Abou-Zaabal Substation Project

Report Date: March 2000
Field Survey: August 1999

1 Project Summary and Japan's ODA Loan

(1) Background

When this project was planned in 1984, the Cairo Zone had a 220kV electricity transmission network with 220/66kV substations. However, with the addition of new power plants the generation capacity exceeded the capacity of the existing transmission and transformer equipment. Therefore it was decided that 500kV transmission lines, which enable high capacity and low losses, should be built for the Cairo Zone. This Abou-Zaabal Substation is the one that forms the center of the 500kV transmission network.

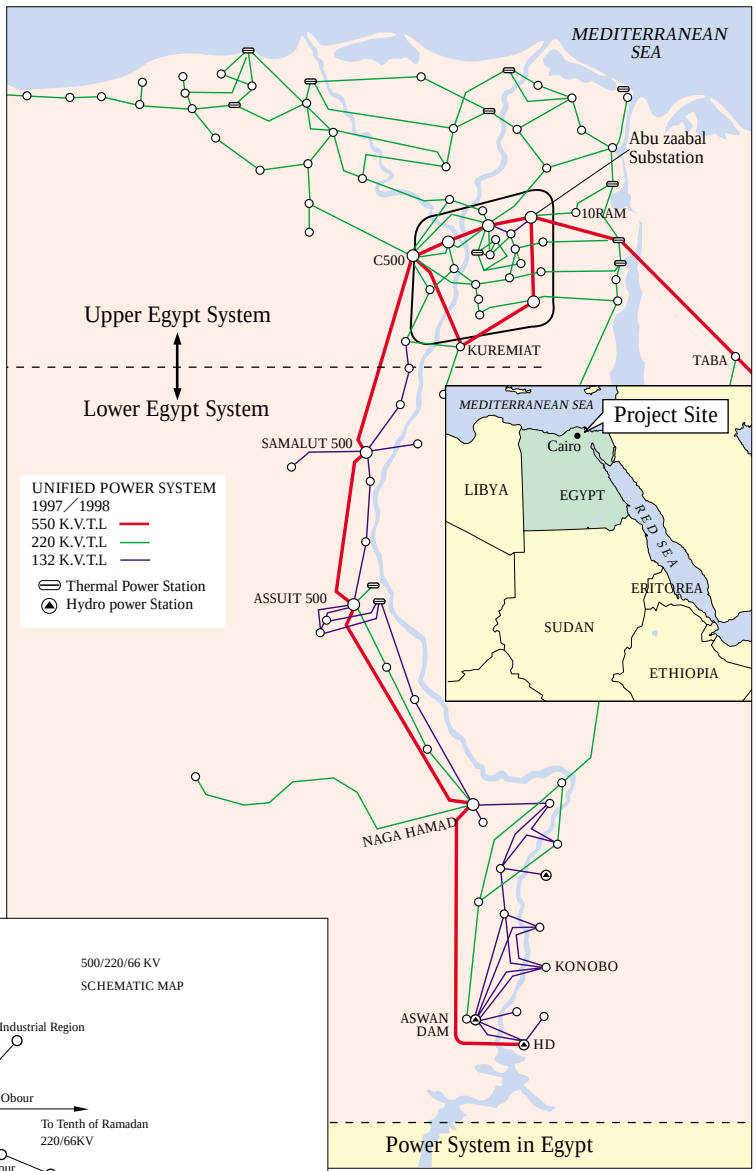
(2) Objectives

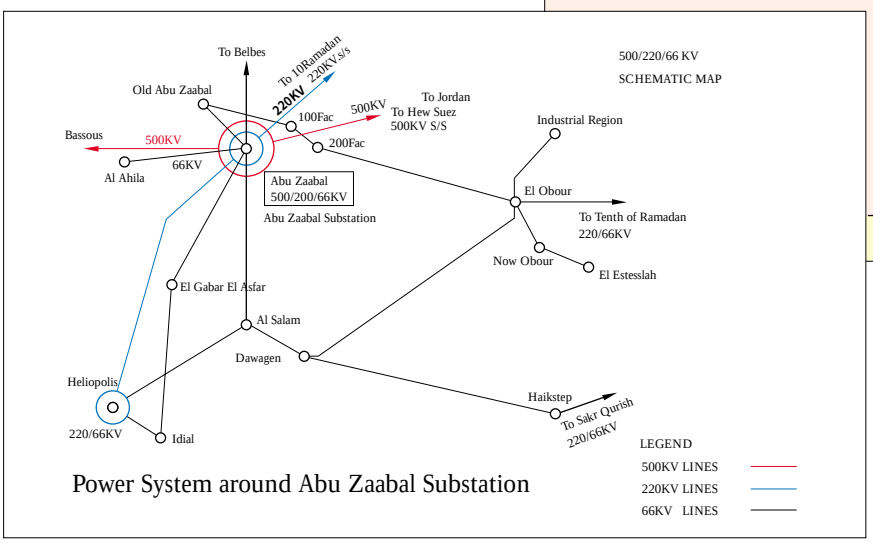
This project aimed to build the substation in Abou-Zaabal in the northeast of Cairo to meet demand for electricity in the Abou-Zaabal Region and to stabilize electricity supply in the greater Cairo Zone.

(3) Project Scope

Project scope consists of the new Abou-Zaabal substation (civil works and installation of the transformer and switchgear).

The ODA loan covered the entire foreign currency portion of the project.





Power System around Abu Zaabal Substation

(4) Borrower/Executing Agency

Egyptian Electricity Authority (Guarantor: Government of Arab Republic of Egypt)

(5) Outline of Loan Agreement

Loan Amount	¥8,200 million
Loan Disbursed Amount	¥8,199 million
Date of Exchange of Notes	April 1985
Date of Loan agreement	October 1988
Loan Conditions	
Interest Rate	4%
Repayment Period (Grace Period)	30 years (10 years)
Procurement	General Untied (Partial Untied for consulting portion)
Final Disbursement Date	October 1993

2 Analysis and Evaluation

(1) Project Scope

The project was completed largely as planned, the only change in project scope being the number of switchgear units.

(2) Implementation Schedule

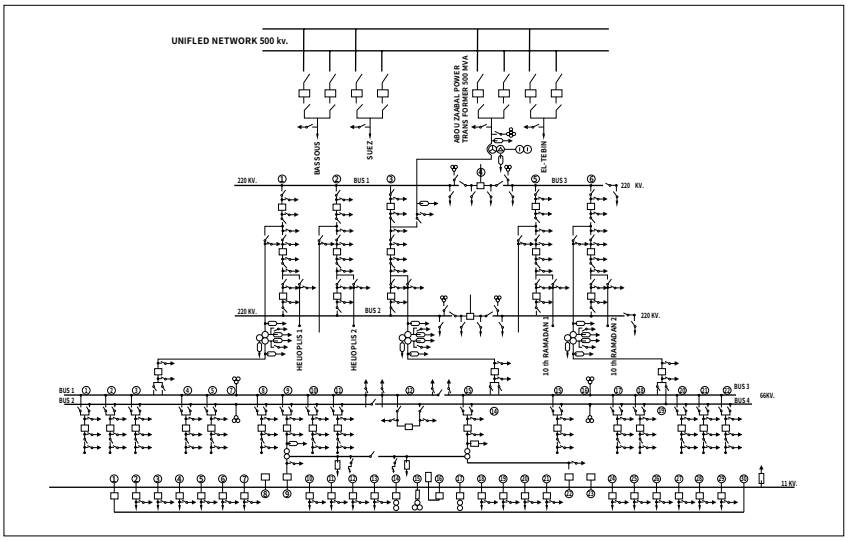
This project took over four years between the exchange of notes and the signing of the loan agreement. The reasons were as follows:

i)Major delays in domestic procedures in Egypt (ratification of the exchange of notes by the Egyptian parliament).

ii)Prolonged negotiations over the loan conditions contained in the loan agreement (interest on arrears and fees).

Once the contracts were signed with the contractors, the project proceeded as planned.

Abu-Zaabal Substation Single Line (500/220/66/11kv)



(3) Project Cost

The local currency of the project cost, which was borne by the Egyptian side, increased, leading to a slight increase in overall cost. The foreign currency cost, which was covered by the loan, was as planned.

Comparison of Original Plan and Actual

Item	Plan	Actual
1.Project Scope		
Transformer		
	・500/220kV transformer (Single-phase*167MVA ×3) + (1 spare)	As planned
	・220/66/11kV transformer Three-phase*125/125/45 MV ×3	As planned
	・66/11kV transformer Three-phase* 25 MVA ×2	As planned
500 kV equipment	・Gas insulation switchgear	
	2 units for transformer	1 unit
	5 units for transmission lines	3 units
220 kV equipment	・Gas insulation switchgear	
	5 units for transformer	4 units
	6 units for transmission lines	As planned
66 kV equipment	・Gas insulation switchgear	
	5 units for transformer	As planned
	12 units for transmission lines	14 units

11 kV equipment	・Solid insulation switchgear 18 units of distribution lines	20 units
2.Implementation Schedule		
(Contract of the main Project to Completion of construction test)	July 1985 to November 1987	March 1990 to September 1992
3.Project Costs		
Foreign currency	¥8,200 million	¥8,199 million
(ODA loan portion)	(¥8,200 million)	(¥8,199 million)
Local currency	3 million Egyptian Pound	24.585 million Egyptian Pound
Total	¥9,040 million	¥9,354 million
Exchange Rate	1 Egyptian Pound = ¥280 (at the time of appraisal)	1 Egyptian Pound = ¥47 (Average rate at the time of loan disbursement)

* Transformer types come in single-phase and three-phase type. Three single-phase units can be combined to produce the capacity and functions of one three-phase unit. Single-phase transformers are often used because of the shipping problems posed by the size and weight of high-voltage, large-capacity transformers.

(4) Project Implementation Scheme

The executing agency and borrower for this project was the Egyptian Electricity Authority (EEA), a corporation under the Ministry of Electricity and Energy which has a long record as the single supplier of electricity to Egypt. There were no significant problems with the EEA's executive ability, and the project made smooth progress after the loan agreement was signed. Contractors made bids for a comprehensive contract, including procurement and installation of all equipment and materials. A Japanese contractor made the winning bid. Project monitoring was originally planned to be carried out by direct management, but eventually Energy Power System, an electricity consulting corporation under the Ministry of Electricity and Energy, was employed. The consultancy fees were paid by the Egyptian side from its own funds. The change was made because the number of projects under the authority of the EEA grew rapidly in the second half of the 1980s and it did not have the capacity to monitor all of them. Therefore the Ministry of Electricity and Energy adopted the policy of entrusting the monitoring of all electricity distribution projects to Energy Power System. There were no significant problems with the performance of the contractor and consultant.

(5) Operations and Maintenance

The operations and maintenance of the substation built under this project is handled by a staff of 26, including 5 engineers and 15 technicians. The substation has suffered no problems since it went into operation. Maintenance is carried out regularly, according to a manual. The major inspection scheduled for the sixth year of operation was carried out in 1998 and found no significant problems.

(6) Project Effects and Impacts

At the time of appraisal, the Abou-Zaabal Region received its electricity supply from adjacent Heliopolis Substation. The Heliopolis Substation was already overloaded, and the electricity demand from the Abou-Zaabal Region was predicted to rise rapidly from 70MW in 1983 to 219MW in 1990 and 264MW in 1992. This substation was intended to meet electrical demand in Abou Zaabal Region, and connect to the 500kV electrical ring main network, which was being built in the greater Cairo Zone at the same time. The connection would enable it to supply electricity to Heliopolis, Tenth of Ramadan, El Gabar El Asfar, El Obour and Idial in the Greater Cairo Zone. Most of these were areas developing in line with the development of the Greater Cairo Zone. Construction of housing and industrial facilities has been increasing rapidly of late. With the progress of this development, the availability factor of Abou Zaabal Substation rose rapidly to 88.5% by the start of 1998, after remaining at 40~50% for around five years after completion. The change was due to two factors : (i)Rising availability factor at the 66/11kV substations which receive electricity from the Abou Zaabal Substation. (ii)New supply areas were added by circuit switching.

Compared to the plan, there was a delay of approximately five years before completion of the project, but the overload in Heliopolis Substation was alleviated by temporary circuit switching to other neighboring substations.

Transit in the Work Rate of 220/66/11kV Transformer at Abou-Zaabal Substation

	Year	1992	1993	1994	1995	1996	1997	1998
Availability Factor*	(%)	40.0	36.3	38.0	46.0	42.0	50.8	88.5
Peak Load	(MW)	120	109	118	139	145	158	287

Source: Calculated on the basis of EEA materials

Note: * Availability Factor = Peak Load/ (transformer capacity × power factor). The equipment capacity as seen from the 220kV side of a 220/66/11kV totals 375MVA, and the power factor is the annual average value (0.865 in 1998).(Power factor compares the apparent power (VA) with the active power (W). This is a characteristic of AC electricity. Not all of the value indicated by multiplying voltage by current is available as effective electrical energy, so the value is called "apparent power". The portion of the apparent power which is effective energy is referred to as "active power".)

The completion of the Lower Egypt System(Note1) Super Grid Plan(Note2) meant that the role of the substation went beyond supplying power from thermal power stations in Upper Egypt and the outskirts of Cairo to the region. It now functions as an element in a 500kV transmission network which runs from Libya through Egypt to Jordan. Further thermal power stations are now being built at three locations in Lower Egypt on a BOT basis, and as the supply of electricity to Libya and Jordan increases, this substation's importance as part of an internationally connected power system will continue to increase.

(7) Environmental Impact

This substation is equipped with appropriate insulation devices to prevent electric shock, and its construction did not have any negative environmental impact. No notable environmental impacts were indicated at the time of the appraisal.

Transformer

Gas Insulation Swichgear

Transmission Line

Note:1) Egypt's electricity supply grids are broadly divided between upper and lower Egypt. The Upper Egypt system consists of 500kV and 132kV circuits reaching Cairo which are powered by the Aswan High Dam. The Lower Egypt system is a 220kV circuit powered by thermal power stations in the north of Egypt.

2) The plan is to link Libya, Egypt and Jordan with 500kV/ 400kV transmission lines, so that Egypt and Jordan will be able to trade surplus electrical power to meet each other's demand. The arrangement would run electrical power equipment more efficiently and reduce investment in equipment.