RENEWABLE ENERGY RESOURCES
FIELD TESTING

STATEMENT OF WORK FOR FIELD TEST #11
WIND FARM AT RAS GHAREB

JUNE 1986

FINAL

Prepared for

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Cairo, Egypt

U.S. Agency for International Development
USAID Mission: Cairo, Egypt

Submitted to

Louis Berger International, Inc.
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STATEMENT OF WORK

Design, Installation and Operating/Maintenance Training for a Wind Farm at Ras Ghareb, Egypt

SECTION

APPENDICES

LIST OF EXHIBITS

EXHIBIT

Design, Installation and Operating/Maintenance Training For a Wind Farm at Ras Ghareb, Egypt

1.0 PROJECT DESCRIPTION

1.1 Background of the Renewable Energy Resources Field Testing Project

The Government of Egypt herein referred to as (GOE) and the U.S. Agency for International Development (USAID) have initiated a four year renewable energy resource field demonstration project (REFT). The Egyptian Electricity Authority (EEA) and Louis Berger International, Inc. are leading a team of subcontractors in the REFT project activities that encompass solar industrial process heat, wind and photovoltaic system applications.

The specific objectives of the GOE/USAID project are twofold: (1) to demonstrate, analyze and evaluate the viability of commercially available renewable energy technologies in Egypt, (2) to establish the infrastructure necessary to ensure that successful renewable technologies are available for widespread use in-country. Three tasks are planned:

(1) Field Tests - Assessment of some selected renewable energy systems/ applications which could be suitable for commercial use in Egypt; develop detailed engineering design hardware specifications and system performance requirements; prepare RFP packages for procuring equipment; supervise the work of hardware contractors; and collect and evaluate data generated from the field tests.

(2) Supporting Analysis - Conduct technical, social, financial, economic, and market analysis of renewable energy systems related to the field tests. Develop a computerized Renewable Energy Information System (REIS).

(3) Training - Improve the skills of the GOE and the private sector in evaluating renewable energy technologies, applications, economics and markets, and provide technical assistance in systems design, installation, operation and maintenance.

The field test task consists of eleven separate renewable energy system application demonstrations; five solar industrial process heat applications, three photovoltaic system applications and three wind system applications. One wind system field test is a demonstration of a grid-connected wind farm at Ras Ghareb along the Red Sea coast in Egypt.

1.2 Summary of Bidder Requirements

The contractor shall submit a proposal for the design, purchase and installation of an instrumented multi-unit wind farm interconnected with an existing gas-powered grid distribution system at Ras Ghareb, Egypt. The proposal shall also include training programs with appropriate classroom, field and in-factory sessions including training materials and manuals, for EEA engineers as well as local Egyptian operators of the wind farm and for local maintenance technicians. The contractor shall support operation of the system for a period of two years after the system is accepted by the EEA.

The hardware shall be commercially available and proven by reliable use in similar wind farm applications. Packaging and shipment of all required hardware to Alexandria, Egypt shall be the responsibility of the contractor. Transportation from Alexandria to the Ras Ghareb wind farm site is the responsibility of the Contractor. The EEA is responsible for custom clearance and permits for required construction or transportation permits, as needed.

The contractor proposal shall define in detail all site preparation procedures, specificatons and interconnect requirements for installation of the wind farm. All site preparation, including the construction of turbine tower foundations and access roads will be the reponsibility of the EEA under contractor supervision. Purchase of transformers, switch gear and interconnect of the wind farm to the Ras Ghareb grid is the responsibility of the contractor.

1.3 Description of the Wind Farm Site

Ras Ghareb is a village of 50,000 to 60,000 people on the Red Sea coast, across the Gulf of Suez from the sourthern part of the Sinai, approximately 320 kilometers from Cairo (see Exhibit 1). The village was settled to support a large drilling and oil production industry in the region that is operated by the GOE-owned General Petroleum Company (GPC).

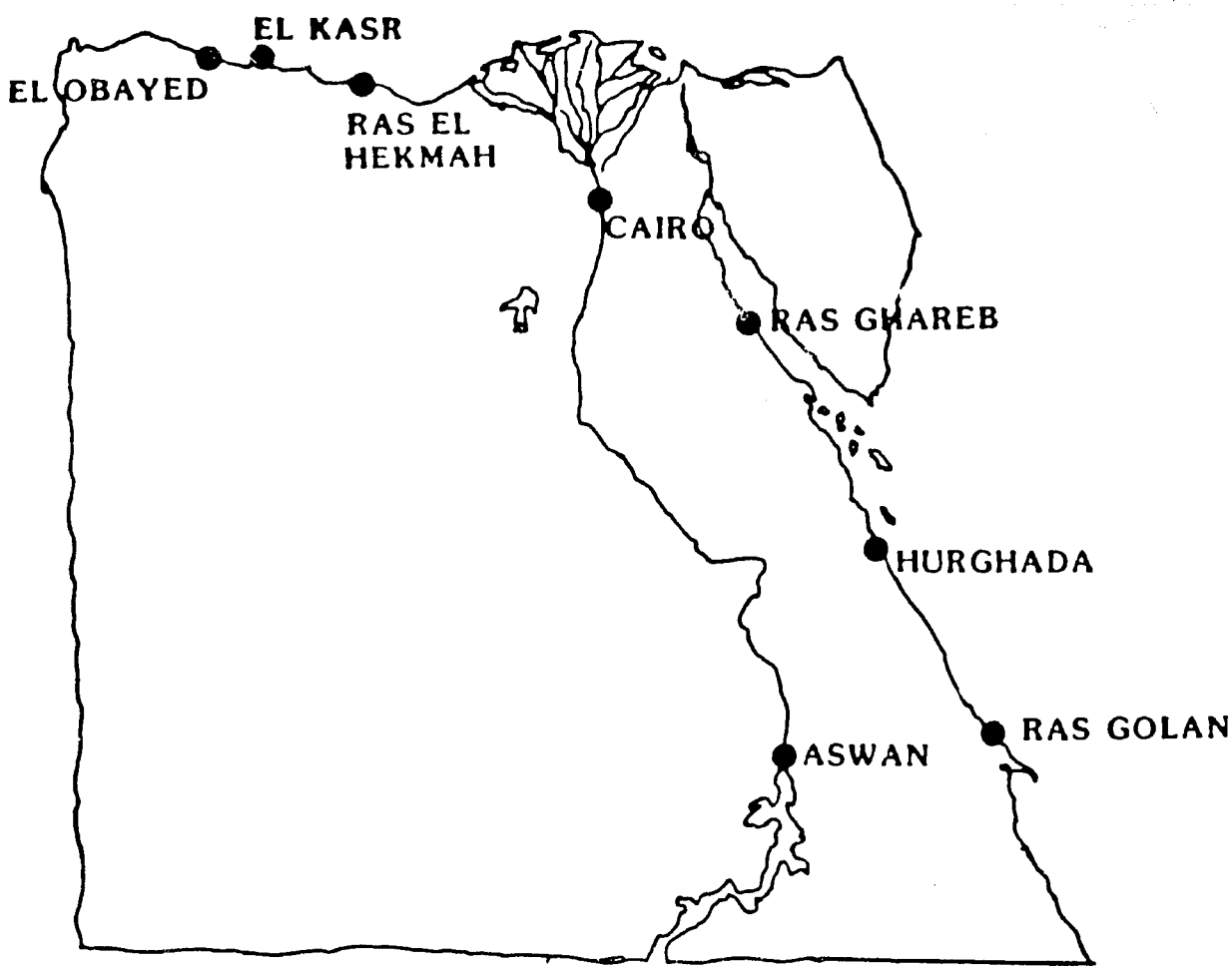


Exhibit 1. Location of Ras Ghareb, Egypt

The wind farm site is approximately two kilometers inland on a ridge line with an unobstructed view to the prevailing northeast winds that blow through the Gulf of Suez (Appendix A). The site is a few kilometers south of the Ras Ghareb village at an elevation of approximately 42 meters above sea level (Appendix B). The site is approximately 200 meters from a 6.6 KV GPC transmission line. The entire region consists of open, treeless desert with low, gently rolling hills.

1.4 Existing Energy System at Ras Ghareb

Ras Ghareb is supplied with 380/220 volt, 3-phase, 50 cycle electrical power from two power plants, one operated and maintained by the General Petroleum Company (GPC) and one by the Egyptian Electricity Authority (EEA). The GPC power plant has two 3-MW gas-fired turbines to meet an average 2.7 MW load demand. The load consists of mostly oil drilling and pumping operations but does include about ten percent of the village power demand. Two 3-MW turbines are used to maintian a 100 percent backup generating capacity because of the critical nature of the oil industry operation.

The EEA power plant consists of two 5-MW gas turbines powered with light "solar" oil that are currently used to supply approximately 1.1 MW of power to satisfy about 90 percent of the village load. A grid distribution system interconnects the various outlying oil fields and the village residences with the respective power plants. There are two distribution systems; 6.6 KV lines for GPC and 11 KV lines for EEA, both overhead and underground lines.

The GPC is planning for a significant growth in the industrial load demand in the Ras Ghareb region as new oil fields are developed and interconnected with the existing grid. In order to maintain a required 100 percent power generation back-up capacity, the GPC is currently installing a new 5-MW gas-fired turbine. This new turbine will become the primary power source for GPC. The two existing 3-MW turbines will be used for back-up. Future total on-line

capacity for the Ras Ghareb power generation system will be 15 MW, with an additional 6 MW backup, shared by two separate distribution systems.

1.5 Summary of Wind Resource Data

There are two major historical sources of wind velocity and direction data for the Ras Ghareb area that indicate a substantial wind resource. One source consists of data gathered by Oklahoma State University for the Egyptian Wind Energy Resource Study (four months of the data were published in November 1979). The other source is the "Harbor Station" which is an Egyptian meteorological station that has been recording wind velocity and direction for the past three to five years. Both of these stations are located along the coast line, at a lower elevation and east of the wind farm site. In general, measurements taken from these sites indicate an annual average wind velocity of 6.4 to 7.3 meters/second (1978 Okalhoma State data and 1983 Harbor Station data respectively).

Under a USAID/Cairo contract with Battelle Pacific Northwest Laboratories, a one-year wind resource assessment of Egypt is being conducted. As part of this effort, a 20-meter tower was installed at the Ras Ghareb wind farm site in late March 1985. Wind velocity and direction sensors are mounted at 10 and 20 meters above ground level. Monthly average wind speeds at the wind farm site range from a low of 6.2 meters/second in February at 10 meters to a high of 10.5 meters/second in June and September at 20 meters. The annual average wind speed is approximately 8.6 meters/second at 20 meters.

Detailed wind resource data for the Ras Ghareb area for use by contractors in response to this request for proposal are presented in Appendix B.

2.0 WIND FARM SYSTEM DESIGN

2.1 Schedule for Wind Farm Design

Within 14-days after contract award, the Contractor shall submit a schedule for design of the proposed wind farm for EEA/USAID review The schedule

for design will be approved in writing (or an alternate recommended) by the Contracting Officer within 14-days of receipt in Cairo. The Contractor shall complete a preliminary design within 30-days of notification by EEA/USAID of the design schedule approval. As a minimum, the preliminary design for the wind farm shall include:

(1) an illustration of the wind farm equipment and layout

(2) a functional block diagram

(3) a description with specifications of all major assemblies and sub-assemblies

(4) wiring diagrams and schematics as appropriate to undertand the installation and operation of the wind farm and its control system

(5) Site preparation requirements and foundation specifications and drawings

(6) tables listing equipment supplied and equipment required but not supplied

(7) a schematic and equipment list (including technical specifications) for the interconnect of the wind farm to the Ras Ghareb grid.

(8) a detailed description of the data acquisition system

This design shall be reviewed by EEA/USAID and/or its authorized representative and approval to proceed given before the initiation of system fabrication as outlined below.

2.2 Design Reviews

The EEA/USAID, or its authorized representative, shall have the right to review drawings and specifications pertaining to the design of the wind farm. Submission of the drawings and specifications for review and the completion of the review will be in accordance with the "Schedule for Wind Farm Design" submitted by the Contractor and approved by the EEA/USAID. The EEA/USAID shall have the right to require modifications to the designs for specified cause, namely: for minimum safety, prevention of harm to personnel and the environment, prevention of significant harm to property or equipment, meeting of minimum

specifications, or jeopardy of General Petroleum Company operations. Included will be the review of the design of electrical generation facilities and the interconnecting system. The EEA/USAID shall have the right to require modification to the design as it deems necessary for proper operation of the wind farm in parallel with GPC/EEA power systems and for disconnect of the wind farm in the event of power outages of either the existing power system or the wind farm.

The Contracting Officer, or authorized representative, shall have the right to be present during the time of major component or system performance testing at the point of manufacture. The Contractor shall notify the Contracting Officer of the date, time and location of such tests at least 10 days prior to testing. Written results of the tests shall be supplied to the Contracting Officer within two weeks of completion.

2.3 General Design Requirements

The wind farm design shall conform to acceptable commercial and standard U.S. industry practice with all equipment sited and sized for efficient and functional use. The American Wind Energy Association standards shall be used as a guideline. Operating and maintenance personnel safety shall be an integral part of the system design. All proposed equipment shall be commercially available and of demonstrated reliability (see Section 4.2); the use of prototype or one-of-a-kind hardware is not acceptable. A minimum operational lifetime expectancy of 25 years in the local Egyptian environment is required. All hardware is to be treated to withstand the environmental conditions specified in Section 4.4.

2.4 Technical Design Requirements

2.4.1 System Sizing

The Contractor shall size the wind farm based on the measured Ras Ghareb wind resource characteristics given in Appendix B. All power generated will be fed to an existing grid distribution system. The wind farm sizing must satisfy

the following design constraints or the contractor must clearly state noncompliance with specific constraints and explain why the noncompliance should be acceptable to the EEA/USAID.

Maximum Size	400 kW
Minimum Annual Energy Production	625,000 kWh (see Section 4.1)
Minimum Survival Wind Speed	54 meters/second (averaged over a period of 15 minutes)

2.4.2 Control System Design

The wind energy conversion system shall employ fail-safe controls to protect the rotor from overspeeding in winds greater than its rated speed. The control system shall also provide for automatic starting when the wind speed drops below the cutout value. A manual control for shutting the machine down to to allow for system maintenance and repair shall be a part of the control system.

2.4.3 Grid Stability

The design and operation of the wind farm must cause no instability to the existing GPC power plant at Ras Ghareb and the existing electrical grid system. The tolerances shown in Sections 2.4.3.1 must be met at all times when the wind turbines are coming on or off-line or operating normally. Any instabilities caused by the wind turbines will be treated as failure to deliver power per Section 4.2.

2.4.3.1 Electrical Tolerances

The following tolerances must be met to deliver power of acceptable quality:

- o Frequency: 50 Hertz $\pm$ 0.5%
- o Voltage: 380 Volts $\pm$ 0.5%
- o Power Factor: Maximum of 0.8 lagging
- o Harmonics: Maximum of 3% of the fundamental.

EMI characteristics of the wind turbines will conform to general standards established for the California wind farms. The contractor at his own expense will correct any EMI levels found unacceptable at any time during construction or operations. Rotor blades must be constructed of wood or fiberglass. No metal blades are acceptable.

2.4.3.2 Electrical Interface

All electrical connectors and terminals including slip rings must have high resistance to temperature, dust, and corrosion. Other equipment such as lightning arrestors, and safety features (breakers, fuses, etc.) must be compatible with EEA electrical codes and be located at ground level for easy operation and maintenance. The contractor shall furnish and install all required equipment to configure the wind farm for electrical interconnect to the existing grid distribution system and to insure personnel safety. Such equipment shall include, but not be limited to, relays, meters, power circuit breakers, sychronizers and any control and/or protective devices. The switchgear and transformers required for electrical interconnect to the existing GPC 6.6 kV transmission line shall be specified, purchased and installed by the contractor under the supervision of EEA engineers. The interconnect grid line is approximately 200 meters from the wind farm site.

3.0 WIND FARM SYSTEM INSTALLATION

3.1 Plan and Schedule for Construction

Within two weeks of EEA/USAID approval of the design of the wind farm, the Contractor shall submit a "Plan and Schedule for Construction" to the Contracting Officer for approval. The plan shall identify any special needs such as specialized equipment, etc. the Contracting Officer will approve the Plan/Schedule, or recommend changes required for approval within two weeks of receipt in Cairo. All construction work shall be completed and the wind farm

shall be interconnected to the grid within 30 days of completion by EEA of site preparation activities and notification to the contractor that the wind farm system hardware is at Ras Ghareb.

The EEA/USAID, and/or an authorized representative, reserves the right to periodically inspect all phases of the work while in progress or after completion of the whole or any part thereof to insure that the work is performed in compliance with the terms of the contract. If EEA/USAID determines that the work is not performed in accordance with the specifications, they reserve the right to require that the work be corrected of deficiencies or be redone if corrections cannot be made acceptable or are too extensive to economically correct. Any part of the work that is redone shall be the Contractor's expense. All work related shall be available at all times for examination by the EEA/USAID Contracting Officer. The Contractor shall provide all necessary facilities for such inspection during contractors regular working hours, if necessary. It should be clearly understood that such inspection shall not constitute acceptance by the Contracting Officer of any part of the work, but will be for the purpose of coordination and assistance in interpretation of specifications and technical requirements.

3.2 Use of General Petroleum Company Facilities

The General Petroleum Company (GPC) is an Egyptian government-owned oil company that will be operating and maintaining the wind farm for and in cooperation with the Egyptian Electricity Authority. The GPC routinely drills for and produces oil from fields in the Ras Ghareb region. The GPC constructs and maintains all their own rigs, including off-shore rigs, and installs their own transformers and switch gear for local electrical transmissions lines, both above and below ground. Whenever possible, GPC equipment will be available for use by the contractor at no charge. The contractor shall include as part of

the bid, a comprehensive list of specialized equipment required to install the wind farm such as backhoes, cranes and heavy transportation equipment. The ability for GPC to provide this equipment will be discussed during final contract negotiation.

If at all possible, the GPC will also provide meals and lodging accommodations in company-owned guest houses in Ras Ghareb for senior engineering and technical personnel for the period of time required for the wind farm installation. Necessary arrangements for these facilities will be made through the EEA. Accommodations for the local labor force must be provided by the contractors.

The contractor shall specify the number of U.S. personnel required for the wind farm installation and the expected duration of the construction period. Lodging and per diem costs for the installation crew shall be a separate cost item in the cost proposal and costed as if the GPC cannot provide such services.

3.3 Site Planning and Construction

All required soil investigations shall be identified in the proposal by the Contractor. There are no existing soil boring data for the Ras Ghareb wind farm site. The Contractor shall include in the proposal a complete report of minimum soil conditions which are necessary for the proposed design of the foundations, earthwork, and drainage, and methods to prevent or minimize erosion.

Any demolition work or clearing, required within the land area of the project shall be the responsibility of the contractor. The site shall be graded for good drainage. Adequate, safe roads and walkways shall be provided as required for facility access. A site grading plan shall be provided by the contractor within 10 weeks of the contract award as part of the Preliminary Design. All site grading shall be completed by the contractor in accordance with the contractor site grading plan.

The contractor shall specify requirements for tower foundations and cost these as a separate item in the cost proposal. In lieu of soil boring data, foundation specifications and cost shall include the minimum and maximum expected based on a range of soil conditions.

The contractor shall provide a building (at least 60 square meters) at the wind farm location for the following purposes:

a. Small conference room for meetings and training of 5 to 10 personnel.

b. Office space for O&M personnel.

c. Space for the wind farm instrumentation system.

d. Limited area for visitors and information aids.

e. Toilet facilities (chemical).

The building shall withstand the environment specified in Section 4.4 for 25 years.

Installation of utility lines and/or conduit pipes to the point of connection to the existing lines, including all transformations from distribution to utilization voltage as may be required, will be the responsibility of the contractor. The contractor shall furnish all material, complete required excavation work and make the final connections, under the supervision of GOE engineers.

Within one month of system acceptance and commencement of electrical service (see Section 7), the Contractor shall enter all changes and corrections to the original wind farm design incurred in the wind farm installation on the original tracings. Changes and corrections so entered shall be indicated by a lettered circle, and noted as "As-Built" in the revision. In the case where no revisions or corrections to an individual drawing were necessary, the notation "As-Built-No Changes" shall be made directly below the revision block. Where several manufacturers' brands, types or classes of items listed have been used in the project, the specific areas where each item was used shall be designated.

Designations shall be keyed to the area and space designations on the contract drawings. Information shall be furnished, typewritten, for the listed materials. Copies of the "As-Built" drawings shall be given to the Contracting Officer.

The Contractor is encouraged to use local Egyptian labor and in-country fabrication of subsystems whenever possible. Low-cost fabrication techniques should be emphasized. The proposal shall discuss the extent to which the proposed system can be constructed and installed by local labor using local materials should the system be replicated elsewhere in Egypt. The contractor shall indicate where this approach has been taken with this or similar equipment in other developing countries.

4.0 OPERATION AND MAINTENANCE

4.1 Schedule of Energy Production

The Contractor shall include in the proposal an "Initial Energy Production Plan and Schedule." This document shall contain, but is not necessarily limited to monthly projections for twelve months of electrical power generation from the wind farm based on the wind data in Appendix A. A complete description of how these projections were computed, including descriptions of any computer models used, is required. Input parameters to any model shall be given including turbine power curves and tables of power output and energy production. Tables should be presented as output parameter values versus 10 minute concurrent average wind speed in one meter/second increments. Operating characteristics (cut-in, cut-out, rated velocities, etc.) for the turbine used to estimate the power production should also be included. In addition, a table of expected daily energy production (kWh) versus average wind speed is required for performance verification and system test acceptance (Section 7).

Planned scheduled outages during the upcoming year and planned changes in equipment, control mode, or operating characteristics significantly impacting the energy production of the wind farm will be given, if applicable. The wind

farm shall be operated with all the appropriate protective apparatus in service whenever any of the wind generators are connected to, or are operated in parellel with, the base electrical system. The wind farm and its protective apparatus shall be operated and maintained in accordance with applicable standards and engineering practices, including, but not limited to, control of line synchronization, voltage, power factor, frequency, and harmonic content to meet the specifications outlined in Section 2.4.3.

4.2 Wind Farm Availability

All the wind farm components must have a mean-time-between-failure (MTBF) of not less than five years and a 95% system reliability under the environmental conditions described in Section 4.4. The system operational life will be at least 25 years. A 90% availability must be previously demonstrated for the proposed equipment in conditions similar to those in Section 4.4 for a period of at least 6-months. Ease of maintenance and repair should be a priority consideration in the wind farm system design.

4.3 Guarantee/Spare Parts Requirements

The contractor shall provide at least a two-year guarantee on all parts from the time of EEA/USAID system acceptance. An option for a 5-year guarantee shall be included as a separately costed option. The contractor shall separately cost an itemized list of spare parts that should be purchased by EEA/USAID and made available to insure trouble-free operation (90% availability) for five years. Any specialized, custom manufactured tools, equipment or instrumentation required for operation and maintenance of the wind farm shall be specified and provided by the contractor.

4.4 Environmental/Climatic Conditions

The contractor shall unequivocally state in the proposal that the proposed

wind farm will operate as specified in sections 4.1 and 4.2 in the environmental conditions specified below. The contractor shall describe in detail measures that would be taken to protect all hardware installed in an environment of airborne dust and sand and salt spray typical of near-shore applications. The contractor shall describe measures to protect hardware in a sulphur environment that has caused moderate to severe corrosion to unprotected and simple galvanized metals. All parts shall be certified to withstand these conditions for the 25 year life expectancy.

Wind: The wind turbine shall operate in wind speeds from any direction greater than the specified cut-in windspeed and less than the cut-out wind speed for the turbines proposed. The turbine and tower shall be capable of withstanding wind speeds of up to 54 meters/second averaged over a period of 15 minutes.

Temperature Range: Ambient air temperature range of -5° to 55° degrees centigrade.

Humidity: up to 95%

Other: Protection of wiring and/or tubing from desert rodents

4.5 Operations Support

The contractor is required to provide technical support of the operation of the system for a period of 2 years after system acceptance by EEA/USAID. The contractor's proposal shall describe the level of support offered, the procedures for management and control of the technical support and related support issues such as availability of spare parts, anticipated response time to a request for support, etc. This technical support shall be costed as a separate cost item in the contractor's cost proposal.

5.0 PERFORMANCE MONITORING

5.1 Field Test Data Acquisition System

The contractor will provide an on-site data acquisition system (ODAS) for monitoring the performance of hardware installed for this field test. This

requirement is in addition to any other requirement for system control instrumentation and instrumentation necessary for routine test and maintenance checks as specified in Sections 2.4.2 and 4.3 of this statement-of-work.

The ODAS will comply with the specifications listed in Appendix D of this statement-of-work and will monitor, as a minimum, the data parameters listed in Appendix D. The contractor will provide output ports and transducers to sample and measure each data parameter as specified in Appendix D and to insure compatibility with the data storage system proposed.

The contractor will also provide a separate meteorological station to monitor data parameters as specified in Appendix D. The meteorological station will have its own data recording system that is compatible with the ODAS.

If an exception must be taken to any of these instrumentation requirements, the contractor will clearly note the exception and explain why the exception should be acceptable to the EEA/USAID.

5.2 ODAS Installation and Training

The contractor will install the ODAS at the same time that the field test hardware is being installed. Training for Egyptian engineers and technicians in the installation and operation of the ODAS will be included in the on-the-job training program described in Section 6 of this statement-of-work.

The ODAS instrumentation and installation shall be a separate item in the cost proposal for this field test. The EEA/USAID reserves the right to replace or modify the proposed ODAS during contract negotiation if required to maximize compatibility with other data collection, analysis and storage requirements of the REFT Project.

5.3 Log Sheets/Maintenance Records

The contractor shall develop, as part of the proposal, a log sheet of

pertinent data that should be manually recorded on each major subsystem to document operations and maintenance history. The recommended frequency for maintenance of each item shall be stated. These logs/records should comply with the specifications outlined in Section 8. In addition, the Contractor shall include in the proposal maintenance records (including cost of parts and labor) of proposed equipment installed in similar wind farms, if available, as an example of actual maintenance history for this type of equipment.

6.0 TRAINING REQUIREMENTS

The contractor is required to support the operation of the wind farm by GPC engineers and technicians for a period of two years after system acceptance by the EEA/USAID. In addition, a series of trainining programs will be developed and presented by the contractor for this project. These training programs fall into three general areas; classroom training in Cairo, in-factory training in the U.S. and on-the-job training at Ras Ghareb, Egypt. Training sessions and materials vary in content and presentation from informal "one-on-one" type instruction to more formal group "lectures and workshops." The sections below describe the training requirements in as much detail as possible at this time. The proposed training program must be flexible enough to conform with the inevitable changes and revisions in the wind farm field test as the project proceeds. All training sessions will be conducted in English and all materials will be written in English and Arabic.

6.1 Operator Training Program

The contractor is required to operate the wind farm for an acceptance testing period of 30 days after the wind farm is designated as operational by EEA/USAID (see Section 7). This activity shall be accomplished by on-site contractor personnel. During the acceptance testing time period, the contractor will provide a training program in Ras Ghareb and Cairo in the operation of the

wind farm to selected EEA and GPC operating personnel. The operations program shall consist of a minimum of 20 hours of classroom training and 80 hours of on-the-job (OJT) field training.

As part of this proposal, the Contractor shall develop a syllabus that briefly summarizes topics and content of the classroom design training program. It is assumed that the OJT field training will consist of selected EEA and GPC personnel accompanying the contractor personnel during normal daily operational tasks. The contractor shall briefly describe, as part of this proposal, the itinerary of wind farm operating personnel on an average day. The itinerary should take into account the demonstration nature of this field test, i.e., the wind farm may be more carefully instrumented and monitored than the average U.S. "operational" wind farm and Egyptian engineers and technicians must understand the function and operation of any specialized equipment and instrumentation.

6.2 Maintenance Training Program

During the 30-day acceptance testing operation of the wind farm by the contractor, the contractor shall provide on-the-job (OJT) training programs for maintenance of the wind farm to selected EEA/GPC maintenance personnel. The OJT maintenance program shall consist of a minimum of 20 hours of classroom training and 140 hours of field training.

As part of this proposal, the contractor shall develop a syllabus that briefly summarizes topics and content of the classroom maintenance training program. It is assumed that the field training will consist of selected EEA/GPC personnel accompanying the contractor personnel during normal daily maintenance tasks. The contractor shall briefly describe, as part of this proposal, the itinerary of wind farm maintenance personnel on an average day.

6.3 In-Factory Training Program

The contractor is required to provide a training program on the Ras

Ghareb wind farm design methodology and results. The training program will be conducted in the contractor's facility for selected EEA/GPC engineers and authorized representatives (approximately 3 to 5 personnel) for approximately 7 days. An additional part of this in-factory program will be a tour of the contractor's facility and the opportunity for visiting Egyptian engineers to observe U.S. turbine manufacturing procedures and factory tests on subsystem and system components. The factory visit and training program will be completed over a period of ten to fourteen days. All the personal expenses for the visiting engineers are the responsibility of EEA/USAID. As part of this proposal, the contractor shall develop a syllabus for the in-factory conceptual design classroom training program and a suggested itinerary for the visit.

7.0 SYSTEM ACCEPTANCE TEST CRITERIA

As stated in Section 6.1, the contractor is required to operate the wind farm with on-site personnel for an acceptance testing period of 30 days after it is designated operational by EEA/USAID. This designation will be based on the contractor's certification that the wind turbines and control system are operational and the EEA/USAID's certification that the interconnect with the existing grid is completed. The contractor must demonstrate a 90 percent availability for the wind farm while generating at least 90 percent of the kilowatthours of electricity specified in the "Initial Energy Production Plan and Schedule "(Section 4.1) over any continuous 14-day period within the 30-day acceptance testing period of performance. If the energy production for the period is lower than that specified, the contractor must demonstrate, to the satifaction of EEA/USAID and/or its authorized representative, that the reason for the lower energy production was the wind resource over the period of time and not the fault of the wind turbines or the control system. The energy production will be measured by the ODAS supplied by the contractor as described in Appendix D.

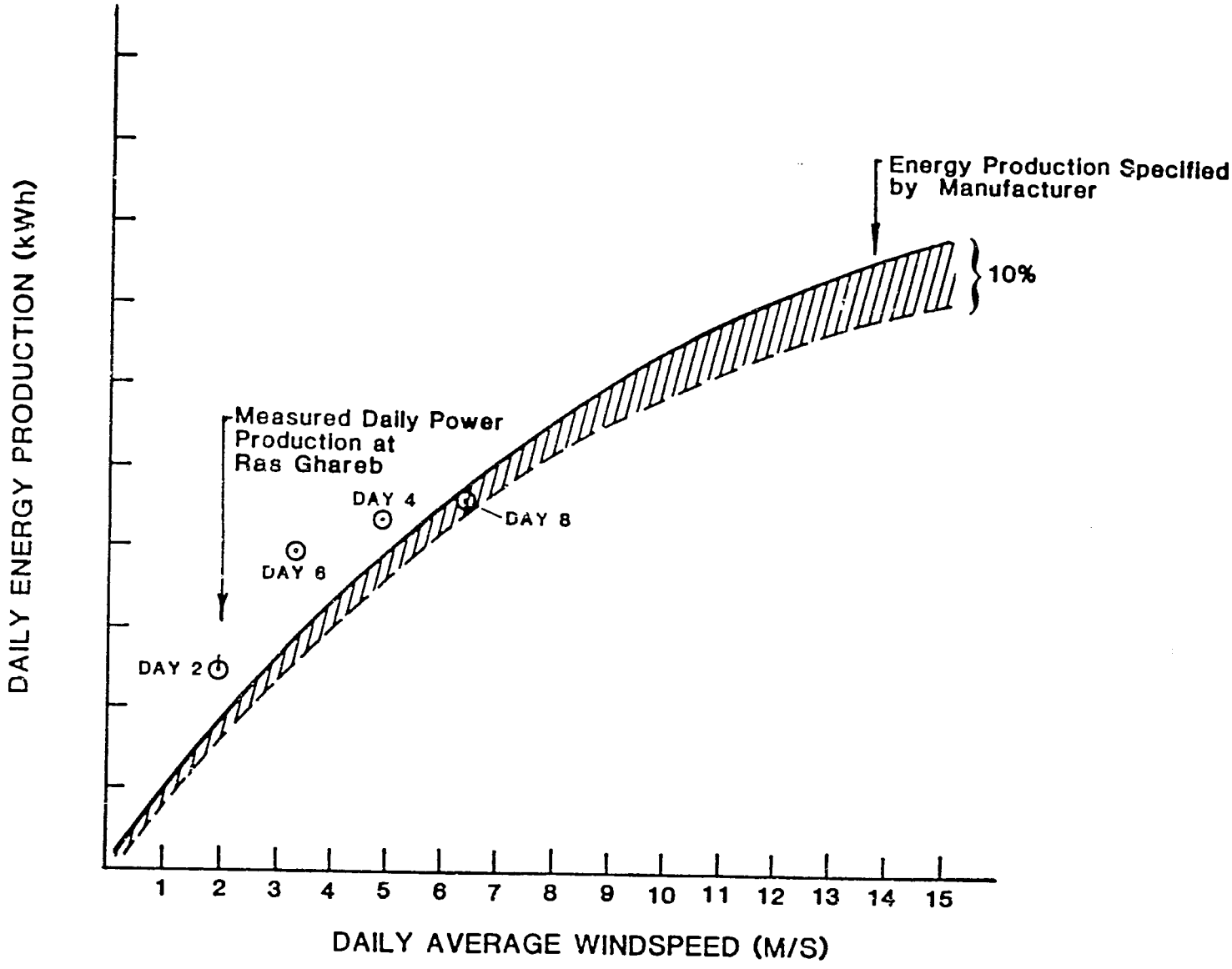


EXHIBIT 2 ***TURBINE PERFORMANCE VERIFICATION***

In addition, daily energy production for each turbine as recorded by the ODAS during the continuous 14-day period must be no less than 90% of the manufacturers performance data provided in the proposal in the "Initial Energy Production Plan and Schedule" (Section 4.1). The performance comparison will be based on measured average daily wind speed for each applicable day during the 30-day performance period. A curve such as that shown in Exhibit 2 will be used to compare the manufacturer's performance specification for each turbine with the measured power production.

The contractor shall fully document any and all operating and maintenance activities that occur during the 30-day acceptance testing period of performance and submit a report to the Contracting Officer within 30 days of the completion of the system acceptance test.

8.0 WIND FARM OPERATIONS AND MAINTENANCE MANUAL

The contractor shall provide a manual prepared to the minimum content listed below. The manual is to be used for operation, maintenance and logistic support of the wind farm system. The manual shall be delivered to EEA/USAID for review at least 30 days prior to arrival of equipment in Egypt. All manuals shall be in English with emergency instructions written in both English and Arabic. Manuals will be revised as needed and a final set submitted not later than 30 days after completion of the 30 day testing period. The minimum requirements for the manual shall include chapters on the following subjects:

1) System Description

This chapter shall include but not be limited to the following:

- a full page composite illustration of the wind farm equipment and layout
- illustrations calling out the major assemblies and sub-assemblies
- a comprehensive description of the type of equipment and its purpose
- a function block diagram

- tables listing equipment supplies and equipment required but not supplied, (i.e., GPC supplied equipment)

- tables of technical, environmental and physical characteristics, as appropriate

2) System Installation

This chapter shall include:

- information on unpacking and proper location of units

- interconnections and initial pre-operational adjustments

- details of cables and ground requirements and cable fabrication (as applicable)

- waveforms of voltage at significant points in the system circuity

3) System Operation

This chapter shall include:

- step-by-step procedures for starting, operating and stopping the equipment

- meter readings and/or results expected from properly adjusted and operated equipment

- tables and illustrations calling out all operational controls and indicators and their functions (all references to controls and indicators throughout the manual shall follow these designations)

4) Principals (or Theory) of Operation

This chapter shall include:

- a functional description of the equipment, based on a block diagram

- for complex mechanical features, a complete explanation, using block diagrams, exploded views or cutaway drawings.

- major assemblies broken into individual circuits, accompanied by complete circuit analysis keyed to simplified schematic

- brief description of conventional circuits

- detailed descriptions of complex and novel circuits

- waveforms of voltage at significant points in pulse or digital circuits

5) Maintenance (Preventive/Corrective)

This chapter shall include:

- a schedule of detailed maintenance adjustments and procedures
- a list of required test equipment provided by the contractor
- lubrication data
- information that permits a technician to locate trouble and to make repairs or adjustments to the equipment
- for complex equipment or where the procedure is not obvious, an outline of disassembly and reassembly procedures
- details of special test procedures
- completed adjustment and maintenance information for relays and other electro-mechanical devices.
- oscilloscope waveforms illustrated with peak voltage, duration, repetition rate, and control positions, as appropriate

6) Parts List

The parts list shall consist of a tabulation of descriptive data on all electrical components and repairable/replaceable commercial or vendor mechanical components in the equipment. All parts shall be sufficiently described to implement reorder/replacement. The parts list shall contain at least the following information:

(a) Reference designation

(b) Name and description of part

(c) True Manufacturer's code and part number (and list of manufacturer's codes and addresses)

(d) Quantity

7) Drawings

In addition to drawings previously specified, the following shall be included:

(a) Schematic diagrams of individual major components, printed wiring boards and/or the completed equipment

(b) Logic diagrams

(c) Interconnection diagrams

(d) Cabling diagrams

(e) Wiring diagrams

(f) Dimensional drawings of all important components with material specifications

9.0 SPECIAL PROVISIONS

9.1 General Petroleum Company Property

The GOE shall make available to the Contractor, for use in connection with and under the terms of this Contract, the GPC property agreed to during contract negotiations and described as Government-Furnished Property. The schedule dates for the services to be furnished by the Contractor under this Contract are based upon the expectation that Government Furnished Property suitable for intended use will be delivered to the Contractor in sufficient time to enable the Contractor to meet such schedule dates. In the event that Government-Furnished Property is received by the Contractor in a condition not suitable for the intended use, the Contractor shall, upon receipt thereof, notify the Contracting Officer of such fact and, as directed by the Contracting Officer, effect repairs or modifications at Government expense. The GOE shall not be liable to suit for beach of contract by reason of any delay in delivery of Government-Furnished Property or delivery of such property in a condition not suitable for its intended use.

Title to all property furnished by the GOE for use in the performance of this Contract shall remain in the Government. In consideration for the Contractor's use of GOE property, the Contractor shall maintain and administer, in accordance with sound industrial practice, a program for the utiliziation, maintenance, repair, protection and preservation of Government property so as to assure its full availability and usefulness for the performance of this contract. The contractor shall take all reasonable steps to comply with all appropriate

directions or instructions which the Contracting Officer may prescribe as reasonably necessary for the protection of the Government property. The contractor shall promptly report any loss, theft, misuse, or material demage to the GOE property to the Contracting Officer. Use of GOE property shall be returned to the Government at that time, or earlier if the property is no longer needed.

9.2 Site Access and Local Labor Provision

Employees and representatives of the Contractor and personnel conducting business with the Contractor relating to this Contract, will be granted a revocable permit to enter Ras Ghareb for the purpose of installation, operation, and/or maintenance of the facilities and equipment providing electrical energy under this Contract. Access to and movement within this area are subject to restrictions and provisions of the security instruction in effect.

It is the Contractor's responsibility to maintain satisfactory labor relations with employees. Representatives of the Contracting Officer will not participate in labor relations matters unless disputes develop that interfere with the proper performance of the contract, at which time the representative may endeavor to assist in settling the difficulty. The contractor is encouraged to hire local labor whenever possible.

9.3 Protection of the Environment and Personnel

During all operations, all GOE and local environmental and labor requirements shall be rigorously observed. The GOE will retain the right to suspend any operation judged to present an imminent threat to the environment or personnel, or a violation of applicable labor laws and regulations or natural resources management agreements, after giving notice to the Contractor.

9.4 Public Release Information

There shall be no public release of information or photographs concerning the aspects of this Contract or other documents resulting from this Contract without prior written approval of the Government of Egypt.

9.5 Pre-Award Survey

The EEA/USAID may make a pre-award survey of the facilities of any apparently successful bidder to determine whether or not such bidder is adequately qualified to perform the requirements of any Contract that may be awarded on the basis of this specification. Investigation may be conducted to determine that the Contractor does regularly engage in the performance of work of the type covered by the specification and has a satisfactory record of performance in this field. The bidder is required to submit information, as well as any other related material, requested by EEA/USAID audit agencies during the course of the pre-award survey.

9.6 Minimum Proposal Requirements

The contractor is required to submit as part of the proposal the following:

- o Organization Chart. Show the organization for accomplishing and managing the project. Explain briefly the responsibilities of each element shown on the organizational chart. Identify key personnel by name in each element and submit their curriculum vitae (resumes). Show the lines of authority within the organization. If important portions of the project are to be subcontracted (e.g., design of the system), identify the subcontracted function, the subcontractor(s), the subcontractor's key personnel, and which elements of the organization will manage the subcontract(s).

- o Key Personnel and Resumes. Provide resumes of key personnel, including those of the subcontractor(s). Be explicit in identifying past training and experience of each individual which qualifies him/her for the position to be held in the organization.

- o Staffing Plan. Indicate the type and approximate number of skilled personnel required in each element of the organization chart. State whether or not the required personnel are available within the organization. If not, comment on the availability of needed skilled personnel within the labor force and outline a schedule and plan for recruitement and/or training.

- o Related Experience. For each of the categories of experience below, list and describe projects or contracts which have provided your firm or that of your proposed subcontractor with related, qualifying experience. The descriptions should include: (1) dates during which the work was accomplished; (2) the scope and price of the total project or contract; (3) statement of what portion of the total project or contract was accomplished by your firm, i.e., an explicit desciption of the responsibilities or role of your firm; (4) financing arrangements; (5) references; (6) approximate payment for your service.

  - Construction Projects. List and discuss projects or contracts providing experience in the construction of facilities, particularly those using wind for electrical power generation.

  - Operation and Maintenance of Wind Energy Conversion Systems. List and discuss projects or contracts providing experience in the operation and/or maintenance of wind energy conversion systems. For each of the items listed, state which of the following functions were the responsibility of your firm; (a) start-up of facilities; (b) operation of facilities; (c) routine maintenance; (d) periodic overhaul of facilities. Also, state what type of facilities were included; (e) wind turbines; (f) controls; (g) electrical switchgear and protection equipment; (h) other. If "other" is listed, please identify or explain.

9.7 Post-Award Site Visit

Upon contract award, winning contractor personnel are expected to inspect the wind farm site to satisfy themselves as to all general and local conditions that may affect the design and installation of the wind farm. EEA/USAID, and/or authorized representative personnel will be available at that time for detailed discussions prior to initiation by the contractor of detailed wind farm design which must be completed within 10 weeks of contract award (see Section 2.1).

9.8 Summary of Deliverables

(1) Contract Documentation Schedule

ACTIVITY	WEEKS AFTER CONTRACT AWARDED*	DURATION (WEEKS) OF ACTIVITY
(a) Schedule for Wind Farm Design.....	2	2
(b) EEA/USAID Approval for Wind Farm Design Schedule.....	5	2

(1) Contract Documentation Schedule (Continued)

ACTIVITY	WEEKS AFTER CONTRACT AWARDED*	DURATION (WEEKS) OF ACTIVITY
(c) Plan and Schedule for Construction.....	8	2
(d) Wind Farm Site Grading Plan.....	10	(Part of Prelim Design)
(e) Preliminary Design Complete.....	10	4
(f) EEA/USAID Design Review Complete (Authorization to proceed).....	13	2
(g) Written Results of Component/Subsystem In-Factory Testing.....	Within 2 weeks of test completion	
(h) Wind Farm Operations and Maintenance Manual.....	Draft: at least 30 days prior to arrival of equipment in Egypt Final: Within 4 weeks of system acceptance	
(i) Unscheduled Maintenance Reports.....	As required to document unscheduled maintenance throughout the 2-year support period	

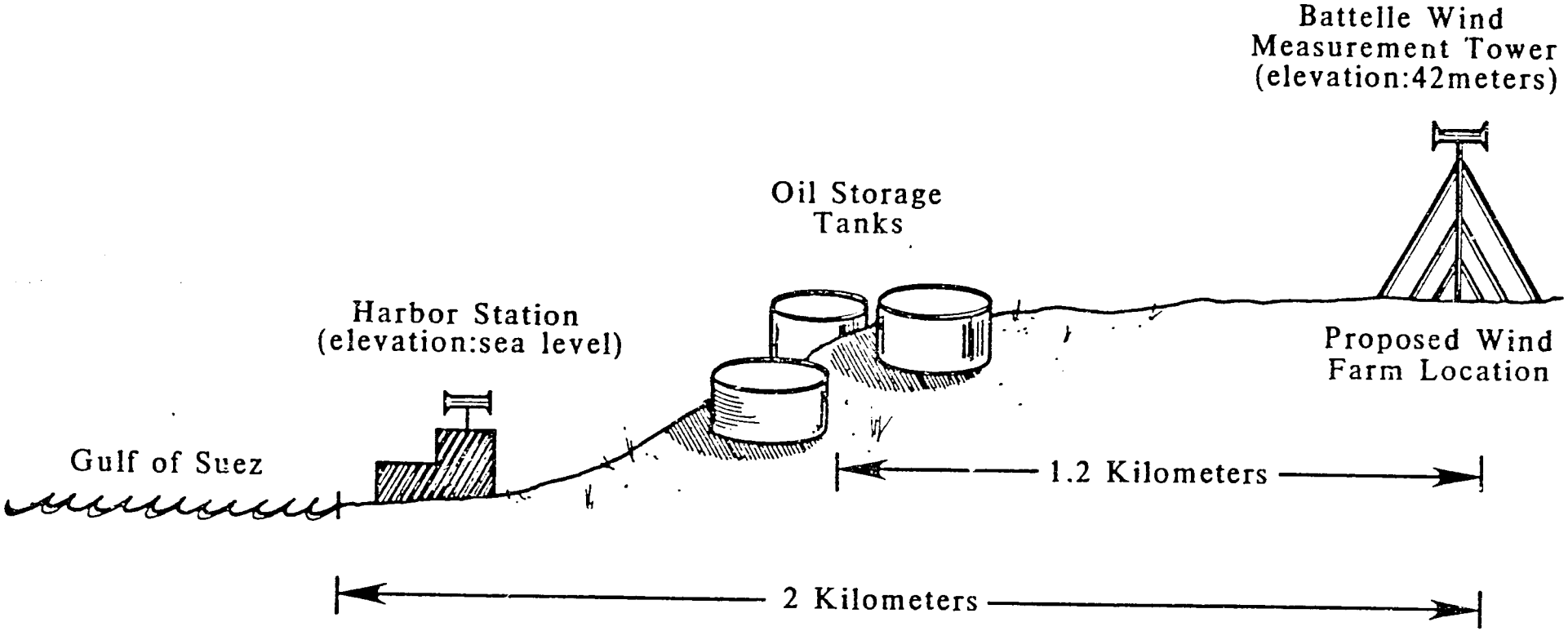
(2) Contract Hardware Installation Schedule

(a) Site Preparation Complete, Hardware Delivered to Site.....	Day 0 (D)
(b) Construction Completed, wind farm Interconnected with the grid.....	D + 30 days
(c) System Acceptance Test Complete.....	D + 60 days
(d) Final System Drawings and System Operations and Maintenance Manual Submitted.....	D + 90 days

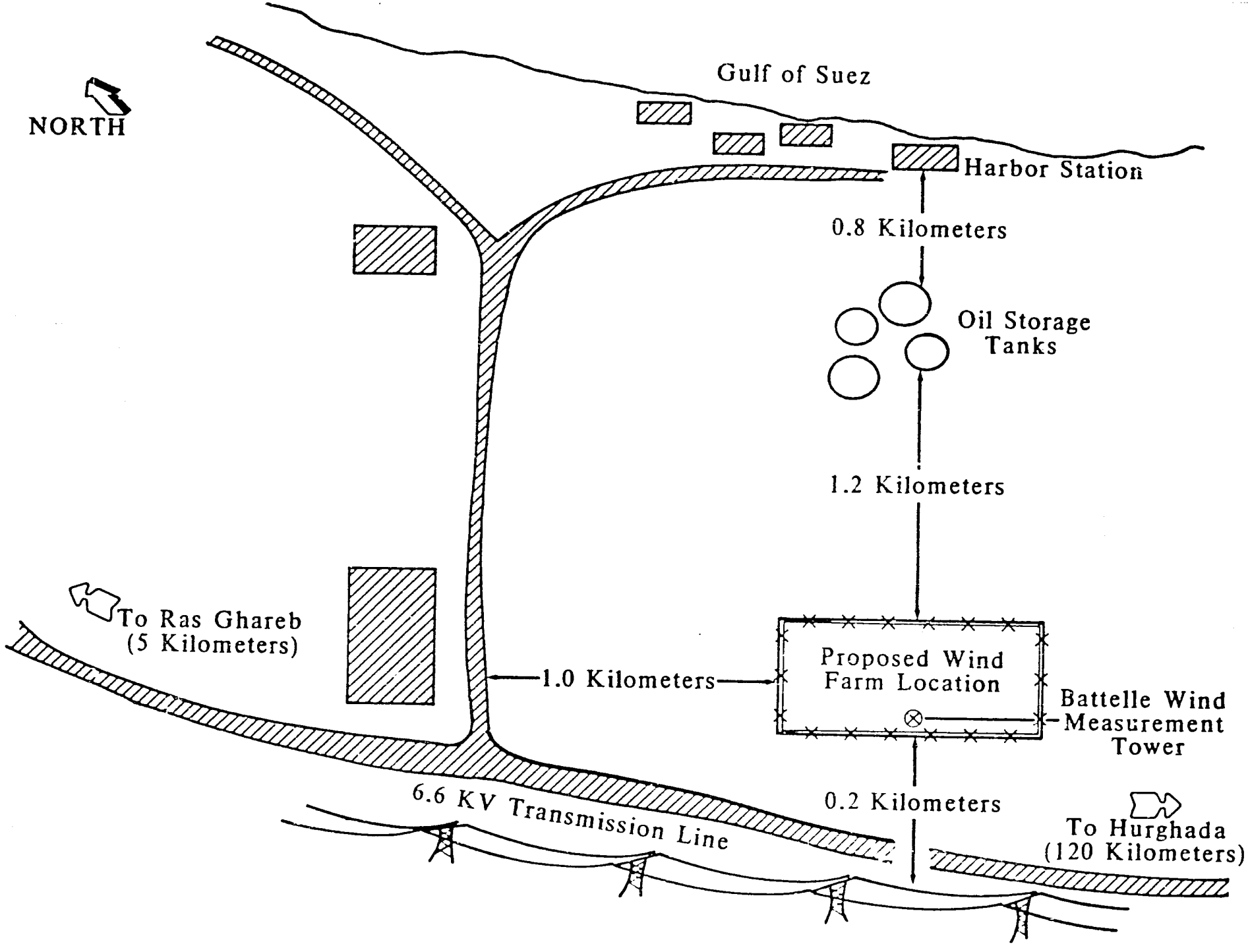
* In this schedule, one week is allowed for transmittal and receipt of documents mailed from either the United States or Cairo.

APPENDIX A

Schematic Layout of Wind Farm Location



SCHEMATIC OF PROPOSED WIND FARM LOCATION-PLAN VIEW



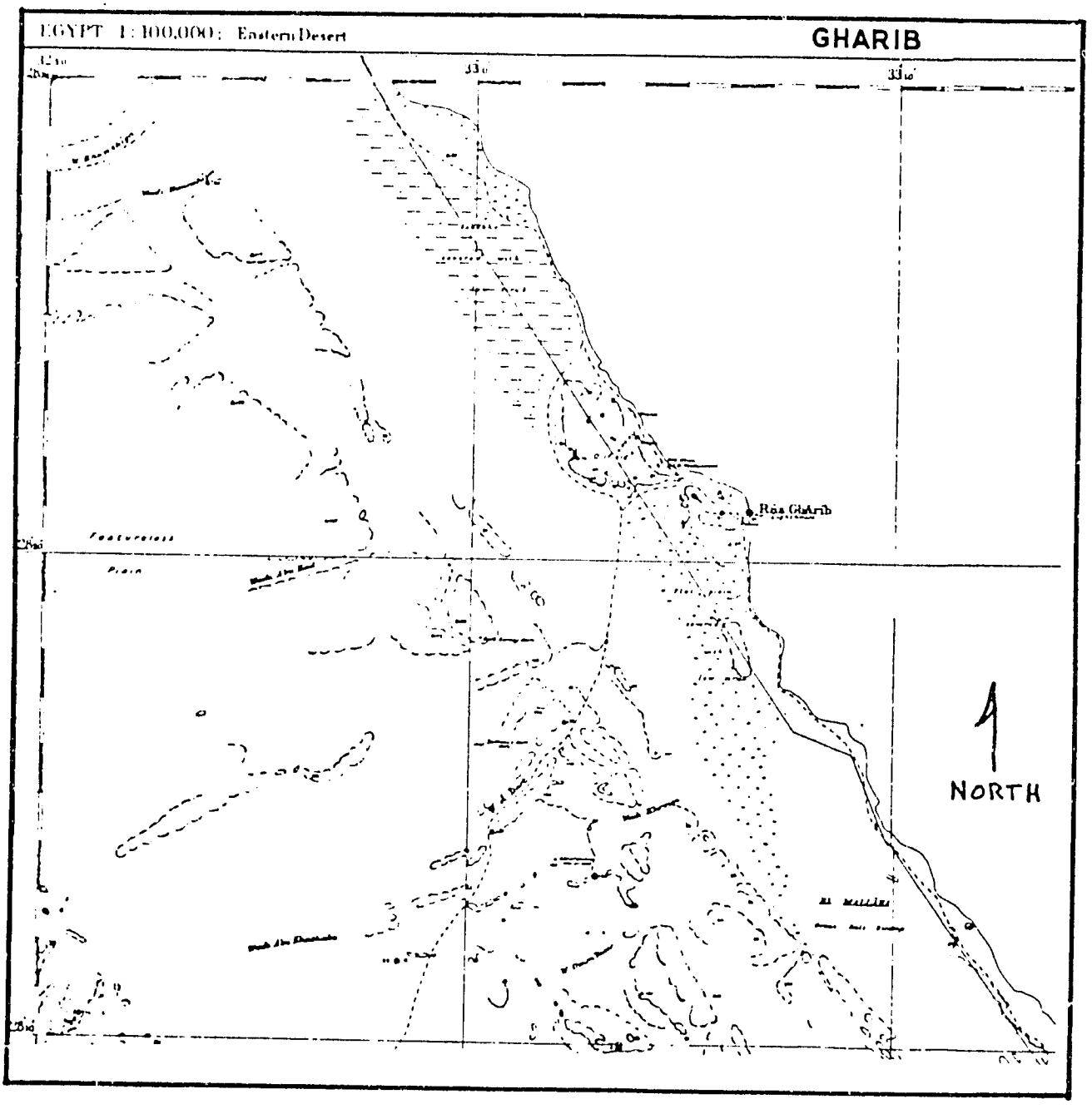
SCHEMATIC OF PROPOSED WIND FARM LOCATION-TOP VIEW

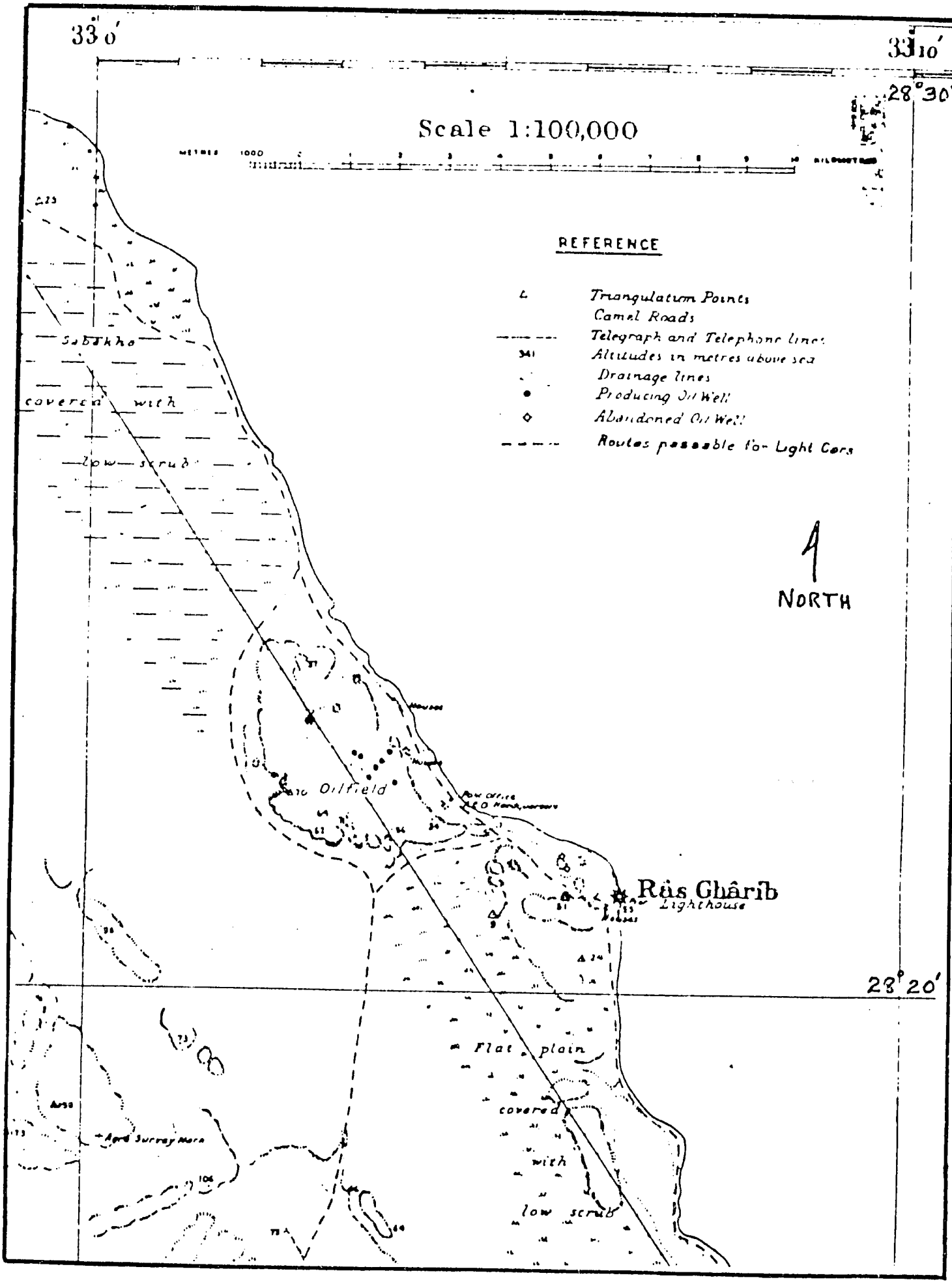
APPENDIX B

WIND RESOURCE DATA FOR RAS GHAREB, EGYPT

APPENDIX C

SITE TOPOGRAPHIC MAP
RAS GHAREB, EGYPT


EGYPT 1:100,000; Eastern Desert
GHARIB
Ras GhArib
NORTH


33° 0′
33° 10′
28° 30′
Scale 1:100,000
METRES 1000
REFERENCE
Triangulation Points
Camel Roads
Telegraph and Telephone lines
341 Altitudes in metres above sea
Drainage lines
Producing Oil Well
Abandoned Oil Well
Routes possible for Light Cars
NORTH
Sabkha
covered with
low scrub
Oilfield
Ras Gharib
Lighthouse
28° 20′
Flat plain
covered
with
low scrub
Aerial Survey Mark

APPENDIX D

INSTRUMENTATION REQUIREMENTS AND SPECIFICATIONS

SPECIFICATIONS FOR A FIELD TEST INSTRUMENTATION SYSTEM

The Renewable Energy Field Test instrumentation system will be used to monitor IPH, PV and wind energy system installations at urban and remote desert locations in Egypt. These energy systems include main power sources (solar collectors, PV arrays and wind turbines) as well as ancillary subsystems depending on specific field test applications. These subsystems include ice-making equipment, desalination systems, a variety of load characteristics ranging from small DC loads to grid-connected applications and back-up power systems (diesel engines and batteries).

The instrumentation system must be a stand-alone system. Failure of the instrumentation system must not affect the performance of the field test system that is being monitored. The instrumentation system must have an on-site data storage system that is non-volatile and capable of easy physical removal and transport to another location for data removal and long-term storage. One form of the non-volatile storage system must be a microchip/ EPROM or CMOSRAM - Type system that can be "milked" on site easily and without danger of a loss of data.

The instrumentation system must be a microcomputer based data logger with programmable input channels and output formats both analog and digital. The user must have control over sampling frequency and output period for each channel. The capability to multiplex some of the channels is also required. Primary design objectives for the instrumentation system should be reliability, simplicity, small size, low power and the ability to operate in environmental extremes as specified (especially high temperature, sand/dust and tropical/sea coast). The unit must be capable of stand-alone battery operation for a period of two months.

The monitoring system for the entire field test will be expected to be a centralized system.

The following minimum specifications are required for the instrumentation system. If an exception must be taken to one or more of these requirements, the exception shall be noted and a clear explanation given as to why the bidder believes that the exception should be acceptable to the purchaser.

System Power Requirements

- Capable of operation using self-contained batteries
- Capability for the use of an external power source to allow continued data collection while changing batteries is desirable.
- Capable of transient protection from spurious electrical charges or lightning.

Environmental Specifications

- Ambient Temperature: -5°C to +55°C
- Relative Humidity: 0 to 95 percent
- Impervious to a tropical, oceanside environment with occasional high airborne sand/dust and/or sulphur levels

Analog Inputs

Number of Channels: At least 12 channels

Voltage Measurement Types: Differential or single-ended

Accuracy of Measurements: at least $\pm$ 0.5 percent

Range and Resolution: Selectable for any input channel from microvolts to several volts full scale

Sample Rates: At least once per second for each channel

Multiplex Capability: at least four channels

Pulse Inputs

Number of Pulse Counter Channels: at least 4 channels

Analog and Digital Control Outputs: a total of three resettable channels each is desired with a range of 0 to $\pm$ 5 volts with a 0.5 volt resolution

Multiplex Capability: at least three channels

Output Signal Interface

Memory: Capable of storing at least 3000 data points per day for a period of two months.

Display: A visual display of instantaneous and stored data is required on-site for data verification before data removal

Peripheral Interface: Downloading of data at the site should be by physical removal of the data storage device or simple, reliable data downloading to a non-volatile storage device. Storage data files shall be IBM-PC compatible on floppy disc either directly from the data logger or through a simple, fast, reformatting technique.

FIELD TEST PERFORMANCE MONITORING DATA REQUIREMENTS

Field Test #11 (Wind Farm)

Parameter	Channel Type	Output Interval
Turbine Power (kW)	P	10 min.
Generator Voltage (volts)	A	10 min.
3 ϕ Generator Current (Amps)	A	10 min.
Frequency (Hz)	A	10 min.
Reactive Power (VAR)	A	10 min.
Power Factor	A	10 min.
Rotor RPM (Rev/min)	P	10 min.
Number of On-off Cycles (Turbine)	P	Daily
KWH Output	P	Hourly

Meteorological Station

Parameter	Channel Type	Output Interval
Horizontal Insolation (kW/m^2)	A	10 min.
Plane of Array Insolation (if appropriate) (kW/m^2)	A	10 min.
Ambient Temp. (°C)	A	30 min.
Humidity (%)	A	30 min.
Air Pressure (Kgr/m^2)	A	30 min.
Wind Speed (m/sec)	A	10 min.
Wind Direction (degrees)	A	10 min.

Existing Power Grid

Parameter	Channel Type	Output Interval
Grid Line Voltage (volts)	A	Hourly
Grid Line Frequency (HZ)	A	Hourly