Syria

Al-Zala Thermal Power Plant Project

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Field Survey: September 2004

1. Project Profile and Japan's ODA Loan

Project Area Map

Al-Zala Thermal Power Plant

1.1 Background

In Syria, the power supply had been obviously inadequate since the latter half of the 1980s as the expansion of power generation facilities was unable to keep pace with the demand for electric power. In 1993, the balance of supply and demand in electric power was in an extremely deteriorated condition, with a total power output of 1,879 MW against a maximum power demand of 2,376 MW. This led to planned blackouts of 5 to 6 hours a day in the capital city Damascus and over 10 hours in outlying areas. In 1994, the supply shortage was alleviated by the start of partial operation of the Jandar Power Station Project, which was also funded by an ODA yen loan. However, an increase in electric power demand was forecast due to high population growth (3.36% in 1993), rapid economic growth (annual average of approximately 8.4% from 1990 to 1993), and potential demand from the mining sector. Syria made a large-scale power development plan in response to the situation, and this project was positioned as a major part of the plan. Meanwhile, Syria's energy policy promoted the export of crude oil and encouraged the use of natural gas for domestic energy needs, and this project was planned to use natural gas which was being developed.

1.2 Objective

The objective of this project was to construct a thermal power plant fueled by both natural gas and crude oil and consisting of 3 generators with capacities of 200 MW each. It would ensure the expansion of Syria's electric power supply, promote effective use of domestic natural gas, and reduce domestic consumption of crude oil for exports, and thereby contribute

to the country's economic growth and the improvement of Syria's international balance of payments through improving the investment climate in that country.

1.3 Borrower/Executing Agency

Syrian Arab Republic/Public Establishment of Electricity for Generation and Transmission (PEEGT)

1.4 Outline of Loan Agreement

Loan Amount/Loan Disbursed Amount	46,199 million yen/42,247 million yen
Exchange of Notes/Loan Agreement	November 1995/December 1995
Terms and Conditions -Interest Rate -Repayment Period (Grace Period) -Procurement	 Main Construction: 2.7% annually Consultant: 2.3% annually 30 years (10 years) General Untied
Final Disbursement Date	January 2003
Main Contractor	Mitsubishi Heavy Industries, Ltd. (Japan)
Consultant Contractor	Mott Ewbank Preece (UK)
Feasibility Study (F/S)	Syrian Government

2. Results and Evaluation

2.1 Relevance

2.1.1 Relevance of the Plan at the Time of Appraisal

In Syria's 7th Electric Power Development Plan (1990-1995), the goal was to boost electric power generation capacity (on a facility capacity basis) to 5,320 MW (equivalent to the maximum electric power demand of Shikoku in 2003) by 2000 in response to the increase in demand for electric power. Moreover, Syria's energy policy promoted use of domestic natural gas to meet domestic energy demand and also promoted the export of crude oil. This project constructing a new power plant in the Al-Zala region of Syria promoted both the expansion of the electric power supply and the effective use of domestic natural gas, and thus was a project with high priority.

2.1.2 Relevance of the Plan at the Time of Evaluation

The current 9th Electric Power Development Plan (2001-2005) aims to boost electric power generation capacity (on a facility capacity basis) to 7,643 MW by 2005 in order to meet future demand for electric power. Moreover, the current energy policy continues to support the increased production of domestic natural gas and the effective use of it for domestic industries, as well as the promotion of crude oil export. This project is consistent with the above-mentioned current policy and thus is a project with continuous importance.

2.2 Efficiency

Most of the output, project period, and project cost were largely in accordance with the plan set at the time of appraisal and some parts were even better than it. Thus the efficiency of the project's implementation is considered as high.

2.2.1 Output

The output planned at the time of appraisal is as follows.

(1) Power generation facility: 600 MW (200 MW x 3 generators)

(2) Transmission and substation facilities: 230 KV transmission lines, 34 km

The actual output was basically as planed, as follows.

(1) Power generation facility: 660 MW (220 MW x 3 generators)

The 10% increase in power generation capacity was made in response to a forecast for higher electric power demand due to economic growth after the appraisal.

(2) Transmission and substation facilities: As planned

2.2.2 Project Period

Whereas the project period that was planned at the time of appraisal was December 1995 to August 1999 (45 months), the actual project period was December 1995 to June 2000 (55 months). The 10-month delay was due to (1) alterations in the design and additional construction to reinforce the foundation work in response to the raised risk rating of the selected project site in earthquake and disaster (4 months), and (2) the position changes of the plant which aim to avoid the effect of wind on the cooling tower. (3 months).

2.2.3 Project Cost

Whereas the planned project cost was 58,854 million yen, the actual cost was 49,612 million yen. The major reason for the cost reduction was the effort to trim costs by efficient order through competitive bidding, etc.

2.3 Effectiveness

As the Table 1 shows, the rate of facility utilization of the Al-Zala Power Plant after completion is high, and the plant steadily generates power. Thus, the effectiveness of the project is considered as high.

Table 1: Operational Effectiveness Indices of the Al-Zala Power Plant

		2001	2002	2003	2004*
Maximum Output (MW)		660	660	660	660
Electricity Production (GWh/year)		3,291	4,089	3,792	2,499
Rate of facility utilization (%)		61	76	70	70
Electric Thermal Efficiency (%)		38.3	38.9	36.6	37.1
Internal Consumption Rate (%)		6.5	6.4	6.7	6.9
Stoppage Time (hours)	Gen. 1	2,585	761	1,118	1,232
	Gen. 2	1,488	1,232	892	1,513
	Gen. 3	924	1,513	1,042	237

Source：PEEGT

Note 1): 2004 data is from January through August.

2.3.1 Actual Operation of the Power Plant

The Al-Zala Power Plant began commercial operation in June 2000. Looking at the actual records from 2001 through 2003 (figures from January through August 2004 are included for reference only), the maximum output was maintained at 660 MW which was the facility capacity. The electricity production[1] and the rate of facility utilization were stable, with an electricity production of 3,291 GWh/year to 4,089 GWh/year (3,724 GWh/year on average) and a rate of facility utilization of 61% to 76% (69% on average). The rate of facility utilization for 2001 was less than 70%, but this was due to restrictions placed on the electric power grid operations by Syria's PEEGT. In short, PEEGT oversees the operations and the periodic inspection plans of 11 power plants nationwide including Al-Zala Power Plant, and PEEGT's central supply command office decides the daily amount of power to be generated by each power plant, while monitoring electric power demand in Syria. The system is such that the amount of power generated by the Al-Zala Power Plant is also determined by order of PEEGT's central supply command office. For this reason, the rate of facility utilization of the Al-Zala Power Plant is less than 70% in some years. The plant maintains a thermal efficiency rate on par with that of thermal power plants in developed countries, with an electric thermal efficiency of 38% on average and an internal consumption rate of 6.6% on average.[2] The stoppage time is affected by the periodic inspection schedule and the amount of daily power production ordered by the central supply command office for each power plant, but each year the stoppage time has been declining little be little.

2.3.2 Effective Use of Domestic Natural Gas

It was expected that the Al-Zala Power Plant would use both natural gas and crude oil as fuel and that domestic natural gas would be effectively used. One of the goals of the project was to meet over 50% of the plant's fuel needs with natural gas, and the goal has nearly been achieved, with a 66% natural gas usage rate in 2002 and a 46% usage rate in 2003. Natural gas is supplied in Syria through a system in which PEEGT and the gas companies confer and decide the total amount of natural gas[3] to be supplied for power generation purposes, with consideration to the balance of demand from the power generation sector with other domestic demand, and then the amount of natural gas supplied to each power plant is determined according to the plant's priority. Consequently, there are years when the natural gas usage rate of Al-Zala Power Plant is less than 50%. Furthermore, Syria is continuously promoting development of natural gas fields, and the plan is to meet 70% of electric power generation

[1] The electricity production is the total generator output minus the amount of electric power consumed within the power plant.
[2] The electric thermal efficiency of thermal power plants in 2002 in Japan (Tokyo Electric Power Company) was 40.4%, the US 33.1%, Great Britain 36.1%, and Italy 39.8% (source: Tokyo Electric Power Company website).
[3] Whereas the total natural gas supply in Syria is 16 million cubic meters/day, the amount of natural gas supplied to PEEGT is 10 million cubic meters/day. So, 62.5% of the total natural gas supplied is allocated to the electric power industry. Of this, supply to Al-Zala Power Plant is 1.6 million cubic meters/day.

needs with natural gas in 2020

2.3.3 Recalculation of Financial Internal Rate of Return (FIRR)

The financial internal rate of return (FIRR) at the time of appraisal was 10.8%. This was calculated taking as expenses the construction expense, fuel expense, and operation, maintenance, and management expense and taking as a benefit the income from electricity sales through this project. The project life was set at 25 years from the start of operation. When FIRR was recalculated for this evaluation using the same conditions, the result was 20.6%. The reason why the recalculated FIRR was higher than the FIRR at the time of appraisal is that the benefit increased due to an 80% rise in the end users' unit cost in 2002 (from 0.8 SP/KWh to 1.44 SP/KWh (approximately 8.5 yen/KWh to 15.2 yen/KWh)).

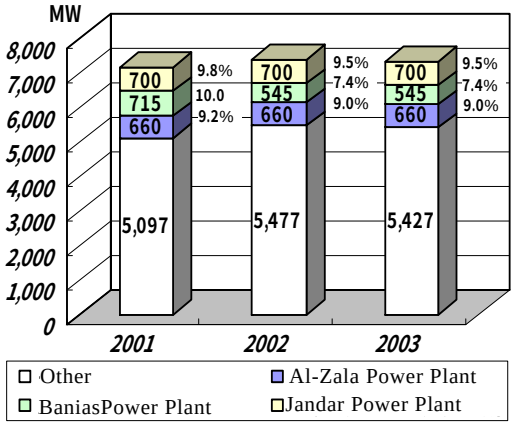
2.4 Impact

2.4.1 Improvement of Investment Climate and Economic Growth in Syria

Through this power plant, this project contributed approximately 9% (660 MW) to Syria's total facilities capacity for power generation (7,332 MW (approximately 3.2% of Japan's facility capacity[4])). If two other ODA loan projects are included (Banias Thermal Power Plant (generators 3 and 4) [5] and Jandar Thermal Power Plant[6]), then the contribution is 26% (1,905 MW). Moreover, this project contributed approximately 14% (3,792 GWh/year) to Syria's electricity production in 2003 (27,487 GWh/year (approximately 2.9% of Japan's electricity production[7])). If the two other ODA loan projects are included, the contribution to electricity production is approximately 38% (10,442 GWh/year). The beneficiary population, extrapolated from Syria's electricity consumption per person (which was 1,386 KWh/year in 2000), is approximately 2.74 million persons for this project alone and approximately 7.53 million persons for the three ODA loan projects combined (Syria's total population is approximately 18 million persons.)

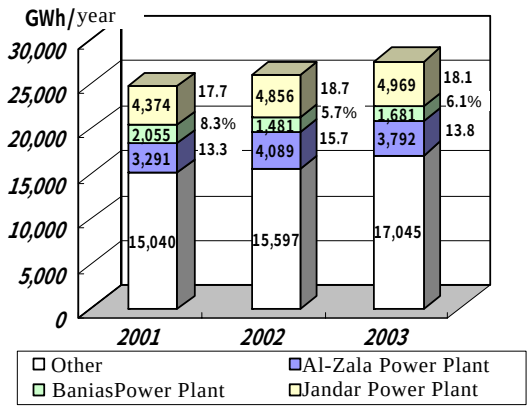
[4] Japan's facility capacity for electric power generation (FY2000) is 228,580 MW total, with 195,630 MW from the 10 ordinary electric power companies and 32,950 MW from the 56 wholesale electric companies (source: website of Japan's Agency for Natural Resources and Energy).
[5] Banias Thermal Power Plant Expansion Project (completed in 1989)
[6] Jandar Power Station Project (completed in 1997)
[7] Japan's electricity production (FY2000) is 939,600 GWh/year (source: website of Japan's Agency for Natural Resources and Energy).

Figure 1: Contribution by 3 ODA Loan Projects



Source:PEEGT

Figure 2: Contribution by 3 ODA Loan Projects



Source:PEEGT

From 1995 through 2002, the foreign direct investment (FDI) in Syria increased from $1 billion to $2.25 billion. The real growth rate of the GDP averaged 3.8% annually from 1995 through 2003, increasing from $16.5 billion to $21.5 billion. It is assumed that contributions to Syria's electric power sector by ODA projects including this project brought about improvement of the country's investment climate and economic growth.

2.4.2 Improvement of International Balance of Payments

There was a recognizable, positive effect on Syria's international balance of payments due to this project. Foreign currency was acquired through sale of crude oil that became available for export due to use of natural gas at the Al-Zala Thermal Power Generation Plant, and trial calculations show that the foreign currency acquired amounts to an estimated 4.15 billion yen in the four years from 2001 to 2004.

2.4.3 Environmental Impact

Both the exhaust gas and the discharged water from the Al-Zala Power Plant meet Syria's standards for waste discharge (Table 2). Furthermore, in this project there was no relocation of residents accompanying site acquisition.

Table 2: Exhaust Gas and Discharged Water from Al-Zala Power Plant

		2002		2003		2004		Syria's Discharge Standards
Exhaust Gas								(unit: mg/m^3)
		NOx	SOx	NOx	SOx	NOx	SOx	
Generator 1	maximum	176	1,848	194	2,341	200	2,188	NOx: 300~3,000mg/m^3
	average	139	1,128	152	1,179	151	1,218	
Generator 2	maximum	191	1,073	184	2,367	196	2,538	SOx: 1,000~3,000mg/m^3
	average	78	435	127	960	136	1,519	
Generator 3	maximum	160	2,182	198	2,361	204	2,128	＊ These standards apply to all general industrial facilities
	average	148	1,298	146	1,368	153	1,112	
Waste Water								(unit: mg/l)
		BOD		BOD		BOD		
Post-treatment waste water	maximum	17		16		15		BOD: maximum 40 mg/l
	average	8.5		7		6		

Source: PEEGT
Note 1) In Syria, the only discharge standards for NOx and SOx are those for all general industrial facilities, which are as shown above. There are no exhaust gas standards established particularly for thermal power plants. For that reason, for the comparison with standards for general industrial facilities in this evaluation, an evaluation of exhaust gas from this project's facility was conducted.
Note 2): The standard for discharged water is the maximum standard level for water discharged to lakes, marshes, and rivers.
Note 3): BOD is an acronym for "biochemical oxygen demand." It is an index that indicates the level of organic contamination in river water, and it is the amount of oxygen consumed when organic substances in the water are decomposed through oxidation by microorganisms within a certain time and at a certain temperature. The higher the BOD, the more organic matter and the more contamination there is.

2.5 Sustainability

2.5.1 Executing Agency

2.5.1.1 Technical Capacity

Staff at the Al-Zala Power Plant receives technical training overseas and at the training center in Syria that was built with grant aid from the Japanese Government. Moreover, there are no technical problems in the operation and management of this power plant because the power generation equipment that it uses is from the same manufacturer as the equipment used at other power plants in Syria and the necessary skills and techniques have been accumulated for its operation and management.

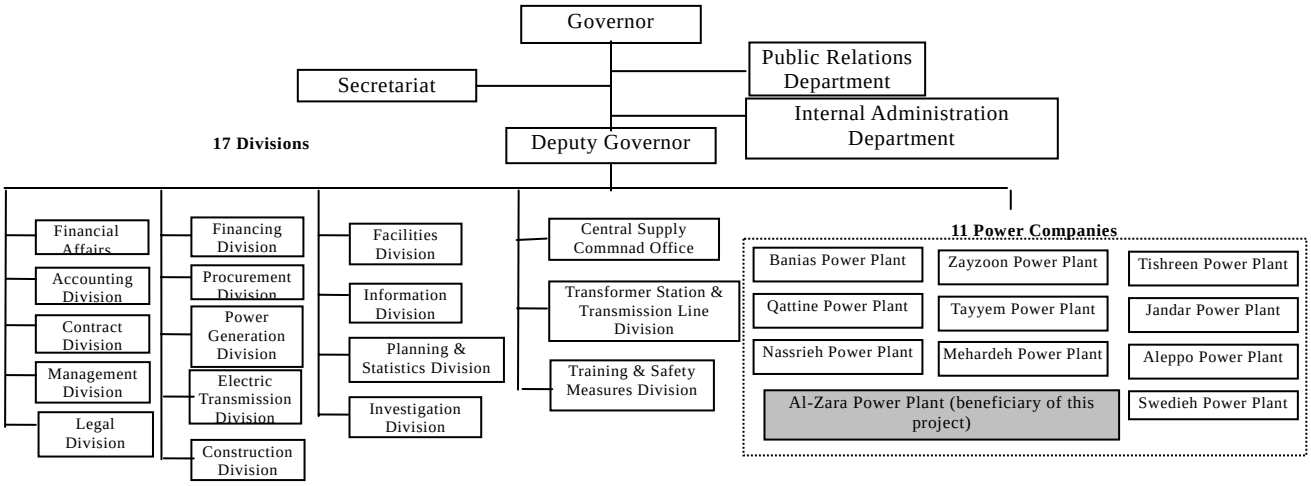
2.5.1.2 Operation and Maintenance System

Syria's Public Establishment of Electricity for Generation and Transmission (PEEGT), which is the executing agency for this project, is a government-run power generation and transmission company with 11 power plants under its management. The direct operation and management of the Al-Zala Power Plant is carried out by its staff of 637 persons.

While the 11 power plants under PEEGT's umbrella are independent companies in their own right, operated as power companies (public corporations) with considerable authority in operation and management, budget, and personnel, etc., the PEEGT headquarters is in charge of the overall electric generation plan, supply management, research and development,

training, budget allocation and adjustment for each power plant, and site operations for the transmission sector. Syria's Public Establishment for Distribution & Exploitation of Electrical Energy (PEDEEE) is in charge of power distribution.[8]

Fig. 3: PEEGT Organizational Chart



PEEGT is also actively taking measures for the environment. In 2004, PEEGT newly established in its headquarters a Central Inspection Department equipped with environmental measurement devices. This department works in cooperation with environmental monitoring bodies in power plants under PEEGT to strengthen measurement of discharge from the power plants and environmental studies on the surrounding environment

2.5.1.3 Financial Status

Each power company including the Al-Zala Power Plant makes a budget request and receives an allocation from the government through the PEEGT headquarters based on each power company's annual plan. Incentives based on each power company's business performance have been introduced, and they include expansion of budget limits and additional special budgets for parts procurement and training.

[8] In 1994, Syria's former electric power public corporation was split into PEEGT, which is in charge of power generation and transmission, and PEDEEE, which is in charge of power distribution.

Table 3: Budgets of Al-Zala Power Plant and PEEGT Overall

(unit: 1,000 Syrian pounds)

	2001		2002		2003	
	Al-Zala	PEEGT	Al-Zala	PEEGT	Al-Zala	PEEGT
Personnel Expense	47,122	1,014,795	71,888	1,113,472	87,026	1,403,675
Production Cost	1,153,287	10,007,240	1,320,522	8,950,875	1,325,902	9,375,918
Non-Personnel Expenses	17,383	263,809	24,649	319,820	22,030	283,378
Depreciation, Public Dues, etc.	1,122,544	13,099,217	1,249,157	14,885,682	1,050,006	9,295,721
Total	2,340,336	24,385,061	2,666,216	25,269,849	2,484,964	20,358,692

Source: PEEGT

Note 1): Fuel expense and parts' cost is included in production cost

Electricity fees in Syria are kept lower than the cost of producing the electricity as a matter of policy. Up to 2002, whereas it cost 1.7 Syrian pounds to produce 1 KWh, the average fee charged was 0.8 Syrian pounds per 1 KWh. The loss was subsidized by the government. To improve this situation, the Syrian Government reviewed the electricity fee system, and currently the cost of electricity stands at 1.44 Syrian pounds per 1 KWh.

2.5.2 Operation and Maintenance Status

Daily, periodic, and preventive inspections are being implemented based on the manual at the Al-Zala Power Plant. Operation and maintenance are being carried out with technical advice received from the contractor where it is necessary. Maintenance reports that include photos are written in detail and are kept for future reference, and so operation and maintenance are being conducted appropriately with no problem. The Al-Zala Power Plant is scheduled for an overhaul in 2006, and currently the implementation plan is being prepared, including a list of parts that require replacement and an overhaul schedule.

3. Feedback

3.1 Lessons Learned

None

3.2 Recommendations

None

Comparison of Original and Actual Scope

Item	Planned	Actual
I. Output		
1. Electric Power Generation Facility		
・ Steam Turbines	200MW×3 units	220MW×3 units
・ Generators	3 units	Same as left
・ Boilers	3 units	Same as left
・ Fuel Tanks		Same as left
・ Natural Ventilation Type Cooling Tower	3 units	Same as left
・ Fuel Supply Equipment	One set	Same as left
・ Coolant/Coolant Treatment Equipment	One set	Same as left
2. Transmission and Transformer Facilities		Same as left
3. Power Plant Building, Staff Lodging		Same as left
4. Consulting Service	Total: 225 M/M	Total: 270 M/M
II. Project Period	December 1995 – August 1999 (45 months)	December 1995 – June 2000 (55 months) *The completion of the project coincides with the start of commercial operation of Generators 1 through 3.
III. Project Cost		
Foreign Currency	46,199 million yen	42,470 million yen
Local Currency	12,655 million yen (1,514 million Syrian pounds)	7,365 million yen (697 million Syrian pounds)
Total	58,854 million yen	49,612 million yen
Japan's ODA Loan Portion	46,199 million yen	42,470 million yen
Exchange Rate	USD1＝11.25 Syrian pound=94.6 yen 1 Syrian pound＝8.40 yen (from November 1995 Appraisal records)	1 Syrian pound ＝ 10.57 yen (weighted average of rate from 1996 to 2002)