PROJECT INFORMATION DOCUMENT (PID)
APPRAISAL STAGE

Report No.: AB2614

Project Name	SOLAR THERMAL HYBRID PROJECT
Region	MIDDLE EAST AND NORTH AFRICA
Sector	Renewable energy (50%);Power (50%)
Project ID	P050567
GEF Focal Area	Climate change
Borrower(s)/Recipient	Government of Egypt
Implementing Agency	New and Renewable Energy Authority
Environment Category	[ ] A [X] B [ ] C [ ] FI [ ] TBD (to be determined)
Date PID Prepared	October 17, 2006
Date of Appraisal Authorization	October 26, 2006
Date of Board Approval	February 15, 2007

1. Country and Sector Background

The political system in Egypt can be characterized by stability and continuity. A comprehensive reform program was adopted in 2004 when significant change took place in the cabinet and several new officials were appointed to key ministerial positions. This new government has made economic reform its key objective, notably in areas such as finance, investment, trade and industry. It has also stated its keen interest in expanding public-private partnerships and undertaking public sector reforms aimed at enhancing the provision of public goods and services, including physical and social infrastructure. The latter includes the power sector.

The investment needs in infrastructure remain substantial. It is estimated that approximately 4-6% of Gross Domestic Product (GDP) needs to be invested annually in infrastructure sectors in the Middle East and North Africa (MENA) region to satisfy new investment requirements as well as maintenance and replacement spending.[1] The decline in investment in the MENA region, including in Egypt, is reported to have compromised the infrastructure base, which is further challenged by the high growth in demand for modern infrastructure services. To ensure adequate provision of electricity, the Egyptian Electricity Holding Company (EEHC), responsible for generation, transmission and distribution of electricity in Egypt, projects requiring on average about 1,500 MW of new capacity each year. Promotion of renewable energy projects plays a key part in Egypt's generation plan. Indeed, today 145 MW of wind-turbines have already been installed and are operational, performing well at an average capacity factor of 42%.

The fast growing demand for electricity requires significant investment in generation capacity each year (the increase in demand for electricity in Egypt averaged about 7% during 1997/98–2003/04 and is expected to remain in the 6%–7% range over the next 10 years). Installed capacity of electric power was 18,119 MW in 2003/04, of which 84% comprised thermal power (8% of which is provided by the private sector through 3 Independent Power Producers, IPPs).

[1] Cited in internal Bank report on "Arab Republic of Egypt: A Short Infrastructure Assessment," December 2004.

The remaining capacity was attributed to hydropower (15%) and wind (1%). Peak load reached 14,735 MW, and about 90% of the thermal power production was based on natural gas. Initiatives are underway to better understand customer consumption patterns and loads to ultimately implement demand-side management measures to reduce the overall consumption and the growth in demand.[2] World Bank assistance is being provided to enhance energy efficiency in the power sector under the El Tebbin Power Project. This covers pricing as well as load management planning.

The Government's strategy is to continue to implement gas fired power plants, with a long-term view to increase the share of combined cycle gas turbine technology in the generation mix. In addition, the Government has a target of meeting 3% of its primary energy needs from renewable energy sources by 2010. The New and Renewable Energy Authority (NREA) has the responsibility to develop renewable resources in Egypt and implement the government's strategy on renewable energy. Until 2001, most of NREA's activities have been in the research and development field, and since then its activities have increasingly turned to the production of renewable energy.

NREA's strategy is to capitalize on Egypt's abundant wind and solar natural resources to meet the renewable energy target set by the Government. For this purpose it plans to install an additional 400MW of wind by 2010 and considers the construction of the proposed Solar Thermal Hybrid Power Plant (151MWe) a key development towards improving and diversifying its institutional and technical capacity in the area of renewable energy.

2. Objectives

The primary objective of the project is to increase the share of solar-based power in the Egyptian generation mix thereby contributing to the Government's aim of diversifying power production.

The key performance indicators for the development objectives of the project include:

a. Total electricity generated from solar field (GWh/year)
b. Solar output as a percentage of total energy produced by the hybrid plant.
c. Total electricity generated from the ISCC power plant (GWh/year)

The global development objective of the project is to reduce greenhouse gas emissions from anthropogenic sources by increasing the market share of low greenhouse gas emitting technologies.

3. Rationale for Bank Involvement

[2] Energy intensity in Egypt in 2004, defined as the energy consumption per unit of GDP was equal to 0.22 toe / 000' 95 US$, which is comparable to other oil producing countries in the region (Algeria: 0.20) and lower than others (Iran: 0.33), but higher than Western European countries such as Germany (0.18) and France (0.19).

The Operational Policy 7 (OP7) of the Global Environmental Facility (GEF) supports the technological aims to increase market share of low greenhouse gas-emitting technologies that are not yet commercial, but show promise of becoming so in the future, and the World Bank has been identified as the main executing agency for the purposes of OP7. In 1996, the GEF's Scientific and Technical Advisory Panel (STAP) recommended high temperature solar-thermal power technology (Concentrating Solar Power, CSP) as a renewable energy technology with significant cost reduction potential and replicability in countries in the world's solar belt.

As such, four projects in Egypt, India, Mexico and Morocco entered the GEF portfolio with a grant volume of US$200 million in total (US$50 million each). The project in India has since been cancelled at the request of the Indian Government, while the projects in Mexico and Morocco are at advanced stages of preparation.

In 2005, the GEF sponsored an updated review of the status of the technology and its potential for replication.[3] The review concluded that i) solar thermal electricity technology is worthy of continued support, ii) the benefits of a successful industry, particularly for developing countries, are significant, iii) the technology is not new and has been proven; however, it is still in the process of becoming competitive, and iv) the technology has the potential to follow a similar cost reduction curve as wind energy.

The Bank's current direct involvement in investment and advisory services across the energy sector in Egypt provides a good basis for development of sustainable energy solutions, including renewable energy, as it allows for substantial dialogue on the policy framework and implementation arrangements associated with and required for this project's implementation, as well as larger scale development and replication of similar projects. Finally, Bank involvement will also help attract strong bidders by ensuring the use of transparent and competitive procurement processes, as well as appropriate management of environmental and social impacts.

4. Description

The project will finance the construction of an Integrated Solar Combined Cycle (ISCC) power plant, to be located in Kureimat, about 95 km south of Cairo, on the eastern side of the river Nile. The main innovation of an ISCC plant is the integration of steam generated by solar energy into a combined cycle power plant, which will require a larger steam turbine to generate electrical energy from the additional solar-generated steam.

The plant will have a capacity of about 150MW, combining a conventional fossil fuel portion of about 120MW and an input from solar sources of about 30MW. When own consumption of 5.3MW is deducted, the net overall plant capacity becomes 145.7MW. The total net energy produced by the plant is expected to be 984 GWh per year, which includes the solar contribution of 64.5 GWh per year. This corresponds to a solar share of 6.6% percent of the total annual energy produced by the plant operating at a full load. The primary fuel for the conventional

[3] Assessment of the World Bank / GEF Strategy for the Market Development of Concentrating Solar Thermal Power, 2005/06 prepared by a group of experts from Global Research Alliance, Fraunhofer Institute for Solar Energy Systems, CSIRO Australia and CSIR South Africa.

fossil fuel portion will be natural gas supplied at the site by Egyptian Natural Gas Holding Company.

The project will be implemented through the following components whose costs are estimated inclusive of import taxes on equipment and contingencies:

Component 1: The design, construction and operation of the proposed Integrated Solar Combined Cycle Plant include two sub-components:

(a) The solar portion of the power plant will include one contract for engineering, procurement, construction, testing, commissioning and five years operation and maintenance (O&M). The solar island consists of a parabolic trough solar field capable of generating about 110 MW (thermal) of solar heat at a temperature of 393°C, the related Instrumentation and Control (I&C) and control room and the heat transfer fluid (HTF) system up to the HTF inlet and outlet flanges of the Solar Heat Exchanger(s).

(b) The Combined Cycle portion of the plant will include one contract for the EPC aspect of the power plant financed by JBIC and a one 5 year O&M contract financed by NREA. The combined cycle island shall consist of one or two gas turbine(s) with ISO rating of about 80 MWe (total), one or two heat recovery steam generator(s) (HRSG), one steam turbine of about 70 MWe, and solar heat exchanger(s) capable to absorb about 110 MW (thermal) solar heat plus all associated balance of plant equipment.

Component 2: Comprises the consulting contract to provide construction management services during the construction, testing and operation of the plant. Its main task will be to: (a) review the detailed engineering designs with special attention to the interface between the solar and CCGT parts; (b) supervise the construction and environmental aspects of the power plant; (c) monitor the commissioning and guarantee tests; (d) prepare the O&M contract for the CCGT part; (e) provide assistance during the 2 years guarantee period as well as assisting NREA in monitoring and evaluation of the performance of the whole plant at least during the first two years of the O&M period; and (f) provide training and transfer of know-how in ISCC plant operation, with particular emphasis to dispatching and integration into the power system so that NREA staff can successfully take over the power plant after the respective O&M contracts expire.

Component 3: Comprises the Environmental and Social Impact management component to be financed by NREA. This component will include the implementation of the Environmental Management Plan (EMP), which mitigates the potential environmental and social impacts associated with the construction and operation of the power plant.

5. Financing

Source:	($m.)
BORROWER/RECIPIENT	59.12
GLOBAL ENVIRONMENT FACILITY	50.00
JAPAN: JAPAN BANK FOR INTERNATIONAL COOPERATION	92.33

(JBIC)

Total 201.45

6. Implementation

Given that the proposed design has yet to be proven commercially world-wide, the Engineer, Procure and Construct (EPC) arrangements will be followed by 5-year Operation and Maintenance (O&M) contracts to ensure proper operation and maintenance of the ISCC plant and achievement of maximum output by the solar field. There will be an O&M contract for each portion of the plant, but the O&M contract for the CCGT will be responsible for efficient operation of the entire plant as well as maximizing the output from both parts.

The construction and operation of the ISCC power plant will be implemented in four separate contracts: (i) the construction and O&M of the solar island; (ii) the construction of the combined cycle island; (iii) the O&M of the combined cycle portion; and (iv) a construction management consulting contract for the supervision and integration of the solar and combined cycle islands. The arrangements will be secured using the international competitive bidding procurement method. NREA, as the Executing Agency and as the mandated agency in Egypt to develop renewable resources, will be responsible for project management. NREA will establish a Project Implementation Unit (PIU) headed by an experienced Project Manager who will report to the Deputy Chairman for Projects and Operation. The PIU will be responsible for the day to day management activities of the proposed project and will be staffed by core specialists in technical, financing/accounting, procurement and environmental matters.

The PIU will benefit from the assistance of the construction management consultant during the implementation of the overall project. Its main tasks are described under section 4 (Project Components) above. This contract will be for the duration of construction plus the two year guarantee period, which will coincide with the first two years of the two O&M contracts (i.e. a total of about 5 years).

During the construction and in particular during the O&M period, NREA will assign counterpart personnel to the construction management consultant to ensure close coordination and transfer of knowledge with regard to the operation of the plant so that NREA can take over its operation when the 5 year O&M and construction management contracts expire, as well as monitor and document the project's lessons learned. It will be important that after the issuance of the operational acceptance certificate (30 months from start of construction), NREA revises and readjusts the PIU organizational structure to take into account the start-up of the 5 year O&M period, especially in terms of personnel.

The project is expected to be constructed between 2007 and 2009, with operations commencing at the end of 2009.

7. Sustainability and Replicability

The Government of Egypt's commitment to renewable energy resource development is strong as evidenced by its declared objective of diversifying energy sources, including having 3% of installed capacity represented by renewable energy by 2010 and the establishment of the

"petroleum fund" which provides economic incentive to renewable energy producers. Furthermore, although it is anticipated that most of the higher capital cost of the hybrid plant will be offset by the proposed GEF incremental cost grant, NREA has declared its willingness to finance incremental cost above US$50 million, recognizing the cap on GEF grant support to the project. Finally, the integration of the solar field with a CCGT ensures that the hybrid will provide the required electricity contribution to the system regardless of solar radiation conditions. For these reasons, the hybrid power plant is expected to operate sustainably as an integral part of the Egyptian power system. The incentive structure for the solar and CCGT O&M operators will ensure efficient operation of the plant and optimal design for integration of the solar thermal with the gas-fired plant and maximize solar output from the plant when in operation.

Dissemination of information about this project will contribute to possible future replication in other countries and to refining the GEF strategy regarding this technology. Indeed, the general approach adopted by the project is highly replicable within Egypt, regionally and globally. An early study carried out by the Energy Sector Management Assistance Program (ESMAP) suggested that sites with ready access to gas supply, electricity evacuation and water infrastructure would be capable of supporting 5-10GW of solar thermal plant in Egypt alone. High insolation sites are available across much of the region, though many lack the necessary infrastructure at this time. Worldwide there are suitable sites and, unlike other renewable technologies, solar thermal hybrid plants are inherently at utility scale. Having said that, the main barriers to further replication are costs and the associated learning needs, the overcoming of which this project (and the ones in Mexico and Morocco) is expected to contribute to by providing a benchmark for costs and operational information and disseminating it throughout the solar thermal community. However, it is unrealistic to expect that this project alone (or even combined with the two being prepared) will bring costs down to levels that are competitive with conventional power plants. Further development of this technology outside of the GEF's OP 7 is needed as well as possibly additional IFI support to additional projects.

8. Lessons Learned from Past Operations in the Country/Sector

Power Sector Development in Egypt

NREA has gained significant experience in designing and implementing wind energy projects with international loan and grant financing. Important lessons drawn from this experience include the importance of transparent and well-managed competitive bidding processes, which have contributed to attracting the interest and comfort of major international suppliers of wind technology with business transactions in Egypt.

Furthermore, through the development of these projects, NREA has operated under Power Purchase Agreements (PPAs) with EEHC and has gained significant experience in structuring and negotiating such agreements. This experience will be very useful for the proposed project, in which a PPA will need to be put in place as well as a Gas Purchase Agreement (GPA).

Solar Thermal Power Plant Development Worldwide

No large scale solar thermal power plants have been built in developing countries to date, however several small-scale projects are under construction around the world. At the moment, GEF-supported projects are also in preparation in Mexico and Morocco. The most significant solar thermal installations are in California where 354MW of parabolic troughs, with back-up gas fired steam boilers have been generating electricity and selling it to the utility since the 1980s.

To meet the cost reduction objective of the project, it is necessary to move beyond the trough/backup boiler design upon which the California plant is based. The purpose is to permit higher thermal efficiencies, improve the dispatchability of the plant and to encourage greater competition in the design and supply of equipment. Such a plant would be more attractive to utilities, thus increasing the market size. For this reason the project includes the following features: (i) price competition will be key, to ensure that low-cost components are used, wherever possible locally manufactured; and (ii) the contractor will have incentives to maximize output from the solar field, which will bring about a focus on O&M costs, thus bringing down life-cycle costs.

9. Safeguard Policies (including public consultation)

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment (OP/BP 4.01)	[x]	[ ]
Natural Habitats (OP/BP 4.04)	[ ]	[x]
Pest Management (OP 4.09)	[ ]	[x]
Cultural Property (OPN 11.03, being revised as OP 4.11)	[ ]	[x]
Involuntary Resettlement (OP/BP 4.12)	[ ]	[x]
Indigenous Peoples (OP/BP 4.10)	[ ]	[x]
Forests (OP/BP 4.36)	[ ]	[x]
Safety of Dams (OP/BP 4.37)	[ ]	[x]
Projects in Disputed Areas (OP/BP 7.60)*	[ ]	[x]
Projects on International Waterways (OP/BP 7.50)	[ ]	[x]

10. List of Factual Technical Documents

1. Conceptual Design for the ISCC – January 2004
2. Draft Environmental Impact Assessment for 150 Mw Kuraymat Integrated Solar Combined Cycle Power Plant Project, June 2004
3. Assessment of the World Bank / GEF Strategy for the Market Development of Concentrating Solar Thermal Power, 2005/06 prepared by a group of experts from Global Research Alliance, Fraunhofer Institute for Solar Energy Systems, CSIRO Australia and CSIR South Africa.

* *By supporting the proposed project, the Bank does not intend to prejudice the final determination of the parties' claims on the disputed areas*

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