Jordan

Aqaba Thermal Power Plant Expansion Project (I) (II)

Report Date: February 2003

Field Survey: October 2002

1. Project Profile and Japan's ODA Loan

1.1 Background

In Jordan during the early 1990s, with the exclusion of captive generation (for self use only) plants, etc., the majority of power generation was carried out by Jordan Electricity Authority (JEA), which was producing approximately 89% of the Kingdom's total capacity. JEA was also responsible for building the Kingdom's generation plants. The majority of JEA generation facilities were thermal (steam turbine, gas turbine, diesel), and in 1994 it had an installed capacity of 988.8 megawatts.

JEA also had control of transmission assets, including facilities construction, with total cabling lengths of transmission lines at 650km (400kV), 17km (230kV), 2,106km (132kV) and 17km (66kV). Distribution was undertaken by two companies in addition to JEA, namely, Jordan Electric Power Company (JEPCO) and Irbid District Electricity Company (IDECO), with JEA predominantly responsible for distribution and construction in the regions, JEPCO for the Amman and Zarqa areas, and IDECO covering the area around Irbid.

Consumption demand between 1985 and 1994 grew at an exponential rate of around 8.1% per year on average, and in 1994 peak load reached 794 megawatts, or roughly 80% of installed capacity (988.8 MW). However, given that the output of the largest unit at existing power plants was 130 megawatts (producing approximately 13% of installed capacity) and shutdowns for overhauls , etc., power demand and supply was in equilibrium. In terms of the economic situation in the Kingdom, in FY94 GDP increased by 5.7% over the preceding year and was expanding steadily; the growth rate in power demand for 1995 through 2005 was projected to be approximately 6% per annum and supplies were forecasted to become extremely tight. In order to respond to this situation, the government of Jordan (GOJ) formulated a power development plan in which this project was an main component.

1.2 Objectives

To build an additional two generators (Units 3 & 4: each 130MW) at the existing Aqaba Thermal

Power Plant (TPP) in order to meet increasing demand for power in Jordan, and in conjunction with these generation facility expansions, to boost the voltage capacity of existing transmission lines so as to facilitate stable supplies of power.

1.3 Project Scope

(1) Construction of two additional generators (Units 3 & 4: each 130MW) at an existing TPP
   1) 130MW steam turbines × 2
   2) Generators × 2
   3) Natural circulation boilers × 2 (dual-firing: heavy fuel oil/natural gas)
   4) Main transformer
   5) Civil works
   6) Fuel tank expansion work
   7) Consulting services

(2) Boost voltage capacity on existing transmission lines between Aqaba and Amman
   8) Voltage step up work
   9) Consulting services

Japan's ODA loan covered components 1) - 4) above, together with the price escalation involved and contingency (total: 15,558 million yen). 5) and 6) were financed by the Arab Fund for Economic and Social Development (AFESD) and 8) was funded by the AFESD and the Islamic Development Bank (IDB). Consulting services were self-financed.

1.4 Borrower/Executing Agency

Government of the Hashemite Kingdom of Jordan (GOJ)/Central Electricity Generating Company (CEGCO)[1]

1.5 Outline of Loan Agreement

	Phase 1	Phase 2
Loan Amount Loan Disbursed Amount	4,745 million yen 4,537 million yen	10,813 million yen 10,769 million yen
Exchange of Notes	August 1994 August 1994	March 1996 April 1996
Terms and Conditions -Interest Rate -Repayment Period (Grace Period) -Procurement	 3.0% 30 years (10 years) General untied	 2.7% 30 years (10 years) General untied
Final Disbursement Date	October 1999	June 2001

[1] The project's executing agency was JEA at the signing of the loan agreement, however, the government unbundled the generation, transmission and distribution sectors in 1999, at which time the executing agency became CEGCO.

2. Results and Evaluation

2.1 Relevance

At the time of appraisal, demand for energy in Jordan was expected to grow at an average rate of 6.0% per annum during 1995-2005, and demand and supply, at that point, were in equilibrium. Given that there was a strong possibility of supply shortfalls emerging in the near future and that the need to expand generation facilities to meet increased demand had been pointed out, this project was positioned as a key component of the Kingdom's power development plan. In view of these factors, the plans, including the objectives and scope settings, formulated for this project at appraisal are judged to have been relevant. Furthermore, the component involving capacity boosting on existing transmission lines was funded by other donors (IDB, AFSED), and since the scope of the ODA loan funded project to be implemented concurrently was complementary to this component, this project was also consistent with the policies of other donors.

Meanwhile, the National Economic and Social Development Plan devised by the Ministry of Planning for 1999-2003[2], is targeting the supply of power, mains water and sewerage, road infrastructure, and health and educational facilities to 860 thousand of the Kingdom's poor population in 200 districts. Moreover, the results from a hearing with CEGCO, the National Electric Power Company (NEPCO), the Ministry of Energy and Mineral Resources and the Ministry of Planning, found that stable power supplies are an important part of the basic infrastructure development commitment of the national plan and that they are acknowledged to be indispensable to the industrial promotion and improvements of living standards, thus the implementation of this project is judged to have retained its relevancy to the present time.

2.2 Efficiency

2.2.1 Project Scope

The contents of the project scope were not revised and were implemented according to the initial plans.

2.2.2 Implementation Schedule

As evidenced by Table 1, the project's implementation schedule was delayed by 25 months. According to CEGCO, the primary reason for these delays was the earthquake that occurred in 1995, which rendered it necessary to review the aseismatic design of the original plans so as to increase safety. Another reason for the delays was that shortly after becoming operational, steam cycle contamination occurred in Unit 3 due to a faulty at drainage valve rendering it necessary to clean the turbine and other related equipment. Whilst it is considered that it would have been extremely difficult to predict the occurrence of either of these situations at appraisal, it is possible that proper studies of the geographical conditions in the region during planning, and the consideration of the potential occurrence of natural disasters such as earthquakes as risk factor, may have been necessary.

[2] The National Economic and Social Development Plan for 1999-2003, Ministry of Planning 1997

Table 1: Comparison of Planned / Actual Project Schedule

Project Scope	Plan	Actual
Facilities expansion at TPP	May 1995 – Dec. 1997	May 1995 – Jan. 2000
Transmission line capacity expansion	May 1995 – May 1997	May 1995 – Dec. 1997
Consulting services	May 1993 – Dec. 1997	Mar. 1993 – Jan. 2000

Source: CEGCO

2.2.3 Project Cost

Total project costs resulted in an overrun of approximately 1.4 billion yen on the revised plan figures (Phase 2), with the foreign currency portion exceeding the estimates by around 2.8 billion yen. There was an underrun of approximately 300 million yen on the revised plan figures for the ODA loan portion of foreign currency costs, however, in addition to the aforementioned delays in the implementation schedule, a cost overrun was generated by the implementation of another project (the linking of the Egyptian and Jordanian power grids, etc.) relating to the transmission line capacity boosting work that was not included in the original plans, and which was thus financed by the IDB and the AFESD.

It should be noted that the delays in funds allocation due to the cost overrun did not cause any hold ups in the implementation schedule.

2.3 Effectiveness

2.3.1 Meeting Demand for Power

As shown in Table 2, consumer demand for power in Jordan increased by an average of 6.2% per year between 1994 and 2001, with peak load growth averaging 6.4% over the same period. By comparison, the capacity usage ratio of plant facilities posted average growth in the region of 4% over the 64.1% at project planning (1994). Despite these year on year increases in demand for power, the only supply shortages that occurred were during the fire at the power plant and due to a temporary technical shutdown. Moreover, as the table evidences, the capacity usage ratio has predominantly remained stable at around 70%, thus it may be inferred that supply capacity is meeting demand.

Table 2: Energy Demand & Supply Results for Jordan

Year	Consumption (GWh) / % increase		Peak load (MW) / % increase		Capacity factor (%)
1994	4,676		794		64.1
1995	5,201	11.2%	862	8.6%	68.9
1996	5,623	8.1%	902	4.6%	71.2
1997	5,886	4.7%	971	7.6%	69.2
1998	6,287	6.8%	1,020	5.0%	70.4
1999	6,636	5.6%	1,099	7.7%	68.9
2000	6,934	4.5%	1,206	9.7%	65.6
2001	7,132	2.9%	1,225	1.6%	66.5
2002	-		1,370	11.8%	-

Source: CEGCO

As illustrated in Table 3, in 2001, power generation at Aqaba TPP accounted for 39% of gross production by CEGCO (30% in 1998), and in view of the fact that the project units (3 and 4) account

for 53% of power generated at Aqaba TPP (29% in 1998), it is judged that the project's objective of meeting demand is essentially being achieved.

Table 3: Changes in CEGCO Generation Volumes (MWh)

Power Plant	1996	1997	1998	1999	2000	2001
Aqaba Thermal (Unit 3 & 4)	0	0	576.3	1,454.7	1,479.9	1,495.2
Aqaba Thermal (all)	2,038	1,820.4	1,944.9	2,479.5	2,741.8	2,818.8
Hussein Thermal	2,285	2,452.4	2,330.4	1,811.5	1,858	1,928.1
Al-Risha	730.9	782.9	715.9	734.7	742.9	768.9
Rehab	301.5	607.4	466.4	115.3	49.4	45.1
Others	266.58	222.99	249.42	39.92	31.77	40.18
Total	5,621.98	5,886.09	6,283.32	6,635.62	6,903.77	7,096.28

Source: CEGCO

2.3.2 Stable Energy Supplies

The operating results of the two units installed under this project are as shown in Table 4.

The two generators produced a total of 1,480 MWh/year in 2000 and 1,495 MWh/year in 2001, which is slightly lower than the planned level of 1,594 MWh/year, however, this is the result of the fire in Unit 3's transformer that occurred in October 2000, and which resulted in the unit being shutdown for 10 months for repair. Production reached 1,527 MWh/year during a nine-month period in 2002, and was forecasted to exceed the target level within the year. The two units are meeting the planned generation output target of 130 MW.

Between 2000 and 2002, the operating capacity ratio of Unit 3 fluctuated at 67.00%, 39.10%, and 98.76%, whilst that of Unit 4 fluctuated at 86.00%, 98.00%, and 95.88%, which means that, excluding the aforementioned period during which Unit 3 was shutdown, operating results are exceeding 70% of the planned level. Regarding fuel consumption, since Unit 3 includes a 10-month period of operational shutdown due to an accident, only the figures for Unit 4 are considered here. In 2001 Unit 4 consumed 234,587 tons of fuel, which represents an increase of approximately 1.3 fold as compared to 50% of the planned total for the two units, i.e. 353,203 tons. This is due to the fact that the operating capacity ratio of Unit 4 has also increased over the target level (70%). As evidenced above, the operating results of Units 3 and 4 are exceeding the planned levels except in fuel consumption, and the two units are thus generally considered to be contributing to the provision of stable power supplies.

Table 4: Operational Status of Project Units

Item	Target	Results					
		Unit 3			Unit 4		
		2000	2001	2002[3)]	2000	2001	2002[3)]
1. Total generation (MWh/year)	1,594 [4)]	643	420	776	837	1,075	751
2. Maximum output (MW)	130	130	130	130	130	130	130
3. Auxiliary power ratio[1)] (%)		7.51	7.20	N/A	7.48	7.45	N/A
4. Thermal efficiency[2)] (%)		37.28	37.09	N/A	36.89	37.59	N/A
5. Operating capacity ratio (%)	70	67.00	39.10	98.79	86.00	98.00	95.88
6. Fuel consumption (ton/year)	353,203 [4)]	17,422	33,722	N/A	186,023	234,587	N/A

Source: CEGCO

1) Auxiliary power ratio is defined as the ratio of power consumed within the power plant to gross generation.

2) Thermal efficiency is defined as the ratio of the heat of net transmission output to the heat of fuel used.

3) The values for 2002 are for the period from January through the end of September.

4) Planned values are the total for Unit 3 and Unit 4.

2.3.3 Transmission and Distribution Loss Status

The JICA study of 1997 indicated substantial power losses in the transmission and distribution network and proposed plans to reduce these losses[3]. NEPCO reports that, of the technical and non-technical losses such as power theft, the latter are not a major problem in Jordan, and in 2001 total power losses stood at around 18%, with approximately 3% lost in transmission and 10% in distribution. CEGCO is responding to power losses in various ways, including via preventive and predictive maintenance. Further, NEPCO is planning to undertake a more detailed study of technical losses in connection with transmission and distribution losses.

In consideration of this project's objective "to facilitate stable supplies of power as a means of meeting increasing demand in Jordan", there is a need to conduct an in-depth study of factors impeding supply, starting with the areas of the distribution network that are closest to the consumer, and EDCO and other distribution companies are currently doing their utmost to implement measures against distribution losses, which are heaviest, on the basis of the recommendations of the JICA study. According to EDCO, distribution losses are predominantly caused by power being supplied at low voltages over long distances and they are currently implementing sequential improvements to their distribution lines. However, the replacement of connections on distribution lines recommended by JICA will require a budget of around JD2 million (approx. US$3m) and will involve the temporary suspension of services while the work is being implemented as well as land acquisition issues when new utility poles are installed, which effectively renders it difficult to implement. According to JEPCO, which covers distribution in the Amman area, losses in the metropolitan area are comparatively low at around 9%, and they are in the midst of implementing loss improvement policies in line with the recommendations of the JICA study. EDCO, which distributes power to the regions, is aware of the problem of power theft as a non-technical loss and is responding through meter management, including checking for unauthorized power use, and promoting the collection of proper electricity tariffs by cooperating with the police in the case of serious offenders. Power losses must be kept to a minimum in order to maintain stable supplies of electricity and the various organizations are currently responding to the problem through a combination of domestic funding and self-help efforts.

2.3.4 Increased Transmission Grid Capacity

The project to boost the voltage capacity of transmission lines was planned during the latter half of the 1980s and targeted the north-south transmission lines, which meet domestic power demand. The Aqaba TPP is key source of power for this network and since the voltage capacity of the transmission lines was insufficient to transmit the power generated at the plant, there were urgent calls for the voltage to be stepped up. Moreover, the implementation of this project made it possible to link the Jordanian transmission grid with Egypt in 1999 and with Syria in 2001. The objectives of linking the transmission network with those in neighboring countries were (1) mutual support in emergencies and (2) the interavailability of surplus power, with the former being pre-eminent; most purchases are currently being made from Egypt (approx. 4% of NEPCO transmissions in 2001). CEGCO predicts that Lebanon, Iraq, Turkey and Libya will be linked to the Jordanian network in the

[3] Study for Planning Electric Power Loss Reduction of Transmission and Distribution Networks in the Hashemite Kingdom of Jordan, JICA: 1997.

future.

As demonstrated above, the boosting of transmission grid capacity has made it possible to establish a mutually supportive power supply system and to purchase power from neighboring countries, and it is evaluated as being partially accountable for the stability of power supplies in Jordan.

2.3.5 Recalculation of Financial Internal Rate of Return (FIRR)

As at appraisal, the FIRR was recalculated on the basis of the following assumptions.

Assumptions

(1) Benefits: Revenue from power sales

(2) Costs: Construction costs, operation and maintenance costs, fuel costs

(3) Project life: 25 years from the start of commercial generation

The recalculated value was 7.1%, which is lower than the planned value (12.4%) and the value at Project Completion Report (PCR) submission (9.9%). This is the result of decreases in revenue due to the 10-month period during which Unit 3 was being repaired after an accidental fire in its transformer and was not generating power, and to the increases in fuel prices (heavy fuel oil) after 2002. However, CEGCO predicts that from 2003, the conversion to natural gas will reduce fuel costs and revisions to electricity tariffs will increase profits from bill collection, thus it anticipates that profitability will improve. It should be noted that since it was not possible to confirm the price of natural gas, current fuel costs (heavy fuel oil) were used for this recalculation.

2.4 Impact

2.4.1 Economic Impacts

Through interviews with CEGCO and other related organizations it was confirmed that the project has led to stable power supplies and that, as a key component of the Kingdom's basic infrastructure, it is contributing to the promotion of economic activity in Jordan. According to the Aqaba Special Economic Zone Authority (ASEZA), which has control over the Aqaba TPP and the Aqaba branch of the Central Bank, there have been no supply shortfalls in the Aqaba region, home to the project TPP, where demand is on an expansionary trend with tourism developments and the like. Furthermore , although there are some fertilizer plants that are generating captive power, others are receiving power from Aqaba TPP, and the consensus is that the plant is contributing to development in the region.

From a perspective of improving the living environment of the citizenry, 99% of the population, including agricultural villages, receive power supplies with the only shortages occurring during the fire at the power plant and as the result of a temporary technical shutdown; annual supply interruptions within the JEPCO's responsible area (including those due to defective transmission or distribution components) are within 4 hours per customer . From this it may be inferred that supplies are meeting demand and are stable.

The consensus among CEGCO, NEPCO, the Ministry of Planning and the Ministry of Energy and Mineral Resources, is that they have noted no circumstances within the power sector that have the potential to hamper economic growth, and current plans involve pushing ahead with the privatization of the power sector as a stable sector and furthering the development of the business,

predominantly using private capital. Privatization is being promoted as a national policy initiative with the program being commenced in sectors that are judged to be comparatively more stable. The power selling price mechanism is currently under government control, and there are no plans to change the current system. CEGCO's selling price to NEPCO, etc. and the end user tariffs charged by the various distribution companies are as shown in Table 5. NEPCO purchases power from Egypt at 26.1fils/kWh (the average for January through September 2001 based on price fluctuations), which is roughly in the middle of CEGCO's price range, and means that NEPCO's purchasing costs will not be dramatically affected even if it purchases power from CEGCO in the event that domestic supply exceeds demand. However, CEGCO's generation costs will decrease with the forthcoming conversion of TPP fuel to natural gas and if this is reflected in its selling price then demand for domestically produced power is expected to grow. CEGCO has as yet to prepare clear guidelines on its policies regarding further facilities investment, production expansions and so forth, and although this is partly due to the fact that neither the National Economic and Social Development Plan for 2004 and beyond nor the Energy Sector Master Plan have been formulated yet, it does represent a flaw in the power sector policies of the Kingdom.

The expansions to the TPP undertaken via this project did not require any land acquisition nor involuntary resettlement.

Table 5: Power Selling Price / Tariff Rates (fils [1)]/kWh)

Power Selling Price	
Distribution companies (NEPCO, etc.)	Daytime: 29, nighttime: 19
Large-scale plants, etc.	Daytime: 47, nighttime: 32
Power Tariffs	
Residential	30-75 (4-phase system based on monthly consumption volumes)
Broadcasting	60
Commercial	60
Medium-sized plants	Daytime: 33, nighttime: 21
Small-scale plants	36
Water pumps	34
Hotels	60
Agriculture	23
Street lighting	20

Source: CEGCO
1) 1JD=1,000 fils

2.4.2 Environmental Impacts

Due to fears of atmospheric pollution stemming from the fact that the low-sulfur heavy fuel oil agreed upon at appraisal was not used after the facilities became operational, and the impact on the coral reef of the change in the position of the heated effluent discharge outlet, JBIC carried out a commissioned study in 2001 after the completion of this project [4], and made recommendations for future countermeasures. In this connection, the following measures are currently being implemented:

2.4.2.1 Atmospheric Pollution

The fact that the low-sulfur heavy fuel oil agreed upon at appraisal was not used after the

[4] Commissioned Study on the Environmental Aspects of the Aqaba Thermal Power Plant Expansion Project, Hashemite Kingdom of Jordan, JBIC: May 2001

facilities became operational gave rise to the possibility that atmospheric concentrations of SO_2 in the vicinity of the project TPP would exceed WHO standards. In view of this, through the environmental impact simulation carried out as part of the commissioned study (see footnote 4), and the results of a 2002 measurement survey confirmed that atmospheric concentrations of SO_2 are clearing WHO standards. Since CEGCO is also scheduled to complete the conversion to natural gas planned at appraisal in July 2003, it can be inferred that the non-use of low-sulfur heavy fuel oil will have no particular impact. Moreover, there are plans for monitoring to be undertaken again once the conversion to natural gas is completed and the results are to be reported to JBIC. ASEZA, which controls the Aqaba TPP, stipulates that the concentration of SO_2 gas emissions from each exhaust gas unit has to be measured and reported on a monthly basis, and this practice is scheduled to continue. Furthermore, Aqaba TPP reports that it is planning to continue the fixed-point observations that it currently conducts outside the plant site .

2.4.2.2 Impact of Heated Effluent on the Coral Reef

Regarding the impact of heated effluent discharged from the Aqaba TPP on the coral reef, it has become clear that, in December 2000, after the plant commenced on-grid generation, the position of the heated effluent pipe was changed on the advice of the Aqaba Regional Authority, responsible for the approval and licensing of the facilities at the time, in order to mitigate the impact on the coral reef. The relevance of this design modification was confirmed during the commissioned study (footnote 4). The results of a periodic study of temperature rises in Aqaba Bay commissioned by CEGCO and undertaken by a local third party organization, Marine Science Station (MSS), revealed a 1^oC-1.5^oC increase in the temperature of the water, which is in conformity with Jordanian national standards (4^oC), World Bank standards (3^oC) and ASEZA standards (3^oC), and in view of the fact that it is below 2^oC, the temperature given as a guideline for the occurrence of coral bleaching, CEGCO do not consider the implementation of any further independent studies to be necessary. There have also been no reports of markedly adverse effects on the coral reef from the ecological surveys of marine life that are periodically conducted by MSS on commission from ASEZA.

ASEZA establishes environmental standards and approves and licenses new developments, and they report that they are planning to begin inspecting existing facilities within the next six months or so in order to ascertain their conformity status vis-à-vis the environmental standards, etc. (including heated effluent standards). Guidance will be provided in the event that any problems are detected. Marine surveys are outsourced to MSS and are conducted on a regular basis; they include seawater temperature measurements and ecological surveys of marine life.

As evidenced above, various measures are being taken against the feared environmental impacts of this project, and given that monitoring is to continue to be undertaken either by the executing agency or by a third party, the possibility of the facilities causing a major environmental problem in the future is not considered to be especially high. Moreover, most of the parties involved are judged to be aware of the importance of the marine environment, including the coral reef that stretches throughout the Aqaba region and to respect the relationship between developmental activities and environmental conservation. The responses to the environmental problems undertaken by the various organizations involved in this project over the years are also believed to have contributed to nurturing awareness of environmental conservation throughout the Aqaba region.

2.5 Sustainability

The sustainability of the Aqaba TPP hinges upon the management system, the operation and maintenance system, the personnel, technical capability, and financial status, and the future plans of CEGCO, the project's executing agency. Each of these items is addressed hereunder, however, no particular problems are observed at the present time. However, since CEGCO itself is slated for privatization under the national policies, it is considered possible that its sustainability as an organization may be affected by future trends in government policy. Further, CEGCO considers that fundamental research into generation expansion and efficiency enhancement are also necessary as these will be reflected in its facilities improvement plans, and is adopting a cautious stance towards the investments needed for these expensive large-scale studies. This also relates to the flawed plans of superior organizations mentioned earlier, and since, if these plans incorporate adequate surveys, there is the possibility that CEGCO, etc., will only need to undertake minimal feasibility studies, coordination with the superior organizations will also be crucial to the sustainability of the project.

2.5.1 Organizational System

In the power sector, CEGCO and EDCO are slated for privatization during 2003 under government policy and will come under a new legislative system; NEPCO will continue to be owned by the state. The GOJ is in the process of exploring the effects that privatization will have on these power sector organizations, however, since the details of its findings have yet to be made public it is currently difficult to assess the sustainability of CEGCO from an operational perspective. According to CEGCO, NEPCO and the Ministry of Energy and Mineral Resources, the GOJ has concluded that independent management of the power sector will be possible by tapping private investment capital and has no further plans to inject public funds, including subsidies.

2.5.2 Operation and Maintenance System

The operation and maintenance of project facilities is being undertaken by Aqaba TPP, which is under the control of the executing agency, CEGCO. Aqaba TPP reports that they are executing various types of maintenance work, including preventive and periodical maintenance and equipment overhauls, at regular intervals throughout the year targeting safe and efficient operations at the plant. Since it takes time to acquire spare parts from the suppliers and there have also been budgetary cuts, efforts are being made to maintain a minimum stock of high-use components, etc. Data on the operational status of the facilities is managed via computer, and in view of the fact that the responsible department was capable of responding rapidly to requests to provide information it is believed that the operation and management system is in good shape.

2.5.3 Personnel / Technical Capability

CEGCO currently employs a total of 1,534 staffs (2001). Of this number, 433 are employed at the Aqaba TPP; a breakdown of the payroll is shown in Table 6. Recruitment is undertaken at the CEGCO head office in response to local requests and the vacancy situation, and training is periodically undertaken both domestically and offshore. One year on-the-job training is provided for new recruits

In addition, the equipment supplier has been implementing maintenance-related technical transfers during the two years since the project units commenced operation (4-7 full-time employees). According to Aqaba TPP, the current levels of staffing and technical capability are

sufficient to operate the facilities. To maintain technical levels among staff, a substantial benefits package, including housing assistance, health checkups, and tie-ups with medical facilities, is provided for employees, which is preventing the drain of highly qualified technical staff. This is to avoid poaching staff by neighboring plants, where demand for such workers is strong. An average ten new employees are taken on each year. Avoiding the outflow of trained personnel is necessary to maintain the technical level of the facilities, and there is a strong chance that the competition for employees will be intensified as development in the Aqaba region progresses. Given the circumstances, it will be necessary to keep pay at a competitive level and CEGCO will need to undertake a thorough investigation of the pay system and so forth, in the event that it is privatized.

Table 6: Aqaba Thermal Power Plant Payroll

Occupation	Number
Managers	21
Engineers	37
Technicians	346
Assistants	29
Total	433

Source: CEGCO

2.5.4 Financial Status

CEGCO's primary source of income is from sales of power to the transmission company NEPCO, and since the decision has been made not to privatize this latter company, the financial viability of CEGCO is secure in so far as it continues the stable generation and selling of power.

Earnings statements evidencing the financial status of CEGCO since it was unbundled in 1999 are shown in Table 7 and it is clear that the company has been posting comfortable profits year on year. The Aqaba TPP currently produces the majority of CEGCO's gross generation volume, but it is planning to construct a new power plant in order to meet projected increases in demand (refer to section 2.5.5 "Future Plans"). Given that privatization is likely to lead to the entry of independent power producers (IPP), it will become necessary to implement market competition. Accordingly, CEGCO has put a policy to reduce generation costs into action, which includes using seawater as a cooling source (a reduction of JD300,000 or around US$400,000 p.a.), and the conversion to natural gas fuel. The company has also recognized that initial investment, including surveys, will be necessary to introduce these new management policies.

From the above, it is possible to judge CEGCO's current investigations into sound operational practices as a means of improving its finances and in the context of its forthcoming privatization in terms of the company's sustainability. However, since CEGCO does not currently have the authority to set the power selling price, it is precluded from adopting managerial policies that will allow generation cost cuts to be shared with the consumer, and this may yet inhibit the sustainability of the company.

Table 7: CEGCO Profit and Loss Statement

(JD)

		1999	2000	2001
▪Revenue				
	Power sales	165,167,466	167,663,837	172,371,141
	Other revenue	146,362	11,561,806	16,539,601
Total		165,313,828	179,225,643	188,910,742
▪Expenditure				
	Generation costs	106,045,696	108,945,166	110,297,316
	Depreciation costs	27,488,785	33,389,772	32,979,845
	Maintenance costs	4,177,530	6,185,953	4,656,994
	General operational costs	2,653,246	3,115,440	3,572,919
	Interest	11,055,066	13,016,750	12,628,228
	Other	6,591,121	560,910	4,033,696
Total		158,011,444	165,213,991	168,168,998
▪Pre-tax profit		7,302,384	14,011,652	20,741,744

Source: CEGCO

2.5.5 Future Plans

Power demand is forecasted to grow at an average rate of 4% per year through 2015 (Table 8), and CEGCO has plans to increase its generation capacity via the installation of two new generation facilities each with a maximum output of 100 MW, scheduled to commence commercial operation in 2003 and 2005, and through improvements to existing facilities. According to NEPCO, JEPCO, and the Ministry of Energy and Mineral Resources, a Belgian IPP is planning to construct a power plant with a maximum output capacity of 450 MW in the Samara district. The vision also incorporates increased power imports from Egypt and Syria.

As long as power demand continues to increase it will be necessary to expand supply and it will become vital for CEGCO to invest in new facilities, improvements of existing facilities and so forth. Moreover, since privatization will also pitch the company into competition with other companies and countries, CEGCO will need to formulate decisive plans for the short, medium and long term.

Table 8: Power Demand Forecasts

Year	Consumption (GWh)	Increase Rate	Peak demand (MW)	Increase Rate
2002	8,429		1,354	
2003	8,937	6.0%	1,429	5.5%
2004	9,468	5.9%	1,518	6.2%
2005	10,038	6.0%	1,611	6.1%
2006	10,779	7.4%	1,722	6.9%
2007	11,271	4.6%	1,807	4.9%
2008	11,727	4.0%	1,874	3.7%
2009	12,154	3.6%	1,940	3.5%
2010	12,539	3.2%	1,998	3.0%
2015	14,151	12.9%	2,249	12.6%
2003-2015 (av.)	-	4.1%	-	4.0%

Source: CEGCO

3. Feedback

3.1 Lessons Learned

3.1.1

Early measures to address emerging problems are effective in the sense that they will facilitate improved ownership by the executing agency.

JBIC indicated the issues that need to be tackled by the executing agency in terms of the environmental impact of the project, implemented a commissioned study when the possibility that problems might emerge and proposed a number of improvement policies, which not only nurtured awareness of environmental issues among the parties involved in project implementation, but also helped to make cost reductions achieved via the conversion from heavy fuel oil to natural gas. The executing agency has acknowledged this to be one of the beneficial technical transfers that occurred as the result of this project, and the recommendations were significant in the sense that they created the momentum for fuel conversion and the use of seawater as a source of cooling. Effectuating a rapid response to emerging problems during the early stages of project implementation is beneficial in the sense that it facilitates improved ownership by the executing agency, and it is hoped that, to the extent that it is applicable, this initiative will be implemented universally on other ODA loan funded projects.

3.1.2

It is necessary to introduce a mechanism that will enable the timely access to information relating to changes in external conditions at the time of appraisal, and to discuss and investigate such matters with the government of the recipient country and the executing agency.

Instances of the executing agency being divested and privatized after project completion are not limited to this project, but in this case these reforms may result in the system of responsibility within the organization becoming unclear. This trend is particularly marked for project scope components not covered by Japan's ODA loan, and has the potential not only to make it difficult to identify and evaluate conditions after completion but also to hamper the sustainability of the project per se. This project's executing agency, CEGCO, and EDCO, the company responsible for distribution, are slated for privatization in 2003, and related legislature is currently being drawn up, however, there are a number of uncertain factors, for example, will it be possible for the project to achieve its original development objectives in terms of the impact of privatization on the pricing system for power sales and on the consumer. Again, will the executing agency be able to fulfill its obligations vis-à-vis the ODA loan contract. Accordingly, in cases where there are trends that would seem to indicate the possibility of changes in external conditions, such as privatization, during the planning and appraisal of a project, it is hoped that a system, to be agreed by the government and the executing agency, can be devised via which relevant information can be obtained in a timely manner, or that a system be introduced that allows for involvement in policy discussions on privatization, etc., being undertaken by the government of the recipient country.

3.1.3

Special consideration must be given to enforcing conformity with matters agreed at appraisal that relate to serious adverse environmental impacts.

The executing agency failed to conform to the agreement on the use of low-sulfur heavy fuel oil that was agreed at appraisal, and since its conformity status vis-à-vis this agreement was not properly confirmed, the possibility of major environmental pollution emerged. In relation to matters agreed at appraisal, such as this, which relate to serious adverse environmental impacts, the executing agency must be made aware of their importance at appraisal and conformity with the agreement enforced, and at the same time, it is also necessary for JBIC to undertake a detailed follow up of conformity status.

3.2 Recommendations

(To the executing agency)

3.2.1 The necessity of developing a Master Plan (M/P) for the energy sector

Although reference is made to the current National Development Plan (valid through 2003), no M/P for the power sector had been developed when this project was in its planning stages, which made it difficult to ascertain matters such as the direction of energy development and the role of the power sector. Whilst the formulation of the M/P is currently under investigation, how the role of the power sector is positioned within this plan will be of crucial importance to energy developments in Jordan and to the formulation of investment plans within CEGCO. These flaws in the plans of superior organizations made it difficult to assess the relevance, impact and sustainability of the project during the ex-post evaluation. The current National Economic and Social Development Plan is valid until 2003, and since privatization policies are already underway, it is considered necessary to investigate and formulate a M/P by around 2005 that encompasses its relationship with this national development plan and projections for the power sector over the next five to ten years.

Comparison of Original and Actual Scope

Item	Original Plan Phase 1	Revised Plan Phase 2	Actual
1) Project Scope	(1) TPP facilities expansion 1) Steam turbine: 130MW × 2 (dual-firing: heavy fuel oil/natural gas) 2) Generators: 2 3) Natural circulation boiler: 2 4) Main transformer 5) Civil works (incl. construction of new 125m stack) 6) Fuel tank expansion work (2) Transmission line capacity boosting 1) Voltage step up work: 132kV→400kV (3) Consulting services	(1) TPP facilities expansion 1) Steam turbine: 130MW × 2 (dual-firing: heavy fuel oil/natural gas) 2) Generators: 2 3) Natural circulation boiler: 2 4) Main transformer 5) Civil works (incl. construction of new 125m stack) 6) Fuel tank expansion work (2) Transmission line capacity boosting 1) Voltage step up work: 132kV→400kV (3) Consulting services	(1) TPP facilities expansion 1) As planned 2) As planned 3) As planned 4) As planned 5) As planned 6) As planned (2) Transmission line capacity boosting 1) As planned (3) As planned
2) Implementation Schedule	(1) TPP facilities expansion Steam turbines and generators Dec. 1994 – Aug. 1997 Boilers Dec. 1994 – Aug. 1997 Fuel tank Dec. 1994 – Aug. 1997 Civil works Dec. 1994 – Aug. 1997 (2) Transmission line capacity boosting May 1995 – Mar. 1997 (3) Consulting services May 1993 – Aug. 1997	(1) TPP facilities expansion Steam turbines and generators May 1995 – Dec. 1997 Boilers May 1995 – Dec. 1997 Fuel tank Jun. 1995 – Feb. 1997 Civil works May 1995 – Mar. 1997 (2) Transmission line capacity boosting May 1995 – May 1997 (3) Consulting services May 1993 – Dec. 1997	(1) TPP facilities expansion Steam turbines and generators May 1995 – Jan. 2000 Boilers May 1995 – Jan. 2000 Fuel tank Jun. 1995 – Mar. 1998 Civil works May 1995 – Jul. 1998 (2) Transmission line capacity boosting May 1995 – Dec. 1997 (3) Consulting services Mar. 1993 – Jan. 2000
3) Project Cost Foreign currency Local currency Total ODA loan portion Exchange rate	 31,811 million yen 5,236 million yen (34,905,000 JD) 37,047 million yen 15,006 million yen 1JD = 150 yen (As of Aug. 1994)	 25,006 million yen 5,214 million yen (36,006,000 JD) 30,220 million yen 15,558 million yen 1JD = 144.81 yen (As of Dec. 1995)	 27,854 million yen 3,739 million yen (23,267,000 JD) 31,593 million yen 15,307 million yen 1JD = 160.7 yen (Average for 1995 – 1997)

Third Party Evaluator's opinion on
Aqaba Thermal Power Plant Expansion Project (I) (II)

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Relevance

Jordan's economic and social development has been experiencing growth. Real Gross Domestic Product (GDP) grew at 4.9% in 2002, but is projected to drop back to 3.5% in 2003. The generated energy forecast in Jordan is continued to increase at an average growth rate of 6.0% for the coming five years. The expansion in the country's manufacturing sector is a major factor that will determine the expansion plan of generating facilities; this expansion in manufacturing sector has been driven by such factors as the US-Jordan Free Trade Area, admitting of Jordan to membership in the World Trade Organization and the establishment of Aqaba Special Economic Zone ASEZ. A direct impact of those factors was a substantial increase in the consumption of electrical energy. This resulted in increasing the imported electrical energy, which jumped from 44.5 GWh in 2000 to 267 GWh in 2001, and that accounts for 500% growth rate.

Therefore, the main objectives of the development plan of electrical sector are to alleviate shortages of electric power and to mitigate adverse impact on the environment. In this respect, Aqaba Thermal Power Plant Expansion and the first Independent Power Producer IPP plant of 450 MW near Amman are key figures in this plan. Furthermore, the sustainable development of social life and improving the living standards of population are in direct relation to the level of industry and the availability of electric energy.

Impact

Aqaba Thermal Power Plant expansion will positively contribute to the economic, social, and environmental aspects of the country's development plan. The availability of the electric energy will promote Aqaba Special Economic Zone Authority to realize their ambitious plans through boosting the industrial and tourist sectors in that region. Furthermore, this project will increase the installed generating capacity of the country and will enable it to meet the increasing demand of electrical energy.

Notwithstanding the fact that 99.9% of population is supplied by electric energy (99.2% for rural areas) the power interruption, which is 7.6 hours/consumer/year for 2002*, tends to increase if the demand will not be covered by additional generating capacity. Thus, the project will have direct result in improving the standards of living in Jordan.

From the environmental point of view the project will not have an adverse impact to the environment in Jordan (per capita carbon emission in 2001 is 0.63 metric ton of carbon vs. US 5.5 metric ton of carbon). But the country is aware of the pollutants produced by generating plants, such as the increased quantity of SO_2 and the discharge of heated effluents in the Aqaba Gulf. The main concern is the limited coastline (26 km) and the unique coral reef, which if destroyed will need a very long time to rebuild itself. Therefore, authorities are looking for measures to mitigate the negative sequence of such projects by monitoring and controlling pollutant parameters. Also, a new policy is adopted for construction of dual firing power plants and converting all old plants to this system. Natural gas fired power plants will dominate in the near future, specially with the new gas pipe line linking Egypt to Jordan for gas transportation.

* JBIC view: The information source of this data is NEPCO, a sole power transmission company in Jordan. On the other hand, according to information from JEPCO, the annual power supply interruptions are within 4 hours per customer as stipulated in JBIC evaluation report.