Basin Bridge Gas Turbine Project

Report Date: March 2000
Field Survey: November 1999

1 Project Summary and Japan's ODA Loan

(1) Background

Basin Bridge Power Station is located in Tamil Nadu State (capital: Chennai, formerly Madras). In fiscal 1987/88 the power plants in this state had a total capacity of 4,984MW (2,503MW during peak periods) and were providing 15,600GWh of electrical power each year. However, the actual amount of power output had fallen below this capacity due to aging facilities and a drop in hydropower production during the dry season. In fact, this state had been forced to purchase power from other states (712GWh were purchased in fiscal 1987/88). Power during peak periods was insufficient and so demand restrictions had to be put in place.

The demand for power in the Tamil Nadu State was 20,414GWh in fiscal 1989/90 and was projected to increase to 30,614G in fiscal 1994/95. Therefore, requests were made for the construction of a new power station to handle this base load. Plans for a thermal power plant (630MW) in northern Chennai was promoted with ADB financing as a precondition. A unique characteristic of power consumption in this region is that peak demand is in the morning and evening when all of the some 1.2 million irrigation pumps (used for raising well water for agricultural and daily use) are operating at the same time. With supply unable to keep pace with demand during these peak periods, power was frequently cut off to main industrial sectors for several hours at a time. These interruptions had a serious negative impact on the economy and society.

The power shortage during these peak times was projected to be 931MW in fiscal 1989/90 and 1,772MW in fiscal 1994/95. Therefore, there was a clear need for the construction of power facilities to increase the supply of power and meet the demand at these peak periods.

(2) Objectives

The goal of this project was to build a gas turbine plant using HSD (High Speed Diesel)/LDO (Light Diesel Oil) as fuel in order to generate power to meet the peak morning and evening periods, while at the same time improving livelihoods and stimulating the economy through the provision of a stable power supply. Plans called for building this plant next to Basin Bridge Thermal Power Plant (coal thermal plant: currently being dismantled due to deteriorating facilities and to prevent pollution) in central Chennai City.

(3) Project Scope

Scope of this project includes the installations of four new gas turbine power generators (30MW × 4) in Basin Bridge Thermal Power Plant, the construction of incidental facilities such as fuel transport equipment and voltage transformers, and the provision of consulting services.

The ODA loan covered the foreign and local currency portion excluding tax and consulting service expenses.

(4) Borrower/Executing Agency

President of India / Tamil Nadu State Electricity Bureau (TNEB)

(5) Outline of Loan Agreemen

Loan Amount	11,450 million yen
Loan Disbursed Amount	10,779 million yen
Date of Exchange of Notes	November 1989
Date of Loan Agreement	March 1990
Loan Conditions	
Interest rate	2.5%
Repayment period (Grace Period)	30 years (10 years)
Procurement	Partial Untied
Final Disbursement Date	March 1998

2 Analysis and Evaluation

(1) Project Scope

The scope of this project was largely unchanged and the project was implemented mostly as planned except for switching the method for transferring the naphtha fuel from a trolley car system to an underground pipeline (4.5km) for the sake of improving safety. The specifications of the power generators were also changed to handle HSD/naphtha as there have been problems in procuring LDO fuel.

(2) Implementation Schedule

The project was scheduled to be completed by December 1992, but was delayed five years and two months to February 1998 (power generator was completed in March 1996 and operations using HSD were started). There were three main reasons for the delay: procurement procedures used by the executing agency, civil works delays, and delays in the drafting of designs by the consultants. In terms of procurement by the executing agency, a considerable amount of time was needed to make decisions due to poor coordination between the relevant departments. For example, the selection of consultants took seven months longer than originally planned. Furthermore, the period from the closing of bids for the gas turbine power generators to the signing of agreement was planned to be only four months, but actually took a year and three months. As a result, the actual signing of agreement took place two years and five months later than originally planned. Civil work projects were not started until January 1994, three years and eight months behind schedule. Even after the project was started a great deal of time was required for underground water measures and to remove the unexpectedly large amount of pipe and cable buried under the idle land of the previous power station. Construction, which was expected to take only a year and a half, actually took four years and two months to complete. Designs for fuel equipment, the switching yard and other facilities to be produced by the consultants were delayed mainly due to the time it took to coordinate with the contractors. These delays pushed back the start of construction of the incidental facilities and produced delays in the overall project. Operations using HSD were started in 1996, and operations using naphtha were started in the second half of 1998 following the completion of the naphtha transport facilities.

(3) Project Cost

The project cost was planned as ¥13,641 million including local and foreign currency portion. The actual cost came to

¥12,970 million, roughly in line with the planned amount.

Comparison of Original Plan and Actual

Item	Plan	Actual
1.Project Scope		
Installation of gas turbine		
a)power generator	Gas turbine power generator: 4	As planned
	Type: Heavy duty type single-shaft gas turbine	As planned
	Output: 37MW(ISO) 31MW(SITE)	As planned
	Fuel: HSD/naphtha/LDO	HSD/naphtha
b) Procurement of incidental facilities	Voltage transformer, switch gear etc.	As planned
c) Civil works	Piling, construction, water supply and drainage construction etc.	As planned
d) Fuel transport system	Transport by trolley and trucks	Transport (naphtha) by pipeline (4.5km)
e) Consultant	Bidding assistance, detailed design etc.	As planned
2.Implementation Schedule		
(Employment of consultant to completion of construction)	September 1989 to December 1992 (40 months)	April 1990 to February 1998 (95 months)
3.Project Cost		
Foreign currency	¥9,258 million	¥6,611 million
Local currency	¥4,383 million	¥6,359 million
Total	¥13,641 million	¥12,970 million
ODA Loan portion	¥11,450 million	¥10,779 million
Exchange Rate	Rp. 1 =¥8.5	Rp. 1 = ¥3.3

(4) Project Implementation Scheme

The executing agency for this project was Tamil Nadu State Electricity Bureau (TNEB). Bidding was conducted for the following project sections: gas turbine power generators, fuel facilities, civil works and incidental facilities. International bids were accepted for the gas turbine power generators, but only domestic bids were accepted for the other aspects of the project. For the incidental facilities, bids were accepted for small lots covering each type of equipment. Designs and inspections were provided by Central Electricity Authority (CEA), which served as a consultant. There were no problems in terms of the quality of the construction work, but the implementation schedule was greatly delayed as mentioned earlier. Construction supervision that would normally be provided by consultants was carried out by TNEB, which did not have experience in constructing gas turbine power generators, and CEA was responsible for visiting the construction sites to check that construction was performed in accordance with the plans. As a result, TNEB was not able to sufficiently deal with the various problems that arose while supervising project execution. When it was learned in 1994 that the project was behind schedule, JBIC conducted SAPI (Special Assistance for Project Implementation) study to uncover the causes for the delay and make recommendations to TNEB. It was thought that delays to the project could be reduced to a minimum if TNEB had adequate project supervision capabilities, or if construction supervision was entrusted to experienced consultants.

(5) Operations and Maintenance

There were no problems with the operation and maintenance scheme put in place after completion of the project. Skilled technicians were in place and a five-year supply of spare parts was always on hand.

(6) Operational Status

Operation of the project was very satisfactory. In accordance with the plans, this power facility was only operated during the peak periods and use of the four power generators was arranged to correspond to the level of demand. The target is for the facilities to be operated 1,440 hours per year, or roughly six hours per day for 240 days (planned annual power generation: 172.8GWh). Output has gradually increased since the start of operations in 1996 with the annual power generation for 1999 coming to 155.1GWH, roughly in line with the operation plans.

(7) Effects on the Environment

This power station is located in the center of Chennai City and therefore special considerations for air pollution were needed. This is why gas turbine power generators using naphtha for fuel were selected. Looking at the content of sulfur in the

naphtha and other such considerations, special attention was given to NOx which is seen as a harmful substance in the gas discharged by this project, and plans were for NOx in the discharged gas to be less than 70ppm. For this reason HSD/naphtha was used as a clean fuel and a water vaporizer method[1] was used to reduce the amount of NOx.

The height of the gas turbine chimney was originally planned to be 75m, but was changed to 30m when it was learned that the height would only have to be 30m or higher to gain project approval from the Indian Environmental Agency and the Tamil Nadu State Pollution Control Bureau[2].

In September of 1999 a test conducted by Tamil Nadu State Pollution Inspection Bureau showed the level of nitrogen oxide within the gas output by this project to be 64ppm, well within the planned value of less than 70ppm. Silencers have also been used to prevent noise pollution, and no noise-related problems were reported at the time of the inspection.

(8) Project Effects and Impacts

(i) Results

The table below shows how capabilities for handling the peak demand periods were improved following the start of this project.

	1996	1997	1998	1999	2000~2013 Planned
Power Generation (GWh)	19.1	47.9	77.2	155.1	172.8
% of Planned Annual Amount	-[2)]	-[2)]	45% [3)]	90%	100%

Note:1) Planned annual amount: 120MW × 1,440 hours = 172.8GWh
2) In 1996 and 1997 HSD was used before the completion of the naphtha fuel transport equipment and consequently comparisons can not be made.
3) The start of actual operations using naphtha was from May 1998.

Currently the power facilities in Chennai City are capable of producing 7,120MW of power, compared to the peak morning (8:00) demand of 4,775MW and the peak evening (19:00) demand of 5,014MW. TNEB has calculated that power produced by this power station to meet the peak demand is 120MW in the summer season when the hydro power amount decreases, and 60~100MW in the winter season when the hydro power increases. As the capabilities of this power station are able to cover the demand from these peak periods, it can be said that this project achieved its goal of meeting the needs of these peak periods.

(ii) Economic Effects

This power station complements the thermal power station constructed in North Chennai at the same time, and contributes to improving both base and peak power supply. With the construction of this power station, a stable power supply can be provided even during the peak periods. As there are no longer power interruptions during the peak morning and evening periods, it can be said that the power situation in this state has been greatly improved.

General View of Basin Bridge Power Station

Gas Turbine Generator

1 The amount of nitrogen oxide generated by burning increases as the temperature become hotter. Therefore, this method is used to shoot water into the burning flames to lower the temperature of the flames and thus produce less nitrogen oxide.

2 In 1994 JBIC sent a study team to determine if a chimney height of 30m satisfied environmental standards (density of SO_2 and NO_2 landing on the ground is 80 μg/m³). The results showed that for specifications in which naphtha is the main fuel, the concentrations for SO_2 and NO_2 when using a 30m chimney were only 11μg/m³ and 20μg/m³ respectively. Therefore, consent was given to the 30m chimney design presented by the executing agency.