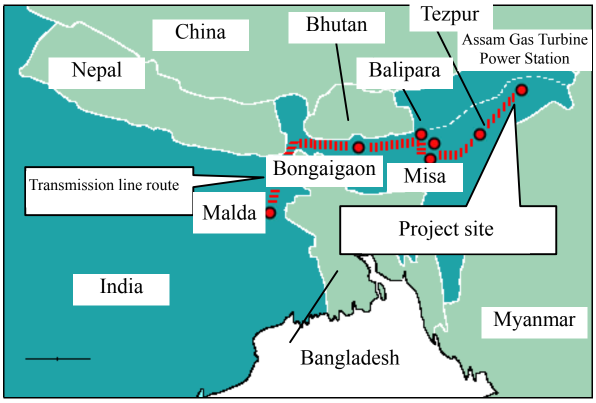
India

Assam Gas Turbine Power Station & Transmission Line Construction Project (I) (II) (II)

Report Date: February 2003

Field Survey: November 2002

1. Project Profile and Japan's ODA Loan



Project site

Assam Gas Turbine Power Station

1.1 Background

A total of Rs4,341bn was pledged for public sector investment under India's Eighth Five-Year Plan (April 1992 – March 1997), with the largest share of Rs795.9bn (18.3%) to be directed to the power sector. On the power sector, the Eighth Plan emphasized improvements to the capacity operating ratio of installed capacity, efficiency enhancements including reductions to transmission and distribution losses (T&D losses), improvements to the financial status of power suppliers, promotion of the construction of new plants, and the utilization of the private sector, and focused on the utilization of natural gas in the Northern, Western and North Eastern regions.

In FY91, per capita consumption of electric energy in India's North Eastern region was 83kWh and was continuing to hover at around 30% of the national average, but was expected to increase in line with the march of industrialization and modernization in agriculture*[1]. Installed capacity was 1,293MW (1992-93) and constituted 56.3% thermal and 43.7% hydel being characterized by a higher proportion of hydel generation as compared with other regions.

Furthermore, in the Eastern region, despite progress with power use from the North Eastern region, as of FY91 per capita consumption remained at 146kWh (approx. 60% of the national average). Installed capacity stood at 11,698MW in FY92, constituting 82.8% thermal and 17.2% hydel generation. Industry accounted for the majority of sectorial power demand at 56.3% and since the region also encompassed the advanced industrial areas of West Bengal State, etc., peak demand was forecast to increase at an average of around 8.8% per annum*[2].

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[1] Shortages in peak demand in the North Eastern region continued intermittently through 1984 (14MW in 1982, 56MW in 1984), as confirmed during the Phase 1 appraisal (based on Central Electricity Authority, CEA, data).

[2] As confirmed during the Phase 1 appraisal, shortages in peak demand in the Eastern region had been on the increase since the early 1980s, with a shortfall of 1,006MW being recorded in 1985 (CEA data).

1.2 Objectives

The project comprised the construction of a combined cycle gas turbine (CCGT) based power plant that would make effective use of oil-associated gas burning in Assam State in India's North Eastern region, as well as related transmission and transforming facilities (T&T facilities); with the primary aim of supplying power to the Eastern region and thereby improving the power situation within said region and of contributing to improvements in living standards and industrial development.

1.3 Project Scope

The project scope was as follows:

(1) Power plant (approx. output: 291MW)
  Gas turbine generators (33.5MW×6)
  Steam turbine generators (30MW×3)
  Heat recovery steam gas boiler (HRSG) (×6)
  Transforming, switch yards and related facilities

(2) T&T facilities
  400kV Kathalguri-Misa transmission line (approx. 325km)
  400kV Misa-Balipara transmission line (approx. 64km)
  400kV Balipara-Bongaigaon transmission line (approx. 280km)
  400kV Bongaigaon-Malda transmission line (approx. 500km)
  220kV Balipara-Tezpur transmission line (approx. 20km)
  Construction of substations (Misa, Balipara, Bongaigaon, Malda, Mariani, Tezpur)

(3) Consulting services

A yen loan of 59,373 million covered all project costs excluding land acquisition costs, project management costs, tax costs, and part of the costs for the generators. The project was implemented in three separate phases, with the yen loan portions (approved amounts) constituting 30,000 million yen in Phase 1, 13,552 million yen in Phase 2, and 15,821 million yen in Phase 3.

1.4 Borrower/Executing Agency

The President of India / North Eastern Electric Power Corporation Ltd; NEEPCO,
POWERGRID Corporation of India Ltd; POWERGRID

1.5 Outline of Loan Agreement

	Phase 1	Phase 2	Phase 3
Loan Amount Loan Disbursed Amount	30,000 million yen 29,607 million yen	13,552 million yen 12,760 million yen	15,821 million yen 10,552 million yen
Exchange of Notes Loan Agreement	February 1986 March 1987	September 1987 February 1988	December 1994 February 1995
Terms and Conditions -Interest Rate -Repayment Period (Grace Period) -Procurement	 4.25% 30 years (10 years) Partial untied	 2.75% 30 years (10 years) Partial untied	 2.6% 30 years (10 years) General untied
Final Disbursement Date	September 1999	February 1997	April 2001

2. Results and Evaluation

2.1 Relevance

The project comprised the construction of a CCGT based power plant*[3] that would make effective use of oil-associated gas burning in Assam State in India's North Eastern region, and the construction of auxiliary T&T facilities; with the objective of supplying power to the Eastern region and thereby improving the power situation within the region and of contributing to improvements in living standards and industrial development.

As stated above, power shortages in the Eastern region were confirmed during the Phase 1 appraisal (1986), with per capita consumption being below the national average. Moreover, the project is considered relevant in that it was also consistent with the goals of the government's Eighth Five-Year Plan.

Power shortages in fact subsequently became more severe in the North Eastern region*[4], with the result that the effects of power station construction were chiefly realized in this part of the country. However, if the Eastern and North Eastern regions are taken as a single area, the initially anticipated effects were achieved, in the sense that the power shortages across the entire region are being addressed, thus the project has maintained its relevancy to the present day.

It should be noted that the project was subject to disruption due to the peculiar circumstances in Assam State. Namely, the state is politically unstable as the result of campaigning by tribal groups demanding sovereignty and there are also security issues, which resulted in a dearth of companies willing to bid for the project and increases in the price of tenders. These factors also created direct and indirect hold ups in the procurement of human resources and construction materials, etc., even after construction work was commenced*[5]. Nonetheless, given that major benefits were realized, something that would not have been possible had the project not been implemented, the project's relevancy is not considered to have been affected.

2.2 Efficiency

2.2.1 Project Scope

(1) Power Station

Construction of the power station was essentially completed as per the plans. However, the duration of consulting services and the man months (M/M) involved were subject to considerable increases over the initial plans (161M/M→395.7M/M). This is attributed to the fact that excessive increases in the estimate (turnkey contract*[6]) submitted by the successful bidder, led to the civil engineering work component being separated from the turnkey contract with the aim of cutting costs. Consequently, local companies were added to undertake the civil engineering component, causing supervision operations to grow to staggering proportions due to the need for quality control, which in turn linked to the above increases in the consulting services. On this point, NEEPCO acknowledges

[3] The choice of gas turbine generation over the cheaper hydel power option was not solely based on making effective use of available gas resources, hydel power requires considerable time in preparation and construction and there are major issues with forest and environmental conservation, involuntary resettlement and so forth, also hydel power already accounts for a substantial share of power generation in Assam State, and there was thus felt to be a need to achieve a balance between hydel and thermal power.

[4] After the Phase 1 appraisal (1980s) and in the latter half of the 1990s, there was an about-turn in the demand and supply volumes in the North Eastern and Eastern regions and the demand-supply gap in the Eastern region was alleviated (see Table 6).

[5] Security issues in the project region apparently impeded the progress of both executing agencies to varying degrees.

[6] A method of plant construction under which the contractor undertakes all processes from land preparation through plant construction and trial operation.

that the removal of the civil engineering component from the turnkey contract actually served to induce increases in project costs.

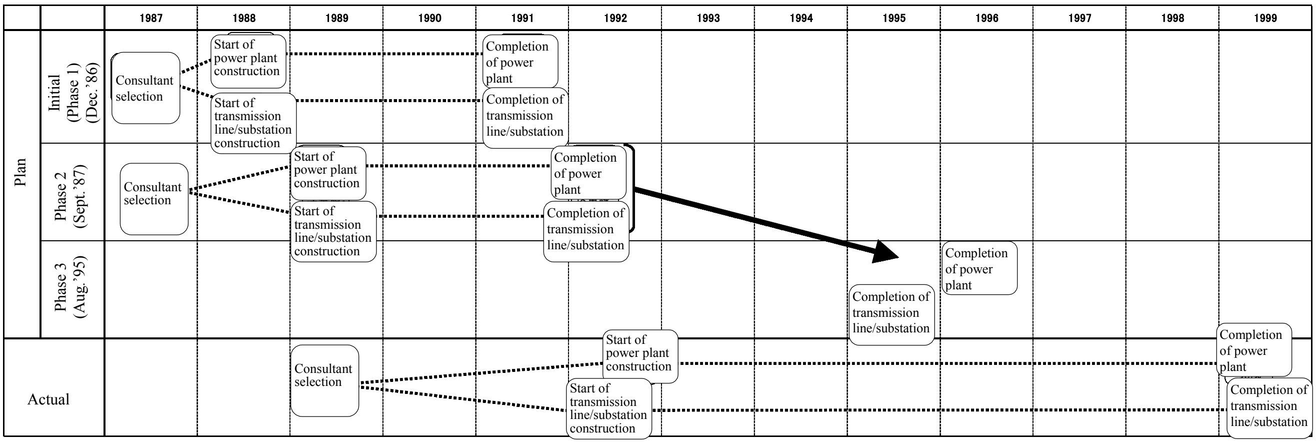
(2) Transmission & Transforming Facilities

Construction was essentially as per the initial plans. There was a slight reduction in the scale of consulting services*[7].

2.2.2 Implementation Schedule

The project was implemented as a consequence of three appraisals. The implementation schedules for each phase were subject to revision. The following figure illustrates the schedules planned at each appraisal and the respective results.

Figure 1: Comparison of Planned and Actual Implementation Schedules



An analysis of the components in the above figure that were subject to particularly marked delays is given below.

(a) Consultant Selection

Aside from the protracted approval procedures of the Public Investment Board (PIB) responsible for making the decision on project-bound investments, the executing agency's (NEEPCO) incompetence vis-à-vis procurement resulted in hold ups in the sequence of bidding procedures incurring a 19-month delay over initial plans, with the consultant contract finally being concluded in January 1989.

(b) Power Station Construction

In addition to the time required for PIB approval procedures, there were major deviations between the estimate and the tender price resulting in an 18-month delay in the contract negotiations for the main plant. Moreover, even after construction was started, defects in the equipment procured by the local company caused a 37-month delay over the final phase (Phase 3) appraisal plans, with the work being completed in March 1999.

[7] NEEPCO was initially scheduled to supervise the transmission component of the project and the power plant, however, changes in the remit for national organizations coinciding with the establishment of POWERGRID resulted in the component being relegated to POWERGRID in 1991, during Phase 2. Due to POWERGRID's experience and technical capability in the field it was decided that some of the consulting services had been rendered unnecessary.

(c) Transmission Lines & Substation Construction

Initial plans envisaged that construction would be timed to coincide with the commissioning of the No. 1 gas turbine generator at the power plant, however, as with the other components PIB approval took six months, which combined with disturbances (political maneuvering, man stealing, etc) by separatists who advocates political independence during implementation resulted in a 44-month delay over the Phase 3 appraisal plans, with the work being completed in June 1999.

As the above indicates, progress was severely delayed by a combination of factors, including hold ups in government investment approval procedures and the bidding procedures, as well as incompetence within some of the companies and security issues, as the result of which the project was finally completed in the middle of 1999. These delays also influenced project costs, the extent of target achievement, and the project's impact.

2.2.3 Project Cost

Since the project was implemented after three separate appraisals, changes were added to project costs at the appraisals for each of the phases. Further, changes in the exchange rate contingent upon the delays in implementation resulted in planned and actual total costs as shown below.

Table 1: Comparison of Total Project Costs (million yen)

	Plan (Phase I appraisal)	Actual (Phase III completion)
Total cost	69,851	71,558
(Foreign currency portion)	54,100	55,493
(Local currency portion)	15,751	16,065
(Yen loan portion)	59,373	52,919

Increases in the market prices for plants, price rises due to additional procurement of associated equipment, and outlay for compensation provisions due to exchange rate fluctuations during the term of the contract caused a slight overrun in the foreign currency portion of project costs, and the local currency portion was also subject to an overrun due to the delays in implementation and security issues*[9].

However, although in yen terms total project costs were virtually on a par with initial estimates, in rupees the disbursed amount exceeded the initially planned amount by a wide margin (initial estimate: approx. Rs5.5bn, vs. actual: approx. Rs15.3bn).

2.2.4 Performance of Consultants & Constructors

The consultants and construction contractors engaged in the work on the power plant and the T&T facilities have been highly evaluated in broad terms by the executing agency. However, there were defects (insufficient liaison while procuring equipment from a number of regions resulting in incompatibility between equipment, etc.) in the equipment procured by one of the local firms (responsible for power plant construction), incurring delays in construction and an escalation in costs.

[9] Some skilled laborers refused to undertake construction work due to security issues rendering it necessary to employ unskilled workers, which hindered progress with construction.

2.3 Effectiveness

2.3.1 Operation Indicators

Operation indicators for the power plant show that in FY01 figures for net electric energy production, capacity factor and forced outage rate were all slightly underperforming target levels, but that overall conditions were comparatively favorable. The figure for the plant's capacity factor, as calculated backwards from the forced outage rate, is also relatively good for plants of its class*[11].

Table 2: Target Achievement Rates in terms of Power Plant Operation Indicators

Operation Indicators \ FY		1999	2000	2001	2002	2003
Net electric energy production (GWh)	Target	1,093	1,306	1,389	1,382	1,407
	Actual	1,077	1,192	1,281	434*	-
Capacity factor (%)	Target	44.21	52.80	56.18	55.90	56.88
	Actual	43.42	48.39	51.93	30.17*	-
Forced outage rate (%)	Target	10.00	10.00	10.00	10.00	8.00*3
	Actual	16.09	22.94	11.38	10.74	-

*Values through October 2002 Source: NEEPCO

According to NEEPCO, as of April 2002 Assam State Electricity Board (ASEB), the plant's largest customer, began purchasing power from the National Thermal Power Corporation (NTPC*[12]) citing excessively high selling prices (225paise/kWh), which led to a situation in which the plant was only operating at 30% capacity due to the lack of demand. However, this was only a temporary phenomenon; there are plans to regulate the price and to recommence sales to ASEB*[13], and the production target for the end of FY02 has been set at 900GWh.

2.3.2 Contributions to the North Eastern and Eastern Regions

(1) Overview

Examined from a more macro perspective, the power plant constructed via this project has been generating around 25% of total capacity in the North Eastern region during the past four years*[14], and as such can be said to be making a substantial contribution to power supplies within the region. Moreover, the plant's contribution is also considered to be substantial in the sense that it is ensuring stable supplies of power in Assam State and the North Eastern region, both of which witness drastic decreases in hydro generation capacity during the dry season*[15].

Table 3: Fluctuations in Power Production at the Assam Gas Turbine Power Station

[11] There are no accurate statistics, however, local experts report that normal capacity factor is around 80-85% for power plants in the same class.

[12] The organization responsible for the commissioning and operation of coal and gas-fueled thermal power stations in the Central Sector. The North Eastern region is outside its jurisdiction.

[13] However, after the field survey in February 2003, CEA issued an order to ASEB to comply with the initially agreed power purchase volume. Power sales to ASEB have increased to the prescribed level without a hitch since the ruling was enforced on April 1.

[14] Such a high share was not initially anticipated but came about due to stalled growth in demand, hold ups with other new generation projects, and a slowdown in hydel generation.

[15] In passing, the power plant was awarded the "Center of Excellence" by the Ministry of Power (MOP) in 2002, having been favorably evaluated for its powerful overall performance. The award means that the MOP has designated the plant as a model in terms of its operation and maintenance.

Fiscal year	1996	1997	1998	1999	2000	2001
Total for North Eastern region (GWh)	-	-	4427.1	4679.4	5155.6	5238.1
Assam PP production volume (GWh)	530.0	702.6	749.4	1106.8	1233.4	1323.7
Assam PP share (%)	-	-	16.9	23.7	23.9	25.3

Source: NEEPCO

Table 4 below indicates the peak demand-supply situation in the North Eastern and Eastern regions. Since the power plant became partially operational in FY95 there has been a steady easing of peak deficits in the North Eastern region, and it may be assumed that the plant has been making a certain contribution to this pattern when judged solely in terms of its share of generation, as mentioned above. Notwithstanding, had construction been completed on schedule (a July 1991 completion date was projected during the Phase 1 appraisal) it is likely that such contributions could have been realized at an earlier stage.

Table 4: Peak Demand-Supply Results for the Eastern & North Eastern Regions (MW)

Fiscal year		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
East	Surplus/deficit	-2425	-2250	-1554	-1549	-1644	-1089	-636	-358	-237	-292
	(%)*	(-5.7)	(-30.8)	(-21.2)	(-20.5)	(-20.5)	(-13.6)	(-8.9)	(-4.9)	(-3.1)	(-3.7)
North East	Surplus/deficit	-107	-263	-220	-90	-100	-13	-53	-27	16	-105
	(%)	(-14.5)	(-32.7)	(-26.2)	(-10.5)	(-11.4)	(-1.4)	(-5.8)	(-2.8)	(1.6)	(-9.2)

*The surplus/deficit ratio to demand. A negative figure indicates a deficit. Source: Grid Management Division, CEA

(2) Improvements to the Power Situation in the North Eastern Region

One of the project's stated objectives was to address power shortages in both the North Eastern and Eastern regions of India via the promotion of energy exchanges from the North East to the East. The following tables (5 and 6) provide a comparison of demand and supply volumes in the Eastern and North Eastern regions.

There have been improvements in the demand and supply volumes in the Eastern region since the latter half of the 1990s, which are indicative of the change in the premise for the aforementioned target of "improving the power situation in the Eastern region via energy exchange".

The reason for these changes in the Eastern region can be attributed to an unforeseen slump in economic activity in the states of West Bengal, Orissa and Bihar, thus there was little growth in power demand.

Table 5: Demand-Supply Results for Eastern and North Eastern Regions (GWh)

Fiscal year		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
East	Surplus/deficit	-6398	-5380	-5222	-4328	-3667	-2381	419	292	27	-490
	(%)	(-17.9)	(-14.2)	(-12.9)	(-10.1)	(-8.3)	(-5.3)	(1.0)	(0.6)	(0.1)	(-1.0)
North East	Surplus/deficit	-555	-374	-371	-566.2	-612	-517.3	-120	73.9	308.2	-80
	(%)	(-15.1)	(-10.2)	(-9.6)	(-12.6)	(-12.6)	(-11.4)	(-2.4)	(1.5)	(5.6)	(-1.3)

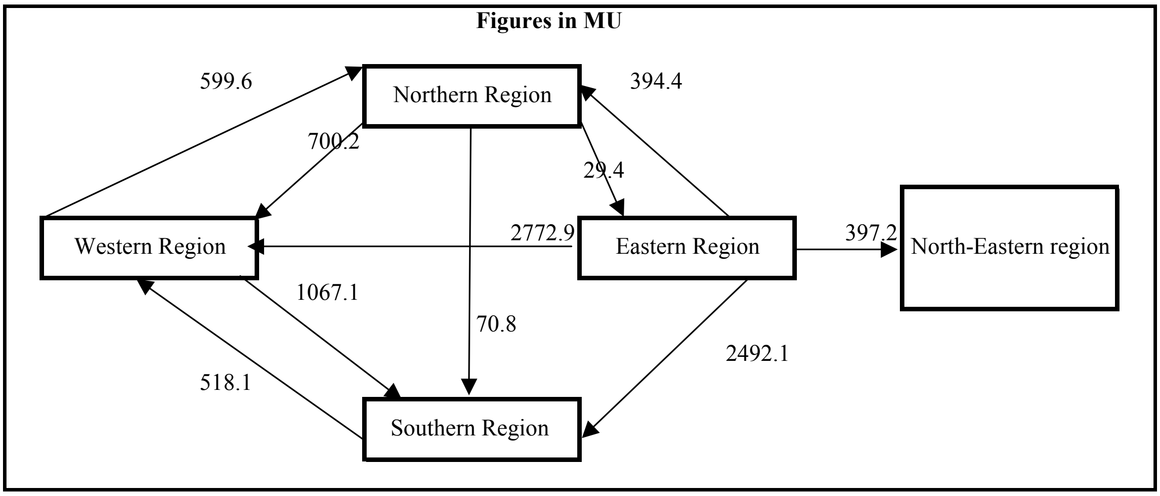
Table 6: Demand-Supply Results for East / North Eastern Regions
(prior to inter-regional energy exchange) (GWh)

Fiscal year		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
East	Surplus/deficit	-6,810	-5,489	-4,764	-3,487	-3,016	64	4,021	6,319	7,243	9,046
	(%)	(-19.1)	(-14.5)	(-11.8)	(-8.1)	(-6.8)	(0.1)	(9.6)	(13.0)	(26.8)	(18.5)
North East	Surplus/deficit	-612	-484	-706	-840	-967	-949	-504	-323	-185	-746
	(%)	(-16.7)	(-13.2)	(-18.3)	(-18.7)	(-19.9)	(-20.9)	(-10.1)	(-6.6)	(-3.4)	(-12.1)

Minus figures indicate a deficit. Source: Produced from Grid Management Division, CEA data

Moreover, as Table 6 and Figure 2 indicate, supply has markedly exceeded demand in the Eastern region since FY97, meaning that in contrast to the projections made at the time of appraisal it has been possible for excess supply to be diverted to other regions outside of peak hours*[16].

Figure 2: Inter-Regional Energy Exchange Results (FY99) (GWh)



*MU=GWh Source: TATA Energy Research Institute

2.3.3 Recalculation of Internal Rate of Return (IRR)

(1) Financial Internal Rate of Return (FIRR)

Recalculated on the basis of actual figures and future projections received from the two executing agencies, the resulting FIRR, at 12.6%, fell short of the initial figure of 19.1%. A comparison of the assumptions used during the recalculation is given below.

[16] Energy exchange results shown in Figure 2 were also similar for several years on either side of FY99.

Table 7: Prerequisites Employed for FIRR Calculations

	Item	Appraisal	Recalculation (current)
Benefits	Power selling price	185.4 paise/kWh	225.0 paise/kWh
	Transmission price	106.6 paise/kWh	76.0 paise/kWh
	Installed capacity factor	68.5%	77.0%
	Generating capacity	291MW	
	Operating hours p.a.	6,000 hours	6,745 hours
	Internal loss ratio	3%	
	Total generation p.a.	1749.63 million kWh	1962.85 million kWh
Costs	Natural gas costs	Rs713/1,000m^3	Rs1,757/1,000m^3
	O&M costs	2.5% (PP), 1.0% (T&T facilities) of investment	
Other	Project life	25 years	

(2) Economic Internal Rate of Return (EIRR)

A trial calculation of EIRR was undertaken as a measure of the project's significance in terms of the "national economy"; however, the result using the following prerequisites was negative.

Volume of Supply

Supply volume: Generation was based on NEEPCO data used for FIRR, with 40% being deducted from FY99 results in Assam State for system losses.

Industry sector based distribution: Average sectorial consumption rates for the state (FY97-99) were used.

Benefits

Following the methods used to evaluate a thermal power plant project implemented in India by the ADB (Asian Development Bank)*[17], the Willingness to Pay Approach was utilized to calculate the benefits to industrial, residential and commercial consumers, and the Resource Cost Saving Approach to calculate benefits to the agricultural sector.

Unit benefit costs based on both Willingness to Pay and Resource Cost Savings were applied to the figures actually employed in the aforementioned ADB reference case after inter-annual adjustment.

Costs

For investment and maintenance costs (equivalent to generation and transmission costs), the economic price obtained by multiplying the figures used to calculate the FIRR (financial price) by a conversion factor (0.9) was utilized. Fuel costs were obtained by calculating the required volume of natural gas from the generation volume and multiplying the resultant figure by the unit price of natural gas (0.2426m^3 of natural gas is necessary to generate 1kWh of power, and the price of natural gas is Rs3.4/m^3). International prices referred in World Bank materials were utilized for natural gas prices. Distribution costs were estimated using data relating to the power sector in Assam State (2001 SEB Report).

More data is necessary if an accurate calculation of the EIRR is to be made. For example, the influence of supplies from project facilities on stability within the region has not been quantified, and the present calculation was ultimately only a trial. On the assumption that the project had been completed within the initial cost schedule the EIRR would have been in the region of 2.3%, which confirms the relevancy of the Phase 1 appraisal (in terms of the national economy), however, the outcome of the delays in implementation and the ballooning of project costs was a gradual contraction of efficacy. Nevertheless, the figure should be referenced and it would be inappropriate

[17] Project Performance Audit Report on the North Madras Thermal Power Project in India (PPA: IND 18181)

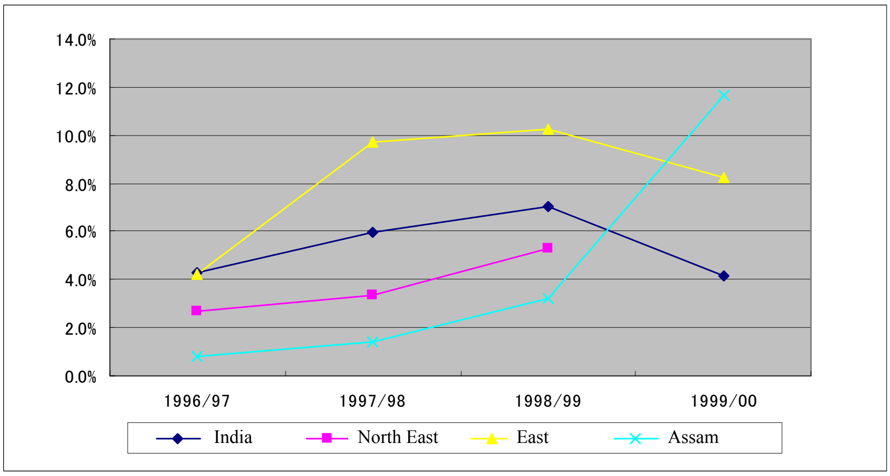
to negate the efficiency of projects with a similar EIRR.

2.4 Impact

2.4.1 Economic Impacts

Figure 3 shows recent economic trends for India and in the states and regions related to this project.

Figure 3: Real Economic Growth Rates for the North Eastern & Eastern Regions, Assam State



Source: Compiled from IMF, Government of India data

The growth rate for the North Eastern region is lower than the national level, whilst the Eastern region is growing faster than the nation as a whole. Growth in Assam State was lower than that for the North Eastern region to which it belongs, but it made strong headway in FY99*[18]. Its primary industries are agriculture, manufacturing and tourism, which account for 61% of total state GDP.

In Assam State, 69% of the working population is employed in agriculture or related industries and self-sufficiency in grain production is at the top of the state government's policy agenda. The agricultural production indicator grew from 166 to 168 in FY00 over the previous year (FY81=100).

Manufacturing accounted for 12.1% of state GDP in FY00. Geographically isolated, industrialization in the state is not advanced in national terms, however, the state is targeting industrial progress using its abundant underground resources (natural gas, oil, coal, etc.). Its industrial production indicator climbed from 178 in FY99 to 188 the following year (FY70=100), and it is believed that advancing industrialization will link to increased demand for power.

The following table illustrates the fluctuations in power consumption for the various sectors in Assam State. The combined total for the domestic, commercial, and industrial sectors plus the tea industry accounts for upwards of 70% of power demand. The respective average growth rates for each sector (for the past four years) are 8.9% for domestic demand, 5.1% for commercial demand, 3.8% for industrial demand, and 2.5% for the tea industry and, within given bounds, the power supplied by the project plant is considered to be underpinning growth in these key production sectors.

[18] Considered to be the result of increased production in the agricultural sector, a key industry in the state.

Table 8: Sectorial Power Consumption in Assam State (GWh)

Fiscal year	1998	1999	2000	2001
Domestic	466	560	690	602
Commercial	138	146	152	160
General purpose	63	102	151	103
Irrigation	15	10	9	9
Industrial (incl. urban & agricultural)	295	263	307	330
Large consumption facilities (educational, etc.)	206	199	201	207
Tea industry	274	268	280	295
Oil and coal industry	51	50	50	46
Farming villages under the fixed rate system	87	74	71	66
Total	1595	1672	1911	1818

Source: Directorate of Economics and Statistics, Assam

2.4.2 Other Impacts

(1) Impact on Local Residents

NEEPCO reports that since the land used in constructing the power station was owned by the state further acquisition was unnecessary, however, since some 120 households were utilizing the scheduled site to graze domestic livestock alternative land was provided for a fixed number of farmers*[19]. A further outcome of the project was the employment of 134 people within the plant upon its establishment*[20], and NEEPCO has constructed schools and health care facilities for residents as a means of supporting the local community.

No resettlement was necessary for the T&T facilities either as the land required for construction of substations, etc., was also state owned.

(2) Environmental Impacts

There were no reports of notably adverse effects on the environment during the construction of either the power station or the T&T facilities, or after the plant became operational.

NEEPCO undertakes periodic environmental monitoring involving surveys of effluent quality (temperature of heated effluent, etc.) and noise levels in neighboring communities, and the measurement of atmospheric pollutants, sulfur oxide concentrations, etc., in exhaust gas emitted by the plant and in surrounding air. All results to date have been kept to within the permissible bounds of the emissions and environmental standards established by the government (Ministry of Environment and Forests).

(3) Effective Use of Oil-Associated Gas

One of the initially envisaged impacts of the project comprised the effective use of oil-associated gas burning within the state. However, the pressure of this type of gas had been proved to be

[19] During a hearing with local residents (comprising 4 residents of avillage, located near the plant and including managers), it was learned that the state government provided alternative farm land or residential land to 40 of the poorest households selected from the total number. No special compensation was awarded to the remaining households with their consent since they also owned land for residential and/or farming outside the proposed construction site. This process was undertaken in line with the provisions of India's Land Acquisition Act.

[20] This represents 34.4% of the power station's total payroll of 389.

unstable and having been judged unsuitable for the power station, which requires gas at a stable pressure, its use as fuel was subsequently abandoned. In consequence, the plant is being fueled by natural gas from nearby local gas fields, thus this impact has not been realized.

2.5 Sustainability

2.5.1 Power Station

(1) Current Status of Facilities

Power station construction progressed essentially as per the initial plans. Further, as mentioned earlier, the various operation indicators (net electric energy production, capacity factor, forced outage rate) reveal the plant's operating status to be comparatively favorable. The power station's availability*[21] was 76.8% in FY00, 85.5% in FY01 and 79.6% in FY02 (up to October); these percentages are appropriate for base-load power plants.

(2) Issues Currently Concerned

NEEPCO undertakes routine and/or periodic maintenance tasks in line with the guidelines and manuals compiled by the equipment manufacturers, and no notable problems have arisen to date. Observations made during this survey would also indicate that the facility is being appropriately maintained.

(3) Operation and Maintenance

As was initially planned, NEEPCO is responsible for the maintenance of the project facilities. Its maintenance department has a staff of 101, which NEEPCO reports is a sufficient number for the applicable maintenance work. Moreover, the technicians employed in on-site maintenance receive regular training and efforts are being made to maintain their technical skills.

Annual outlay for maintenance costs in the three years from FY99 to FY01 was essentially in line with the initially planned criteria of Rs300 million (approx.)*[22]. In terms of NEEPCO's financial status, the company secured profits for FY98 through FY00, but its profit ratio is on the decline due to increases in depreciating costs and interest payable. Its borrowings are also trending upwards.

Table 9: NEEPCO Earnings Statement (million Rs)

Fiscal year	1998	1999	2000
Operating revenue	3,219	4,406	5,297
Power generation costs	1,813	2,594	3,545
Fuel costs	524	836	1,073
Depreciation costs	747	1,026	1,516
Operating profit	1,406	1,812	1,753
Ordinary profit	620	519	243
Net income after tax	620	519	223

[21] Known as station availability, this figure expresses the potential availability rate of the facility after allowing for stoppages for periodic inspection and/or breakdowns only.

[22] Actual figures were Rs328 in FY99, Rs370 in FY00, and Rs283 in FY01 (million Rs).

Table 10: NEEPCO Balance Sheet (million Rs)

Fiscal year	1998	1999	2000
Current assets	5,879	10,319	12,024
Fixed assets	32,466	36,549	38,858
Total assets	38,346	46,868	50,881
Current liabilities	2,393	3,661	5,271
Fixed liabilities	16,030	22,133	23,260
Capital	20,015	21,167	22,442

(4) Power Sales and Tariff Collection Status

Fuel (natural gas) costs, which have a major impact on the cost of production, have been stable at Rs1,400/1,000m^3 for the past three years. According to a local expert, there are abundant reserves in neighboring gas fields, and it is presumed that supplies will remain stable for the foreseeable future. Further, fuel prices are regulated by the government and are anticipated to continue stable within a fixed range.

Since the introduction of a new system in 1999, electricity tariffs calculated according to a prescribed method*[23] by the provider (in this instance, NEEPCO) must be filed with the Central Electricity Regulatory Commission (CERC*[24]) for approval. Since 1998, the price for the Assam Power Station has been fixed at 225 paise/kWh (1 paise = 0.01 rupees).

In the past few years there have been cases when it has proved difficult to collect tariffs from individual state (SEB) customers, however, accumulated receivables are being recovered and improvements in regular payment of tariffs have been made recently.

However, the latest issue is not so much tariff collection as power sales per se. Specifically, a situation occurred in which Assam State Electricity Board (ASEB), the plant's largest customer, switched to the National Thermal Power Corporation (NTPC) claiming that the plant's price of 225paise/kWh was excessively high. This has served to restrict the plant's generating capacity to 30% since April 2002. To address this situation, NEEPCO expressed their commitment to the following measures during this survey (November 2002)*[25].

(a) Offering ASEB a competitive price

(b) Selling power to regions outside the North Eastern region and direct sales*[26] to West Bengal SEB via the Power Trading Corporation*[27]

ASEB is planning to construct a new transmission line linking the plant with Tinsukia, which NEEPCO anticipate will become a new sales route.

[23] The tariff is calculated by multiplying each of the following factors: the interest on necessary project funds, depreciation costs, maintenance costs, taxes, return on equity, and the interest on working capital by a fixed coefficient factor.

[24] The CERC was established on the basis of the 1998 Electricity Regulatory Commissions Act and is an independent government organization with a quasi-judicial function. Its primary role is to regulate the tariff of power generated in the Central Sector, plus tariffs on inter-state power sales involving two or more states and inter-state tariffs. In passing, the establishment of production and transmission costs within a state is the task of State Electricity Regulatory Commissions (SERC).

[25] For details of the post-survey situation refer to footnote 13.

[26] Price competitiveness is key to opening new sales channels and NEEPCO explains that it is intending to "introduce the so-called Availability Basis Tariff (ABT) method in the near future. Using this method a fixed volume of generation is secured, which increases the Plant Load Factor (PLF) and decreases costs with the result that the price also drops."

[27] An organization belonging to the Central Sector that was established in 1999, it handles contracts on the purchase of power from Independent Power Producers (IPP). It also deals with energy exchanges, directing surplus power in one region to regions suffering shortages.

2.5.2 Transmission & Transforming Facilities

(1) Current Status of Facilities

Related T&T facilities were constructed essentially as per the plans and no specific problems have been reported to date.

(2) Issues Currently Concerned

POWERGRID has already established a maintenance system (as an organization). As stated above, no problems were observed in the maintenance of the facilities developed via this project.

(3) Operation and Maintenance

POWERGRID is responsible for the maintenance of project T&T facilities. There have been no changes of note within the company's organizational system in recent years, inclusive of its maintenance division. Workers engaged in maintenance receive regular training and efforts are also made to upgrade the level of technology. The NERTS (the department responsible for the North Eastern Region) office of POWERGRID also has responsibility for the project. Further, an annual budget of Rs100 million is being continuously provided for maintenance costs.

Figures for net income after tax for the last three years are Rs4,444 million, Rs6,009 million, Rs7,425 million, and there are not considered to be any specific issues with the organization's finances.

Table 11: POWERGRID Earnings Statement (million Rs)

Fiscal year	1998	1999	2000
Operating revenue	17,703	21,239	26,826
Costs	8,924	10,230	12,597
Operating profit	8,779	11,008	14,229
Ordinary profit	4,970	6,806	8,123
Net income after tax	4,444	6,009	7,425

Table 12: POWERGRID Balance Sheet (million Rs)

Fiscal year	1998	1999	2000
Current assets	16,275	20,422	22,474
Fixed assets	109,820	119,301	129,378
Total assets	126,095	139,722	151,852
Current liabilities	7,143	8,764	9,149
Fixed liabilities	65,311	73,153	80,622
Capital	53,708	59,412	66,285

(4) Power Sales and Tariff Collection Status

Transmission tariffs are based on POWERGRID's financial data and are calculated on the basis of multiple expenditure factors*[28]; CERC approval is required. Transmission costs computed on the basis of investments undertaken in the North Eastern region are 76 paise/unit. However, all the states in the North Eastern region have only agreed to pay half this rate, i.e. 35 paise/unit, and tight state (SEB) finances across the board mean that they will struggle to meet payments even at this level.

The outcome of this situation with tariff collection is that POWERGRID is forecast to post losses

[28] Maintenance costs, transmission line/substation depreciation costs, return on equity, interest payable, corporate taxes, etc.

until FY06, however, it is proposing that the government make up a minimum of half these losses.

2.5.3 Current Status of Assam State Power Sector

ASEB's financial status had deteriorated markedly due to power losses and low operating capacity ratios at power plants in the latter half of the 1990s. To address this it began implementing reforms from around 2002 and has been executing a number of countermeasures (promoting the collection of unpaid tariffs, strengthening measures to prevent power theft, personnel reductions, etc.) aimed at improving its financial soundness.

Its financial status has improved as a result, however, it has yet to record a current account surplus and the operational status of its power plants, in terms of PLF and other indicators, remains unfavorable. In consequence, there is little reason for optimism since tariff collection from ASEB continues to be unreliable. Since this will also serve to put pressure on NEEPCO to reduce its power tariffs and could jeopardize NEEPCO's financial viability, it will be necessary to monitor scrupulously the progress of reforms in the power sector.

In summary, the power plant constructed via this project is more than fulfilling the functions envisaged for it at appraisal, and there are virtually no physical problems at the present time. The organization, personnel and budget necessary for facilities maintenance are in place and the necessary work is being appropriately undertaken.

However, although the finances of the executing agencies are currently sound, sales of and the collection of tariffs on the power produced at the plant, including transmission tariffs, are becoming increasingly precarious, and it is considered difficult to be optimistic about the overall sustainability of the project.

3. Feedback

3.1 Lessons Learned

Cost-benefit analysis requires further augmentation

The liberalization of India's power market has been progressing and power tariffs are now more reflective of the supply-demand situation, moreover, there is greater flexibility in customer selection. This project has been also faced with the situation that the SEB identified as the principal purchaser has begun purchasing power from another generating company, claiming that the recommended retail price of the executing agency (generating department) was too high.

It is considered that, in future, it will become increasingly important to emphasize the profitability of yen funded projects in view of the fact that the high cost of supplying power has the potential to render operations unsustainable even if a power plant has excellent functions. To this end, it is crucial that advance cost-benefit analysis be increasingly thorough and that improvements be effectuated.

3.2 Recommendations

(To MOP)

As stated above, a situation arose, albeit transiently, in which ASEB went against initial forecasts by failing to purchase power from the plant citing excessively high prices. The primary reason for the increase in the selling price was security issues in Assam State, which inflated project costs pushing up the cost of production.

The deregulation of competition in respect of market principles is crucial to improvements within the power sector as a whole, however, ignoring the specific details/background to the establishment of power stations and enforcing competition based solely on price is not without issue. The construction of the project power station in Assam state went ahead as part of Indian national policy and in spite of difficult security and geographical conditions within the state, and in view of these facts, it may, depending on the circumstances, be necessary to consider the provision of an exceptional support from a managerial perspective.

Comparison of Original and Actual Scope

Item	Plan	Actual
1. Project Scope		
Power station	1) Gas turbine generators 2) Steam turbine generators 3) Heat recovery steam gas boilers 4) Transforming, switchyards, related facilities	1) As planned 2) As planned 3) As planned 4) As planned
Transmission / transforming facilities	1) 400kV Kathalguri-Misa transmission line 2) 400kV Misa-Balipara transmission line 3) 400kV Balipara-Bongaigaon transmission line 4) 400kV Bongaigaon-Malda transmission line 5) 220kV Balipara-Tezpur transmission line 6) Substation facilities (Misa, Balipara, Bongaigaon, Malda, Mariani, Tezpur)	1) As planned 2) As planned 3) As planned 4) As planned 5) As planned 6) As planned
Consulting services	1) Power station: 161 M/M 2) Transmission/transformer: 129 M/M	1) 396 M/M 2) Not detailed
2. Implementation schedule	(Phase 1 appraisal)	(Phase 3 completion)
Power plant	Sep. 1988 – Jul. 1991	Nov. 1992 – Mar. 1999
Transmission lines	Jul. 1988 – Jul. 1991	Jan. 1992 – Jun. 1999
Substations	Jul. 1988 – Jun. 1991	Jan. 1992 – Nov. 1998
3. Project Cost		
Foreign currency	54,100 million yen	55,493 million yen
Local currency	15,751 million yen	16,065 million yen
Total	69,851 million yen	71,558 million yen
ODA loan portion	59,373 million yen	52,919 million yen
Exchange rate	1 rupee = 11.6 yen (February 1986)	1 rupee = 3.40 yen (Weighted average of the rate applied to the two executing agencies)

Third Party Evaluator's Opinion on
Assam Gas Turbine Power Station and Transmission Line Construction 1,2,3

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Relevance

At project appraisal, the project objectives were fully in line with the aims and objectives of the national plans for development of the region and the sector. The situation in this respect is different now. This is because in the long interregnum between the initial appraisal of this project and its commissioning certain changes that could not have been anticipated occurred.

These background changes have affected several aspects. Most significant of these is the excess generating capacity that came about in the Eastern and Northeast regions because of implementation of expansion plans by other agencies – chiefly NTPC – and the low system demand owing to larger political and socio-economic factors. Also, at the time of project appraisal, assured off-take of all generated output was the norm; this is not so today and the Assam plant is at a disadvantage to compete on price basis with large pit-head coal based stations operating in the adjacent Eastern region.

India's northeast is one of the country's regions endowed with oil and gas reserves; hence the plant design, initially proposed to be fuelled by gas being flared in the course of oil extraction was appropriate to the system needs. The replacement of flared gas by natural gas later does not seem to have had adverse impact because natural gas prices applicable in the northeast (prices fixed by the central government) are significantly lower than for the rest of the country. The differential is around Rs. 2.00 per cu.m. On a consumption figure of 0.2426 cu.m per unit of electricity generated, this translates to a cost advantage of Rs. 0.49 per unit for the Assam plant vis-a-vis Faridabad. (However, the much higher transmission costs neutralise this advantage).

Impact

Apart from lower than envisaged system demand and reforms-induced flexibility in inter-region power transactions, a third crucial factor that has adversely affected the effectiveness of the plant is poor project implementation. Undoubtedly, the project was executed in very adverse (close to 'disturbed') conditions in the state of Assam. But inefficiencies in procurement of plant and services seem to have compounded the difficulties posed by the disturbed law and order situation. In this respect, it is likely that the lack of previous experience of the beneficiary agency with respect to gas based power projects was a factor. In the result, it is a reality that it will be some time before the goals set out while designing the project are realised. More than the introduction of 'Availability Based Tariffs' grid linkages to facilitate inter-region transfers will serve to speed up this prospect.

It is seen that the plant is well maintained and achieves a satisfactory capacity factor. On the environmental side, while the gains envisaged from use of flared gas cannot be realised, the stipulated emission norms are being met. Hence no adverse impact results.

In conclusion, a very positive political contribution may be noted. Given the remoteness –

geographical as well as from the national mainstream – of the region served by the plant, an operational project of this nature serves as an instrument for overcoming politically divisive forces that are active in the region.