICIPATE ON DISCRETE PORTIONS OF THE PROJECT RATHER THAN AS THE PROJECT MANAGER ENTITY.

FINALLY, A CONCERN REGARDING COST AS STATED IN HANDBOOK 12, 182C: IT IS BELIEVED THAT A PRIVATE CONTRACTOR WOULD CHARGE AN ESTIMATED 100 PERCENT MORE FOR ITS SERVICES. A DETAILED COST COMPARISON ANALYSIS CAN BE PERFORMED, IF REQUIRED. THE 100 PERCENT FIGURE IS AN ESTIMATE BASED UPON OUR PREVIOUS CONTRACTS IN THE ENERGY SECTOR.

B. MISSION CONCURS WITH NECESSITY TO HAVE AN ANALYSIS OF OHREA'S CURRENT CAPABILITY AND PLANS TO SUPPLY INSTITUTIONAL AND STAFF RESOURCES, AS WELL AS INTERFACE WITH OTHER RESPONSIBLE GOE ORGANIZATIONS.

WE HAVE BEGUN DIALOGUE WITH OHREA ON THIS AND EXPECT TO HAVE THE REQUIRED ANALYSIS BEFORE PRO AG IS SIGNED. IF THAT DOES NOT OCCUR, WE SHALL INCLUDE AS A CP PRIOR TO FIRST DISBURSEMENT.

C. PER PAGES 24-25 OF PROJECT PAPER, AID/W HAS AGREED TO FURNISH TECHNICAL ASSISTANCE TO ESTABLISH AN INFORMATION SYSTEM FOR THE PROJECT. THE PROJECT MANAGEMENT CONTRACTOR WILL BE RESPONSIBLE FOR FURNISHING THE OUTLINE OF THAT SYSTEM DURING THE FIRST THREE MONTHS DOF PROJECT IMPLEMENTATION, WITH A DETAILED INFORMATION COLLECTION AND DISSEMINATION SYSTEM TO BE DEVELOPED AND PUT INTO PLACE DURING THE FIRST PROJECT YEAR.

D. MISSION WILL INCLUDE NEAC'S SUGGESTED PARAMETERS IN ON-GOING ECONOMIC ANALYSES DURING PROJECT IMPLEMENTATION.
E. TECHNICAL CRITERIA HAVE BEEN INCLUDED IN DRAFT PROJECT AGREEMENT. IF NE HAS SPECIFIC WORDING FOR CRITERIA REQUIREMENTS, PLEASE ADVISE.

F. MISSION WILL SEEK TO INVOLVE EGYPTIAN PRIVATE SECTOR COMPANIES IN THE PROJECT AS MUCH AS POSSIBLE DURING ALL PHASES OF IMPLEMENTATION.

G. MISSION WILL BE UTILIZING RESOURCES OF S AND T AS WELL AS DRPS. THESE COMBINED RESOURCES WE BELIEVE TO BE ADEQUATE FOR PROJECT OVERSIGHT.

H. MISSION CONCURS.

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ANNEX U
CORRESPONDENCE

23 SEP 1982

ACTION MEMORANDUM FOR THE ADMINISTRATOR

THRU : ES

THRU : AA/PPC, John Bolton

FROM : AA/NE, W. Antoinette Ford

SUBJECT: Egypt - Use of NASA as Contractor for Renewable Energy Field Testing Project (263-0123.2)

Problem: Your signature is requested on the attached letter to James Beggs, Administrator of National Aeronautics and Space Administration, which solicits the services of NASA under a PASA with A.I.D. for the subject project.

Discussion: The $24.1 million Renewable Energy Field Testing sub-project was authorized on July 29, 1982, and the Program Agreement with the Government of Egypt was signed on August 29, 1982. The Project Paper clearly set forth that sub-project implementation is to be conducted through the NASA Lewis Research Center as the management entity. The issue of contracting with NASA for the role of project manager as well as for providing technical assistance has been fully reviewed by USAID/Cairo and the Near East Bureau, and the decision has been made that the envisioned role for NASA is appropriate and in the best interest of the Agency. Briefly, the project oriented and legal reasons for this decision follow:

1. While the PASA will be executed for $20 million, approximately 92% ($18.4 million) of this sum will be used for subcontracts with private sector firms. A portion of the other 8% ($1.6 million) will be used for PSCs.

2. Talks on the project have been ongoing with GOE officials for the last three years, with the GOE indicating a very strong desire to work with NASA. It will take approximately 90 days to execute a PASA with NASA while up to one and a half years would be required to obtain a prime contractor outside the USG. Based on previous experience, the Egyptians have confidence in NASA and NASA is knowledgeable about the project as a result of their technical assistance during the design phase.

3. While there are firms available in the private sector who could manage the project and provide technical assistance, NASA's systems management experience and familiarity with a broad range of renewable applications are unique. NASA/Lewis, currently in the third year of a five year PASA with S&T/EY, typically sets technical specifications based on the requirements of AID, host countries, and the international development assistance community.

Examples are medical refrigerators which were built and tested in accordance with World Health Organization and Center for Disease Control requirements, and the Tunisian village photovoltaic system which meets Government of Tunisia electrical codes. NASA has been involved with terrestrial renewable energy applications since the early 1970s and is keenly aware of the differences between space and terrestrial requirements. Owing to their orientation towards space applications, they appreciate the unique requirements for low maintenance and high reliability for applications of renewable energy technologies, while maintaining awareness of the relationship between cost and system reliability. Their involvement in other AID projects has provided valuable experience which would be most readily tapped by their involvement in Egypt.

4. Portions of the program oversight that will be included in the PASA cannot legally be delegated to a non-USG entity. If we try to separate functions between oversight and purely technical aspects, we will almost certainly lose, to a significant degree, managerial coherence. The size of the staff in the S&T office in Cairo as compared to the size of the portfolio presently under implementation underscores the need for one entity to perform the oversight role. NASA is performing a similar function in Tunisia Renewable Energy Project (664-0325) and has clearly demonstrated their overall technical and managerial expertise.

5. NASA will only charge AID general and administrative costs, not overhead. This will ensure that more of the project funds can actually be used for the demonstration sites, as compared to going the private sector route with significantly higher attendant overhead costs.

6. We checked with other labs - Argonne, Idaho Engineering; Brookhaven, Jet Propulsion - and we are satisfied that NASA offers the best technical/managerial mix for this project.

7. Using NASA as prime contractor will offer small business and minority firms a greater chance for being awarded subcontracts for implementation of specific activities. The PASA scope of work will be written in such a way as to encourage this involvement.

AA/PPC does not recommend that NASA be employed and instead advocates the use of various private firms for requisite technical services. Their concern is one of policy, i.e. the philosophical preference of the private sector over the governmental, with attendant benefits normally associated with private enterprise. The Near East Bureau feels that the recommendation to secure NASA services through a PASA is consistent with, and the option most in furtherance of, both FAA Section 621 and OMB Circular A-76. Private enterprise will be used extensively, while government managerial functions are properly retained in a procurement made exacting the lowest total cost.

When the project authorization package was presented for signature, memoranda were attached outlining the views of NE and PPC Bureaus on the use of NASA. While the decision on the use of NASA did not have to be made at that time, the authorization was signed without comment.

Recommendation: That you clear the attached letter to James Beggs requesting that NASA manage and provide technical assistance under the Egypt Renewable Energy Field Testing Project.

The PPC alternative is approved.

JBKimball
Oct 20, 1982

3c

4 OCT 1982

ACTION MEMORANDUM FOR THE ADMINISTRATOR

THROUGH: ES

FROM: AA/PPC - Frederick W. Schieck (Acting) FWS

SUBJECT: Egypt: Use of NASA as Contractor for Renewable Energy Field Testing Project (263-01232)

Problem: The NE Bureau is forwarding for your signature a letter to James Beggs, Administrator for National Aeronautics and Space Administration, to request the services of NASA under a PASA with A.I.D. for subject project. PPC recommends that the private sector should provide the technical assistance to the GOE, rather than a U. S. Government Agency, and that if USAID/Egypt needs NASA help with project management, a much narrower scope should be established.

Discussion: When the subject project came forward for project authorization in July, Mr. Bolton attached an action memo (See Tab A) detailing PPC's reasons (that remain valid) for urging that the private sector provide technical assistance to the GOE for implementation of the project.

PPC continues to believe we should not employ NASA for the technical assistance. Such action would forego our emphases on expanding the private sector role for those activities where private sector participation is most appropriate and in addition is inconsistent with the Reagan Administration's domestic energy policy.

We have the following additional comments that respond to points made in the NE action memo:

--To argue as NE's memo does that a substantial portion of the work will be subcontracted to the private sector fails to address the central issue: What are the parameters, and who frames them, for private sector involvement? PPC believes the private sector should perform this function.

--The NE Bureau substantially overstates the time and cost dimensions when it claims that it would take 18 months to obtain a prime contractor. If we accept the NE lines of argument, A.I.D. would never contract with private firms for technical assistance, because it would always take longer and cost more.

--NASA's systems management experience and capability is not only not unique, but it brings a very different mind set to the preparation of technical specifications than that of a private firm involved with commercial applications. The Mission argues the preparation of the specifications is a "government function"; it is precisely this function that should be performed by the private sector.

--If the USAID wishes to supplement its project management responsibility with a PASA with NASA, we have no objection. We do object to confusing (and merging) A.I.D.'s responsibility for project management with the provision of the technical assistance. Rather than losing managerial coherence with this separation, as NE claims, we believe project management is made cleaner and more efficient.

--We can and should assure small business and minority contracting. However, we do not need to contract with another USG agency to assure these objectives are met, on this project or any other.

Recommendation: That you do not sign the letter to NASA, and request the Mission to negotiate with the GOE to utilize a private firm to provide the required technical assistance. If the Mission needs support for project management, the PASA with NASA could readily be restructured to limit NASA's role to these activities.

Attachment:

Tab A - Bolton memo, 7/26/82.

Approved

Oct 20, 1982

cc: AA/NE - Ms. Ford
S&T/EY - Mr. Vanderryn
PPC/PDPR - Mr. Eriksson

AID:PPC:EY:SKlein:10/1/82x23693

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UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON D.C. 20523

Not approved JTBK 10/20/82

Dear Dr. Beggs:

The purpose of this letter is to request the participation of NASA Lewis Research Center in the newly approved Renewable Energy Field Testing Project in Egypt. The role envisioned for NASA is that of project management on behalf of the AID Mission there.

As a result of the 1978 Joint U.S.-Egypt Energy Resources Assessment, AID began discussions with the Egyptian Ministry of Electricity and Energy concerning follow-on energy projects. The Lewis Research Center's known expertise in renewable energy technologies, resulted in the USAID/Cairo Mission request that it develop, in collaboration with an Egyptian counterpart team, a Renewable Energy Field Testing Project. The $24 million project that resulted from this effort was approved by AID in May of this year, and the project agreement with the Government of Egypt was signed on August 29, 1982.

The five year project will:

A. Conduct field tests on selected renewable energy technologies to determine the technical, economic and social feasibility in a variety of Egyptian industrial, agricultural and remote settings.

B. Establish an information system to collect and disseminate data on the proposed field tests on a continuing basis to support policy and investment decisions, as well as replication of those applications which are most promising in a five to ten year time frame.

C. Provide training, education and operational experience to potential users of renewable energy systems and Egyptian decision-makers to enhance and accelerate the building of the required technical infrastructure.

D. Provide the means to evaluate and support new initiatives in the form of studies and field tests which may evolve as the solar energy technologies are proven and accepted in the Egyptian environment.

Dr. James M. Beggs, Administrator
National Aeronautics and Space Administration
NASA Headquarters
Washington, D. C. 20546

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In order to accomplish the above, a strong project management/coordination entity is essential. The Government of Egypt has specifically requested the participation of NASA as a trusted U.S. government agency whose management style and technical expertise it feels is necessary for the successful implementation of this project.

It is our considered opinion that NASA Lewis Research Center has the uniquely qualified personnel who have shown themselves capable of working closely with the Egyptians and could serve to upgrade Egyptian capability in this most important area. The Center has shown outstanding ability to assist in the implementation of other AID projects, especially in the area of project management in Tunisia and Upper Volta. For the foregoing reasons, AID considers NASA input to be invaluable for the success of this project.

AID's economic assistance program in Egypt is its largest program in the world, totalling approximately $1 billion per year. The successful implementation of this project will have enormous political as well as economic impact. In addition, it should open a significant market for U.S. private sector involvement in solar technologies.

I look forward to receiving your positive response to this request in the very near future so that we may commence what we anticipate to be a most fruitful collaborative effort. In development we are one.

Sincerely,

M. Peter McPherson

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E.O. 12356: N/A
TAGS:
SUBJECT: USE OF NASA/LEWIS AS CONTRACTOR FOR EGYPT
RENEWABLE ENERGY FIELD TESTING PROJECT (263-0123.2)

REF: A) STATE 298746, B) CAIRO 27777

1. ON NOVEMBER 30, COUNSELOR TO AID, AFTER CONSIDERATION OF CONTENTS REF B AND MEMO FROM ST/EY (POUCHED TO USAID ON 12/3/82), REAFFIRMED HIS OCTOBER 20 DECISION TO DISAPPROVE USE OF NASA/LEWIS AS PRIME CONTRACTOR. COUNSELOR WILL EXPLAIN HIS DECISIONIN LETTER TO MISSION DIRECTOR.

2. DECISION DID NOT PRECLUDE USE OF PASA WITH NASA/LEWIS FOR A MORE LIMITED ROLE ASCONSULTANT TO MISSION.

3. DURING CONTRACTING PROCESS, CONSIDERATION SHOULD BE GIVEN TO 8A FIRMS/SMALL BUSINESSES AS POTENTIAL PRIME CONTRACTOR. AS MISSION AWARE, AT LEAST ONE 8A FIRM HAS STRONGLY EXPRESSED INTEREST IN PRIME CONTRACT. NE/TECH AND ST/EY WILLING TO ASSIST MISSION IN REVIEWING CAPABILITY STATEMENTS OF THOSE 8A AND SMALL BUSINESSES SUBMITTED TO NE BUREAU BY THE OFFICE OF BUSINESS RELATIONS. BUREAU AND ST/EY ALSO WILLING TO ASSIST IN DRAFTING SCOPE OF WORK AND

RFP FOR PRIME CONTRACTOR.

4. PER PL 95-507, IF PRIME IS AID DIRECT CONTRACT, PRIME CONTRACTOR WILL BE REQUIRED TO SUBMIT SUB CONTRACTING PLAN FOR SMALL BUSINESSES AND MINORITY OWNED SMALL BUSINESSES.

5. IF MISSION PROCEEDS WITH PASA WITH NASA, PLEASE ADVISE DATE BY WHICH MISSION INTENDS TO SUBMIT PIO/T. CAN WE ASSUME THAT USAID/CAIRO WILL BE CONTRACTING OFFICE FOR PRIME CONTRACT? DAM

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ANNEX V

A.I.D. Project Number 263-0123
Activity Number 123.2

ACTIVITY

GRANT AGREEMENT

BETWEEN

THE ARAB REPUBLIC OF EGYPT

AND THE

UNITED STATES OF AMERICA

FOR THE

RENEWABLE ENERGY FIELD

TESTING ACTIVITY

OF THE

ENERGY POLICY AND

RENEWABLE ENERGY FIELD

TESTING PROJECT

Dated: August 29, 1982

CONFORMED COPY

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Annex 1

ACTIVITY DESCRIPTION

Annex 2

PROJECT GRANT STANDARD PROVISIONS

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A.I.D. Project No. 263-0123
Activity No. 123.2

Activity Grant Agreement

Dated August 29, 1982

Between

The Arab Republic of Egypt ("Grantee")

And

The United States of America, acting through the Agency for International Development ("A.I.D.").

Article 1: The Agreement

The purpose of this Agreement is to set out the understandings of the parties named above ("Parties"), with respect to the undertaking by the Grantee of the Activity described below and with respect to the financing of the Activity by the Parties.

Article 2: The Activity

SECTION 2.1 Definition of Activity. The Activity, which is further described in Annex 1, will assist the Grantee to collect data on selected renewable energy field tests which will permit the Grantee to determine the technical, economic and cultural feasibility of utilizing renewable energy technologies in Egypt.

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Annex 1, attached, amplifies the above definition of the Activity. Within the limits of the above definition of the Activity, elements of the amplified description stated in Annex 1 may be changed by written agreement of the authorized representatives of the Parties named in Section 8.2., without formal amendment of this Agreement.

The Parties are planning this Activity as part of the Energy Policy and Renewable Energy Field Testing Project which, it is expected, will include the activities to be undertaken under this present Agreement, the Energy Policy Planning Activity which is governed by a separate agreement and one additional activity for Utility Management. The latter activity is now under design and may later be added to the Project under a third agreement.

SECTION 2.2. Incremental Nature of Activity.

(a) A.I.D.'s contribution to the Activity will be provided in increments, the initial one being made available in accordance with Section 3.1 of this Agreement. Subsequent increments will be subject to availability of funds to A.I.D. for this purpose, and to the mutual agreement of the Parties, at the time of a subsequent increment, to proceed.

(b) Within the overall Activity Assistance Completion Date stated in this Agreement, A.I.D., based upon consultation with the Grantee, may specify in Project Implementation Letters appropriate time periods for the utilization of funds granted by A.I.D. under an individual increment of assistance.

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Article 3: Financing

SECTION 3.1. The Grant. To assist the Grantee to meet the costs of carrying out the Activity, A.I.D., pursuant to the Foreign Assistance Act of 1961, as amended, agrees to grant the Grantee under the terms of this Agreement not to exceed Five Million Three Hundred Thousand United States ("U.S.") Dollars ($5,300,000) ("Grant").

The Grant may be used to finance foreign exchange costs, as defined in Section 6.1, and local currency costs, as defined in Section 6.2, of goods and services required for the Activity, except that, unless the Parties otherwise agree in writing, Local Currency Costs financed under the Grant will not exceed the equivalent of One Million U.S. Dollars ($1,000,000).

SECTION 3.2. Grantee Resources for the Activity.

(a) The Grantee agrees to provide or cause to be provided for the Activity all funds, in addition to the Grant, and all other resources required to carry out the Activity effectively and in a timely manner.

(b) The resources provided by Grantee for the Activity will be not less than the Egyptian Pound equivalent of One Million U.S. Dollars ($1,000,000), including costs borne on an "in-kind" basis.

SECTION 3.3. Activity Assistance Completion Date.

(a) The "Activity Assistance Completion Date" (AACD), which is August 28, 1987, or such other date as the Parties may agree to in

writing, is the date by which the Parties estimate that all services financed under the Grant will have been performed and all goods financed under the Grant will have been furnished for the Activity as contemplated in this Agreement.

(b) Except as the Parties may otherwise agree in writing, A.I.D. will not issue or approve documentation which would authorize disbursement of the Grant for services performed subsequent to the AACD or for goods furnished for the Activity, as contemplated in this Agreement, subsequent to the AACD.

(c) Requests for disbursement, accompanied by necessary supporting documentation prescribed in Project Implementation Letters are to be received by A.I.D. or any bank described in Section 7.1 no later than nine (9) months following the AACD, or such other period as the Parties may agree to in writing. After such period, A.I.D., giving notice in writing to the Grantee, may at any time reduce the amount of the Grant by all or any part thereof for which requests for disbursement, accompanied by necessary supporting documentation prescribed in Project Implementation Letters, were not received before the expiration of said period.

Article 4: Conditions Precedent to Disbursement

SECTION 4.1. First Disbursement. Prior to any disbursement or to the issuance of any commitment documents for funds made available under this Agreement, the Grantee shall, except as the Parties may otherwise

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agree in writing, furnish to A.I.D. in satisfactory form and substance a statement of the names and titles of the persons who will act as the representatives of the Grantee, together with a specimen signature of each person specified in such statement.

SECTION 4.2. Additional Disbursement. Prior to any disbursement or to the issuance of any commitment documents from funds made available under this Agreement for the long-term technical assistance contractor, the Grantee shall, except as the Parties may otherwise agree in writing, furnish to A.I.D. in satisfactory form and substance the names of those persons who will be serving as Activity and assistant Activity managers for implementation.

SECTION 4.3. Terminal Dates for Conditions Precedent. If all of the conditions specified in Section 4.1 have not been met within 30 days from the date of this Grant Agreement, or such later date as the Parties may agree to in writing, A.I.D. may terminate this Agreement by written notice to Grantee.

If all of the conditions specified in Section 4.2 have not been met within 60 days from the date of this Agreement, or such later date as the Parties may agree to in writing, A.I.D. may cancel the then undisbursed balance of the Grant, to the extent not irrevocably committed to third parties, and may terminate this Agreement by written notice to the Grantee.

SECTION 4.4. Notification. When the conditions precedent specified in Section 4.1 and 4.2 have been met, A.I.D. will promptly notify the Grantee.

Article 5: Special Covenants.

SECTION 5.1. Activity Evaluation. The Parties agree to establish an evaluation program as part of the Activity. Except as the Parties otherwise agree in writing, the program will include, during the implementation of the Activity and at one or more points thereafter:

(a) evaluation of progress toward attainment of the objectives of the Activity;

(b) identification and evaluation of problem areas or constraints which may inhibit such attainment;

(c) assessment of how such information may be used to help overcome such problems; and

(d) evaluation, to the degree feasible, of the overall development impact of the Activity.

SECTION 5.2. Organizational and Communication Links. The Grantee agrees to establish the organizational and communication links necessary to coordinate activities under this Agreement and to exchange information among the participating companies, universities, CARE, OEPA and the concerned ministries.

SECTION 5.3. Personnel. The Grantee agrees to take appropriate action to establish and fund a mechanism by which Qattara Hydro Renewable Energy Project Authority may procure sufficient personnel for each year of the Activity as necessary for successful implementation.

Article 6: Procurement Source

SECTION 6.1. Foreign Exchange Costs. Disbursements pursuant to Section 7.1 will be used exclusively to finance the costs of goods and services required for the Activity having their source and origin in the United States (Code 000 of the A.I.D. Geographic Code Book as in effect at the time orders are placed or contracts entered into for such goods or services) ("Foreign Exchange Costs"), except as A.I.D. may otherwise agree in writing, and except as provided in the Project Grant Standard Provisions Annex, Section C.1(b) with respect to marine insurance.

SECTION 6.2. Local Currency Costs. Disbursements pursuant to Section 7.2. will be used exclusively to finance the costs of goods and services required for the Activity having their source and, except as the Parties may otherwise agree in writing, their origin in Egypt ("Local Currency Costs").

Article 7: Disbursement

SECTION 7.1. Disbursement for Foreign Exchange Costs.

(a) After satisfaction of conditions precedent, the Grantee may obtain disbursements of funds under the Grant for the Foreign Exchange

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Costs of goods or services required for the Activity in accordance with the terms of this Agreement, by such of the following methods as may be mutually agreed upon:

(1) by submitting to A.I.D., with necessary supporting documentation as prescribed in Project Implementation Letters, (A) requests for reimbursement for such goods or services, or, (B) requests for A.I.D. to procure commodities or services on Grantee's behalf for the Activity; or,

(2) by requesting A.I.D. to issue Letters of Commitment for specified amounts (A) to one or more U.S. banks, satisfactory to A.I.D., committing A.I.D. to reimburse such bank or banks for payments made by them to contractors or suppliers, under Letters of Credit or otherwise, for such goods or services, or (B) directly to one or more contractors or suppliers, committing A.I.D. to pay such contractors or suppliers for such goods or services.

(b) Banking charges incurred by Grantee in connection with Letters of Commitment and Letters of Credit will be financed under the Grant unless Grantee instructs A.I.D. to the contrary. Such other charges as the Parties may agree to may also be financed under the Grant.

SECTION 7.2 Disbursement for Local Currency Costs.

(a) After satisfaction of conditions precedent, the Grantee may obtain disbursements of funds under the Grant for Local Currency Costs required for the Activity in accordance with the terms of this Agreement, by submitting to A.I.D., with necessary supporting documentation as

prescribed in Project Implementation Letters, requests to finance such costs.

(b) The local currency needed for such disbursements may be obtained by acquisition by A.I.D. with U.S. dollars by purchase. The U.S. dollar equivalent of the local currency made available hereunder will be the amount of U.S. dollars required by A.I.D. to obtain the local currency.

SECTION 7.3. Other Forms of Disbursement. Disbursements of the Grant may also be made through such other means as the Parties may agree to in writing.

SECTION 7.4. Rate of Exchange. Except as may be more specifically provided under Section 7.2, if funds provided under the Grant are introduced into Egypt by A.I.D. or any public or private agency for purposes of carrying out obligations of A.I.D. hereunder, the Grantee will make such arrangements as may be necessary so that funds may be converted into currency of the Arab Republic of Egypt at the highest rate of exchange prevailing and declared for foreign exchange currency by the competent authorities of the Arab Republic of Egypt.

Article 8: Miscellaneous

SECTION 8.1. Communications. Any notice, request, document, or other communication submitted by either Party to the other under this Agreement will be in writing or by telegram or cable, and will be deemed

duly given or sent when delivered to such Party at the following addresses:

To the Grantee:

Ministry of Investment
and International Cooperation
8 Adly Street
7th Floor
Cairo, Egypt

To A.I.D.:

A.I.D.
U.S. Embassy
Cairo, Egypt

To the Implementing Organizations:

Ministry of Electricity and Energy
Abbassia, Egypt

Qattara Hydro Renewable Energy
Project Authority
Garden City
Cairo, Egypt

All such communications will be in English, unless the Parties otherwise agree in writing. Other addresses may be substituted for the above upon the giving of notice.

SECTION 8.2. Representatives. For all purposes relevant to this Agreement, the Grantee will be represented by the individual, holding or acting in the office of the Deputy Prime Minister for Economic and Financial Affairs and Minister of Investment and International Cooperation, Minister of Electricity and Energy, or the Administrator

of the Department for Economic Cooperation with U.S.A., and A.I.D. will be represented by the individual holding or acting in the office of Director, USAID, each of whom, by written notice, may designate additional representatives for all purposes other than exercising the power under Section 2.1 to revise elements of the amplified description in Annex 1. The names of the representatives of the Grantee, with specimen signatures, will be provided to A.I.D., which may accept as duly authorized any instrument signed by such representatives in implementation of this Agreement, until receipt of written notice of revocation of their authority.

SECTION 8.3. Standard Provisions Annex. A "Project Grant Standard Provisions Annex" (Annex 2) is attached to and forms part of this Agreement. For the purposes of such annex, this Agreement shall be deemed to be the Project Grant Agreement.

IN WITNESS WHEREOF, the Arab Republic of Egypt and the United States of America, each acting through its respective duly authorized representatives, have caused this Agreement to be signed in their names and delivered as of the day and year first above written.

ARAB REPUBLIC OF EGYPT	UNITED STATES OF AMERICA
BY : M. A. Fattah Ibrahim	BY :
NAME : M. A. Fattah Ibrahim	NAME : Henry Precht
TITLE: Deputy Prime Minister for Economic and Financial Affairs and Minister of Investment and International Cooperation	TITLE: Charge d'Affaires a.i.

: F.D. Iskander

: Fouad Iskandar

E: Administrator of the Department for Economic Cooperation with U.S.A.

BY :

NAME : Owen Cylke

TITLE: Acting Director, USAID/Cairo

Implementing Organization

acknowledgement of the foregoing Agreement, the representative of the ementing Organization has subscribed his name:

MINISTRY OF ELECTRICITY AND ENERGY

BY :

NAME : Mohamed Maher Abaza

TITLE: Minister of Electricity and Energy

ANNEX 1
ACTIVITY DESCRIPTION

I. Summary Project Description

The Project is composed of three activities, one of which, Renewable Energy Field Testing, is authorized by this Agreement. Another activity, Energy Policy Planning, is authorized by a separate agreement. The third activity, Utility Management, is expected to be added to the Project at a later time by an additional Agreement. The overall Project goal is the efficient utilization of Egypt's extensive and increasingly complex range of energy resource options. The Project is designed to deal with three of the major problems which have been identified as needing urgent attention for their impact upon the economic and social development of the country and, as such, are intimately related to each other.

Strengthening overall national energy, economic and technical planning, as well as management capability, will enable the Grantee to analyze various energy supply options and develop a sound program to identify energy demand and the capability to implement it in a more efficient manner. It is expected that these analyses will also result in a better understanding of the technical and economic characteristics of renewable energy resource systems and thereby help to convince decision-makers within the Government of Egypt and donor organizations to consider renewable energy as having important potential in Egypt's future energy resources.

Although renewable energy resources are not now economically attractive to the end-user in Egypt because of heavy subsidies on fossil fuel-based energy, the Government of Egypt is moving toward reducing some of those subsidies. In the meanwhile, the Renewable Energy Field Testing Activity will permit the Government of Egypt to evaluate the appropriateness of renewable technologies from a technical, cultural and economic (based on world energy prices) point of view. Then, when energy prices in Egypt approximate world market prices, the Government of Egypt will be able to move more confidently in the use of renewable energy.

It is envisioned that the third activity, Utility Management, will be closely coordinated with the other two activities.

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A. Energy Policy Planning

The Energy Policy Planning Activity will be directed toward institutionalizing within the Government of Egypt the capacity to collect and analyze data necessary for national energy planning. This will be accomplished by providing technical assistance, on-the-job training, selected long-term training and appropriate hardware in order to upgrade capabilities in energy economics, analysis, technology, conservation, information systems management and systems analysis.

Activities in renewable energy must also be closely field tested in Egypt and coordinated with all other power sector activities. The Energy Policy and Planning activity will seek to encourage such coordination by enhancing the Egyptian capacity to plan renewable energy development as part of its overall energy development plan.

B. Renewable Energy Field Testing

In view of the potentially important role of renewable energy resources in Egypt and the likelihood that the Government of Egypt will soon move forward on the issue of adjusting energy pricing, the Parties have developed an activity to field test, at selected sites, proven, commercially available, renewable energy technologies.

The tests will determine the feasibility of a variety of applications, ranging from wind energy for electricity generation to solar energy for water pumping. An important part of this activity will be to select those types of renewable energy which appear to have the best chance for being competitive at world energy prices. Testing will require monitoring and follow-up of actual maintenance and operating expenditures associated with the renewable energy applications being tested in order to determine their costs as compared to competing energy sources. The field tests will be coupled with an education, training and promotion activity which will seek to enhance the awareness of Egyptians on the potential of renewable energy in Egypt. However, the main purpose of these activities is to test the viability of renewable energy technologies in Egypt so that as the energy pricing structure changes, those technologies which have already been proved successful will be ready to come into widespread use.

C. Utility Management

A joint detailed review and assessment of the current and planned management development program efforts of both the Egyptian Electricity Authority ("EEA") and the Rural Electrification Authority ("REA"), is being undertaken. Recommendations will be translated into an appropriate activity. An understanding of the current organizational structure, admininstrative practices and procedures and managerial roles, is essential for the technical assistance required for expanding the power sector.

Utility management capabilities must be strengthened while assistance in policy planning and analysis is underway so that policy decisions which must be translated by management into implementable programs will be carried out by a cadre of well-trained persons.

II. Detailed Description for the Renewable Energy Field Testing Activity (Activity No. 123.2)

1. General Activity Description

The Renewable Energy Field Testing Activity has four major elements, viz. Field Tests, Supporting Analyses, Training and New Initiatives, through which the Grantee will:

- Collect and analyze information on selected renewable energy technologies in order to determine their technical, economic and social feasibility;

- Provide on-going technical support to the subproject through establishment of a broader data base, social, economic and market analyses, and supporting studies to evaluate existing field tests, identify new opportunities for renewable technologies and energy conservation, and determine where maximum impact from system replication is possible, as well as, provide planning support for interfacing with other Egyptian programs and follow-on activities;

- Provide training in system operation and maintenance to support and accelerate the building of the requisite technical infrastructure; also, provide information dissemination and technology transfer through training activities and operational experience to encourage acceptance and growth of renewable energy technologies; and

- Review, evaluate and support appropriate new initiatives in renewable energy to promote acceptance and replication in related industrial, agricultural and remote applications.

a. Field Tests

The Renewable Energy Field Testing activity will emphasize field testing of various technologies for Grantee-identified, high-priority needs and applications. Eleven applications involving four basic solar technologies have been selected and are recommended for field testing. Final selection of field tests will be based upon detailed analyses of available technologies to accomplish the individual field test objectives. System definitions of contending concepts, using actual application data, will be prepared and evaluated so that the final decision by A.I.D. and Qattara Hydro and Renewable Energy Project Authority ("QHREA") to proceed with each field test and its configuration will be based upon the best technical, social and economic options.

b. Supporting Analysis

This element will provide critical data and analysis needed for decision-making and activity implementation and will include four tasks: (1) The definition of additional candidate renewable energy technologies and applications and associated field tests; (2) the acquisition and analyses of technical and social data and the development of design and performance specifications required for specific field tests; (3) continuing economic and environmental analyses covering both currently planned and future field tests of renewable energy applications; and (4) the establishment of an information system on this and other Egyptian renewable energy activities as well as state of the art developments which will permit a judgment as to the feasibility of their replication within five to ten years.

(1) A number of renewable energy applications have been identified for potential field tests. The Parties will further analyze and define possible applications so that technical design parameters, size, and location of field tests are optimized. Once all of the pertinent information has been acquired for a specific application, analyses will be carried out to select the preferred field test sites.

(2) In the majority of the field tests proposed for implementation in this activity, design and performance specifications can be developed by analysis of existing data and a limited survey of technical requirements for each site. However, it is expected that, in some cases, existing data will be inadequate and potential sites will have to be more thoroughly instrumented to obtain all the required technical data. Examples include the acquisition and analysis of wind data, environmental conditions (sand, salt spray, water quality, and wind loadings) and plant operational and process heat requirements. Social data collection, will form part of the information system (task 4).

(3) The third task of this activity element involves several types of analysis to develop data necessary for the design of current and selection of future field tests within the activity. One class of analysis involves an intensive examination of the cost-effectiveness of the renewable energy technologies relative to conventional energy sources. The analysis will consider the effect of reduced solar system costs as a result of improvements in technology or higher production rates for solar systems; or the increased cost of conventional energy due to higher fuel costs; and considerations of system reliability, operations and maintenance, and fuel availability and transport. New cost-effective solar applications may also be identified based on these same factors. A second type of analysis will examine the size of the potential Egyptian market for various solar applications as a function of the energy

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requirement of the application, i.e., the number of shallow well pumping installations as a function of the required pumping energy. This type of analysis will be used to identify specifications for the optimum size of solar energy sources for different applications within Egypt. The analysis may also determine that certain sources may be cost effective for a number of different applications if they are within a given size range. In addition, continuous environmental analysis will be conducted on the field tests so that information can be made available on their impact.

(4) Task four, the establishment of an information system on Egyptian renewable-energy projects, will provide a mechanism for collection of social, environmental, institutional, economic and technical data on a continuing basis. The information will be important not only for activity monitoring and evaluation, but also for providing the basis for decision-making for future Egyptian activity in renewable energy. It is anticipated that the method of data collection used in the activity will be utilized for all other renewables projects so that a set of easily comparable, comprehensive data will be generated for analysis and dissemination.

In order to have comparative data it will be necessary to collect, for example:

i. Data on system design and on adaptations in system design.

ii. Data on measurements which are mostly physical data; that is, measurements of energy availability in sun, water, biomass of energy inputs and outputs for a system; operating data and data on work actually accomplished by a system measured in other than direct energy output.

iii. Impact and effectiveness data on both the technology and the project implementation strategies in terms of economic, social and environmental criteria.

The analysis of the data provided by the information system will be utilized by the Supreme Council on Renewable Energy. The information will be fed into the energy data bank of and be utilized by the Organization for Energy Policy and Analyses (OEPA) which will be seeking, in cooperation with this subproject, to provide information and analysis on the proper role of renewable energy in the overall energy sector.

c. Training

Training in this activity may be classified into three categories: general, field test-related and information dissemination:

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(1) General. Grantee personnel will be trained in areas such as project and contract management, energy management and economics and solar systems and engineering.

The policy and decision-makers, which include Ministry and Governorate officials and industrial executives, will be provided with a broad exposure to renewable energy technology and its potential. Several seminars are planned which will address the economics and impact of solar technology and cost projections. Two seminars per year will be given by U.S. experts in Egypt for from twenty to fifty persons per session. There will also be technical seminars given by QHREA as well as other Egyptian experts in areas not covered by the U.S. experts but particularly relevant to Egyptian needs. These seminars will be held twice a year for approximately twenty to fifty participants from both the private and public sectors.

Engineers and technical managers who are reponsible for implementing Goverment of Egypt energy policies, will receive in-depth technical training in theory and system design, enabling them to design, install and maintain renewable energy systems.

Short-term training of 120 person-months (four persons per year for six-month courses) will be given over the five-year life of project at U.S. institutions in the fields cited above. In addition, the Grantee will provide for five persons to attend at least two courses per year in Egypt over the five years of the activity.

(2) Field Test Training. User training will greatly affect the successful operation of the field tests. Site managers assigned by the QHREA to each field test will be trained at a U.S and/or Egyptian institution in aspects of renewable energy technology. On-the-job training by the U.S. sub-contractors will also be provided to the site manager and other site personnel and users. During installation of the field test, the site personnel will participate in all phases of activities.

(3) Information Dissemination. The Grantee will utilize visits to field tests, seminars, radio, television, brochures and printed reports to inform the public about solar energy and its use in Egypt. This information will be disseminated by QHREA, other Ministry of Electricity agencies as well as A.I.D. on a regular basis once the activity has begun. The contractor will work with QHREA on the form and substance as well as the best mechanism for dissemination of the information, which will form part of the information system to be developed during the first three months of the activity.

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All training tasks will be coordinated and integrated with activities being conducted under the Energy Policy Planning Activity.

d. New Initiatives

The Parties expect to receive both solicited and unsolicited proposals for new field tests during the activity, and the Supporting Analysis element will identify other field tests. Improved concepts will probably be formulated by the subproject as additional detailed experience in Egypt is gained. Criteria for selection and actual selection of New Initiatives will be determined by QHREA in collaboration with the prime contractor and A.I.D. The New Initiatives element will provide a resource for assessing the merits of any proposal or suggested concept for a renewable energy system field test as well as fund a limited number of new starts.

Proposals will be analyzed and evaluated for the technical soundness, feasibility, the projected cost-effectiveness, if implemented on a major scale, and the relationship to the renewable energy field tests and Grantee goals in the sector. The New Initiatives element will also support the initial selection functions required before the procurement of hardware. These functions include working with the QHREA and appropriate Egyptian organizations on selection of a specific site or sites for the proposed new field tests.

2. Implementation

This activity is planned for five years. The management structure for this activity is based on (1) the creation of an activity management coordinator and Egyptian activity manager and field-test site managers; (2) centralized planning and control by the subproject manager and the other organizations; and (3) decentralized activity executive, through administrative authority outside the activity and site managers' organizations by activity and site managers, but who take direction from the managers.

The activity contractor will be responsible to QHREA's project manager and, in a collaborative manner, provide the technical inputs to the activity. QHREA will be fully responsible for coordinating all field test entity activities, including site preparation for installation of equipment, human and financial resources for that installation, agreements with those entities for establishing a system for careful monitoring and data collection before and after the systems are installed. QHREA will be responsible for coordination with local participating ministries, governorate offices, companies, universities and CARE where applicable.

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Technical assistance will be provided by A.I.D. through a prime contractor who will coordinate U.S. inputs including goods and technical services. QHREA will be responsible for implementing host country activities with technical assistance and support supplied by the contractor and its subcontractors.

A formal reporting and information and control system will be established in accordance with A.I.D. requirements, the evaluation plan and QHREA needs. The system will summarize technical, managerial, and financial status, problems, and prospects compared to approved implementation and annual operating plans. In addition to the formal written system of reporting, a series of regular, formal meetings between A.I.D., the prime contractor and QHREA activity managers will be scheduled.

3. Evaluation

The activity will be evaluated from technical, economic and social viewpoints. The activity will be reviewed and evaluated annually by A.I.D. Two external evaluations will be financed by the activity, one near the mid-point of the activity after installation of the initial field tests and all activities have begun and one at the end of the activity. The specifics of the evaluations and the composition of the evaluation team will be detailed in the Activity Management Implementation Plan to be supplied by the contractor within three months of being contracted. Evaluations will be conducted jointly by A.I.D. and the Grantee, the external ones with the assistance of technical experts outside A.I.D.

The technical performance of the field test systems, including reliability and maintenance, will be monitored and evaluated throughout the life of the activity. Attention will be given to the specification of data requirements, the design and installation of instrumentation, and data collection and analysis of results.

A continuing analysis of the economics and social acceptance factors of the systems and applications will be conducted under the Supporting Analysis element and used in the evaluations. Price per unit of delivered energy, actual operation and maintenance costs, product yield, system efficiencies and displaced fuel will be factors considered. The evaluations will also compare the economics of the solar systems with conventional systems.

An important criterion to be used in the final evaluation of the activity will be whether there has been some move toward adoption in industrial and agricultural settings of systems and applications of technology which field tests have shown to be successful and replicable. Sociological aspects regarding the introduction, disposition, and long-range

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sustainability of the solar systems will also be considered in the evaluation. The involvement of communities and users will be of special interest. The ability of end-users to adapt to these new technologies and contribute to their installation, operation and maintenance costs will provide a measure of whether or not these systems are appropriate for the Egyptian environment. Finally, the reactions of policy-makers within the Government of Egypt and the private sector will be sought as field test experience is gained.

4. Illustrative Financial Plan

Table I provides a summary cost estimate for the activity. The total activity cost is $28.5 million. Of the projected A.I.D. contribution of $24.1 million, approximately $11.0 million is for field tests, $2.0 million for supporting analysis, $.8 million for training, $2.0 million for new initiatives, $2.4 million for activity management and $5.9 million for inflation, contingency, evaluation and other costs.

The Grantee contribution of the Egyptian pound equivalent of approximately $4.4 million will pay Egyptian salaries and in-kind contributions. Changes may be made to the financial plan by written agreement of the representatives of the Parties identified in Section 8.2 without formal amendment of the Agreement, provided such changes do not cause (1) A.I.D.'s Grant contribution for the Activity to exceed the amount set forth under Section 3.1 or (2) the Grantee's contribution for the Activity to be less than the amount set forth under Section 3.2.

Activity No. 123.2

TABLE I

RENEWABLE ENERGY FIELD TESTING

ACTIVITY ILLUSTRATIVE FINANCIAL PLAN

(US $000's)

ACTIVITY ELEMENTS	A.I.D. FX	A.I.D. LC	A.I.D. TOTAL	GRANTEE LC	GRANTEE TOTAL
FIELD TESTS	9,067	1,985	11,052	1,418	12,470
SUPPORTING ANALYSIS	1,580	315	1,895	205	2,100
TRAINING	650	185	835	75	910
NEW INITIATIVES	1,665	335	2,000	550	2,550
ACTIVITY MANAGEMENT	1,760	659	2,419	840	3,259
OTHER (Evaluation, Inflation, Contingency)	4,600	1,317	5,917	1,273	7,190
TOTAL	19,322	4,796	24,118	4,361	28,479