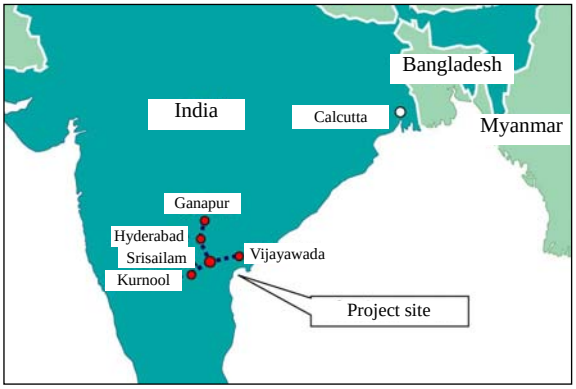
India

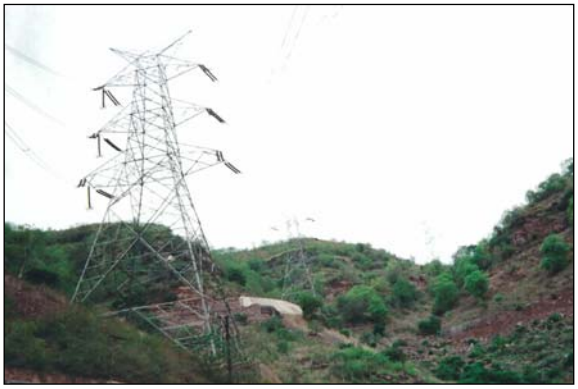
Srisailam Power Transmission System Project (2)

Field Survey: July 2003

1. Project Profile and Japan's ODA Loan



Location of project site



A steel tower and transmission lines constructed under the project

1.1 Background

In its 8th 5-Year Plan (FY1992-1996), the Indian government set the goals of eliminating power shortages, enhancing capacity utilization ratio of power generating facilities, improving power supply efficiency by reducing power transmission and distribution losses, ensuring fair electricity rates, and encouraging private sector participation.

As of the end of March 1991, the installed power generation capacity in Andhra Pradesh (AP) State was 4,893MW, and the installed power generation capacity owned by the Andhra Pradesh State Electricity Board was 4,131MW, the third largest capacity among state electricity boards in India following Maharashtra and Uttar Pradesh. However, looking at the supply-demand balance, the total amount of electricity provided in FY 1990, including the power supply from central government organizations such as National Thermal Power Corporation, was 3,465 MW, or only 90% of the estimated peak time demand of 3,801MW.

In terms of energy amount (FY1990), only 21,009GWh of electricity was supplied against the demand of 23,103GWh, a shortfall of 2,094GWh (9.1%). In AP State, as state policy keeps electricity rates for agricultural use at low levels, demand for the power sector was increasing, while power supply to the manufacturing sector had been limited. Therefore, intermittent power supply restrictions were imposed in AP State, which impeded the state's economic development (especially manufacturing).

At the appraisal (1992), electricity demand in AP State was projected to increase by an average of 7.4% a year. In the regions of Hyderabad, Kurnool and Mahabubnagar, which were targeted by the project, electricity demand was growing sharply. In order to meet the rising demand, construction of new electric power plants and transmission lines were needed.

1.2 Objectives

The objective was to improve the supply/demand balance in AP State by constructing transmission

lines connected to Srisailam Pumped Storage Power Station*[1], and thereby contribute to economic development of the state.

1.3 Output

The planned outputs of this project were as follows (at Phase 2 appraisal)

(1) Transmission lines

- Power station – Hyderabad: 400kV 2 lines 138km
- Power station – Kurnool: 400kV 1 line 104km
- Power station – Vijayawada: 400kV 2 lines 217km
- Hyderabad: Ganapur: 400kV 1line 46km

(2) Substations

- Hyderabad (construction): 400/220kV 630MVA
- Kurnool (construction): 400/220kV 630MVA
- Vijayawada (expansion): 400kV 2 bays added
- Ganapur (expansion): 400kV 1 bay added

Of the project cost of 16,527 million yen, the ODA loan covered part of the foreign and local currency portions totaling 13,352 million yen: 3,806 million yen for Phase 1 and 9,546 million yen for Phase 2.

1.4 Borrower/Executing Agency

Borrower: The President of India

Executing Agency: Andhra Pradesh State Electricity Board (APSEB)*[2]

1.5 Outline of Loan Agreement

(Phase 1)

Loan Amount / Loan Disbursed Amount	3,806 million yen / 2,627 million yen
Exchange of Notes / Loan Agreement	October 1992 / December 1992
Terms and Conditions -Interest Rate -Repayment Period (Grace Period) -Procurement	 2.6% 30 years (10 years) Partially untied
Final Disbursement Date	April 2000

[1] A pumped storage power station built using the existing dam in order to reduce power shortages during peak time (upper reservoir: Srisailam Reservoir; lower reservoir: Nagarjuna Sagar reservoir; installed capacity: 990MW). The construction of the power station was separately financed by ODA loan under the Srisailam Left Bank Power Station Project (I) – (III).

[2] After unbundling of the State Electricity Board in 1999, the executing agency changed to the Transmission Corporation of Andhra Pradesh Limited (APTRANSCO).

(Phase 2)

Loan Amount / Loan Disbursed Amount	9,546 million yen / 7,494 million yen
Exchange of Notes / Loan Agreement	December 1994 / February 1995
Terms and Conditions -Interest Rate -Repayment Period (Grace Period) -Procurement	 2.6% 30 years (10 years) General untied
Final Disbursement Date	April 2002

2. Results and Evaluation

2.1 Relevance

At the time of appraisal, as already stated, AP State was expected to have continuous shortages in both installed power generation capacity and electricity supply, and therefore it was urgent to develop new power supply routes. Also, in the regions of Hyderabad, Kurnool and Mahabubnagar, which were targeted by the project, electricity demand was increasing sharply, resulting in a strong need to raise and stabilize power supply.

An increase in power supply was among the objectives of the national development plan at that time. Therefore, this project was consistent with government policy. The project aimed to ease power shortages in AP State in combination with the related Srisailam Left Bank Power Station Project. It was also expected that a power transmission network via this power station would be established, thereby reinforcing the entire regional network.

Thus, the project was highly necessary and important to fulfill beneficiaries' needs and government policy, and the project plan can be seen relevant.

In the 10th 5-Year Plan (FY2002-2006), the government set forth a policy of reducing dependency on the private sector and promoting development of the electricity sector mainly in remote regions, while basically following the policy of the 9th 5-Year Plan *[3]. In addition, the "Development Plan towards 2020"*[4] for the state's electricity sector was adopted to increase power generation capacity and improve electricity system efficiency. The project has closely followed these policies in recent years and therefore has remained highly relevant to the present.

2.2 Efficiency

2.2.1Output

The project was implemented almost as initially planned. Details are provided in "Comparison of

[3] This plan puts emphasis on "development led by the public sector" and aims at increasing power generation capacity (by a total of 41,110MW) by the end of the plan period, among other objectives in the 9th 5-Year Plan, such as "improvement of operating efficiency of existing power stations," "promotion of hydroelectric power generation," "reinforcement of the nation-wide power transmission network," "promotion of electrification of remote regions," and "promotion of reform of the electricity sector."

[4] This plan set the targets of increasing power generation capacity by 36,000MW, raising electricity consumption per person (target: 2000kWh), reducing transmission and distribution losses (to below 10%), improving the quality of electricity, and lowering power generation costs.

Original and Actual Scope".

2.2.2 Project Period

The whole project was initially planned for completion in June 1996, but it was actually completed in March 2002, nearly six years behind schedule. The executing agency pointed out the main reasons for this delay were as follows (actually these reasons combined to cause further delay in implementation):

- Forest impact assessment took time.
- Acquisition of substitute planting land took time.
- Acquisition of permission from the Ministry of Environment and Forests for forest clearance at the construction site of transmission lines was delayed.

The executing agency explained that it was difficult to prevent these events because they could not foresee them and the period required before the start of the project.

The construction and improvement of transmission lines and substations under the project were completed in time for the start of operations of the Srisailam Power Station (the construction of the Srisailam Power Station was also delayed*[5]).

2.2.3 Project Cost

The project cost was less than the initial estimate. This is the result of efficient contracting through competition, etc. By currency, the foreign currency portion was 8,187 million yen against the estimated 10,692 million yen (76.6%) and the local currency portion was 1,399 million Rs against the estimated 1,736.7 million Rs (80.6%). The total cost in yen is 12,524.5 million yen against the estimated 16,527 million yen (75.8%). A breakdown of costs is shown below.

[5] According to the executing agency of the power station project (APGENCO), geological factors (inundation by water from the reservoir, difficulty in building a tunnel through the fault zone, etc.) coupled with other factors (fund shortages, a workers' strike, etc.) contributed to the delay.

Planned and Actual Project Costs by Item

Item	Foreign Currency Portion (million yen)		Local Currency Portion (million Rs)		Total (million yen)	
	Planned	Actual	Planned	Actual	Planned	Actual
1. Materials and machinery costs	8,946	7,285	232.5	180.8	9,727	7,845
2. Personnel costs /construction costs	0	0	283	754	951	2,337
3. Transportation costs	0	0	137	7	460	23
4. Site acquisition costs	0	0	93	92.7	312	287
5. Customs duties	0	0	697	330	2,342	1,023
6. Price escalation	282	244	211.5	34	992	349
7. Reserve funds	461	0	82.7	0	740	0
8. Consultant fees	102	108	0	0.6	102	110
9. Interest during construction	901	550	0	0	901	550
Total	10,692	8,187	1,736.7	1,399.1	16,527	12,524.5

*Planned costs are those estimated at the appraisal and the actual costs are those reported by the executing agency.
Exchange rate: 1 Rs = 3.36 yen (at appraisal); 1 Rs = 3.1 yen (at completion)

In summary, the project was essentially implemented as originally planned, and the project cost was below the initial estimate. There was no particular problem with the supervising and constructing ability of participating companies. However, as the delay in obtaining approval to acquire the construction site for the transmission lines, which was necessary prior to implementation, and the difficulty in construction due to topographical factors caused extension of the implementation period, so the efficiency of the project implementation can be said not very high.

2.3 Effectiveness

2.3.1 Generation of Expected Effects

According to the Project Completion Report (PCR) submitted by the executing agency in March 2003, the transmission lines constructed under the project produced the following effects. In the region around Hyderabad, where transmission voltage was low in spite of this region being a major load center*[6] in AP State, the project enabled high-voltage power transmission and thus helped stabilize power supply and reduce transmission loss. This proves that the project achieved another objective — to reinforce the power transmission network in the target region — in addition to alleviating the power shortage in AP State.

[6] A load center means a place where an extremely large amount of electricity is consumed. Hyderabad is the largest load center in AP State, and Vijayawada and Kurnool are also major load centers.

Effects of the Project Produced by Each Transmission Line

Transmission Line	Actual Effects
Power Station - Hyderabad (400 kV)	The voltage of the 220kV transmission line in Hyderabad has increased (improved) by 8kV
Power Station – Vijayawada (400 kV)	The voltage of the 220kV transmission line in Vijayawada has increased (improved) by 10kV
Power Station - Kurnool (400 kV)	The voltage of the 220kV transmission line in Kurnool has increased (improved) by 22kV

The data on availability factor obtained from the executing agency are shown below.

Availability Factor of Each Transmission Line (%)

Fiscal Year	2000	2001	2002
Power Station – Hyderabad (400 kV)	99.89	97.82	99.75
Power Station – Vijayawada (400 kV)	99.92	99.93	95.66
Power Station – Kurnool (400 kV)	99.92	99.93	99.03
Hyderabad – Ganapur (400 kV)	100	100	100

The average availability factor *[7] of four routes in the past three years is 99.32%, indicating they are in good condition.

The transmission loss rate of the entire system under the control of APTRANSCO has been declining from 8.8% (FY2000) to 8.13% (FY2001) and 7.47% (FY2002).

2.4 Impact

2.4.1 Impact on Activation of Industries

The increase of voltage mentioned above has helped activate industries in some areas. In a survey of several companies*[8], they mentioned that they had rarely had an outage in three years and that a sudden voltage drop had not occurred since a year earlier. This situation has improved the investment environment in Hyderabad, representing high-tech city in India, and investment by major IT-related companies from around the world has been increasing.

The average annual growth rate of real GRDP of AP State between FY1998 and FY2001 was approximately 6.7%, exceeding the national average of 5.7%.

Changes in GRDP and Power Consumption in AP State

Fiscal Year	1993	1994	1995	1996	1997	1998	1999	2000	2001
Real GRDP (10 million Rs) *1	57,867	61,114	64,729	68,809	67,866	76,116	79,605	85,522	88,765
Power Supply (GWh) *2	27,879	29,979	30,918	33,657	38,170	40,612	45,752	46,745	46,951

Source: *1.Economic Survey 2002-2003, Government of Andhra Pradesh (based on fixed price in FY1993)
*2.APTRANSCO

[7] In Japan, availability factor is defined as "the maximum load divided by the product of rated capacity and power factor," while in India, it is defined as "operating time (the time for which the line and other equipment are available for use)/ total time." The operating time is the total time less annual downtime.

[8] On July 2, interview was conducted to three companies which had just started business in Hyderabad (These companies provide support related to information and infrastructure for companies that invest in the IT industrial estate.).

2.4.2 Other Environmental and Social Impact

(1) Environmental Impact

As a result of the examination of the environmental impact*[9]of the project outcome for the electricity transmission business, there found no problem. Also, no problem was reported in interviews with the executing agency. As a required countermeasure for deforestation for the construction of transmission lines, permission for forest clearance was obtained from the Ministry of Environment and Forests and 72 million Rs was spent to acquire substitute planting land (560ha).

(2) Impact on Local Residents

The project did not involve acquisition of private land or relocation of residents.
Also, no one has accidentally received an electric shock from the transmission lines. This was confirmed in an interview with local residents.*[10] Where the transmission lines constructed under the project cross roads, railway or rivers, the executing agency took necessary measures under laws and regulations and followed appropriate procedures such as obtaining permission from competent authorities (for example, in order to reduce possible disruption to telephone service, power transmission facilities were established at a certain distance from telephone line facilities).

2.5 Sustainability

2.5.1 Executing Agency (APTRANSCO)

(1) Technical Capacity

The power transmission facilities covered by the project (transmission lines and substations) are operated and maintained by the executing agency. Employees in charge of operation and maintenance receive training both at home and abroad as necessary, and a system is in place in which the executing agency can handle major repairs on its own. At substations, three shifts of employees monitor the operations 24 hours a day and are always prepared to take necessary measures in event of a problem. The executing agency considers its technical staff sufficient in terms of both quality and quantity.

(2) Operation and Maintenance System

The executing agency APTRANSCO had 5,007 employees as of the time of evaluation. Shortly after APSEB (total employees: 72,511) was unbundled (divided into power generation, power transmission and power distribution sectors that were then made public corporations) in 1999, the number of employees was 5,500. This means that the employees have been reduced by 10%.
With regard to the two substations built by the project, Hyderabad Substation has 94 employees including 33 engineers, and Kurnool Substation has 18 employees including 14 engineers. Although

[9] The possibility of electric shock, impact of the installation and use of facilities on the ecosystem, impact on the landscape, impact of the installation of facilities on historical and cultural heritages, impact on the existing infrastructure, impact on land use, environmental impact during the construction work, the need for environmental monitoring, etc.

[10] Transmission lines run from Srisailam Power Station in three directions, and there is no residential area in two directions. We interviewed two residents (both are storekeepers) in the only community that has long been existing in the vicinity (about 5 km north of the power station) about the impact of the Srisailam transmission lines construction project.

they are under the direct control of the headquarters, the local side (each substation) plays a leading role in most actual operations.

(3) Financial Status

According to the executing agency, a sufficient amount of money is and will continue to be secured for operation and maintenance costs. APTRANSCO's purchase and sales prices of electricity are regulated by Andhra Pradesh Electricity Regulatory Commission (APERC).*[11] As 95% of the sales to distribution companies are collected, there is no problem.

As for the financial status of APTRANSCO as a whole, it posted a deficit of 1,744 million Rs in FY2002, a decrease from a deficit of 3,960 million Rs the previous year. It has not received any subsidy from the state government since FY2002.

The factors behind the improved financial condition include cost-cutting efforts such as personnel restructuring, improvement of the sales collection rate and the sales increase due to the reduction of transmission loss. As the construction of more substations and transmission lines is expected to help further reduction of the transmission loss in the future, the financial condition is expected to improve.

APTRANSCO Profit and Loss Statement (Unit: million Rs)

Fiscal Year	2000	2001	2002
Total Income	77,621	76,592	85,058
(Subsidies)	29,357	200	0
Operating Income	48,264	76,392	85,058
Ordinary Profit/Loss	86	-4,677	-1,140
Final Profit/Loss	0	-3,960	-1,744

APTRANSCO Balance Sheet (Unit: million Rs)

Fiscal Year	2000	2001	2002
Current Assets	5,942	7,464	24,296
Fixed Assets	45,912	53,068	48,011
Total Assets	51,854	60,532	72,308
Current Liabilities	21,663	27,357	32,648
Fixed Liabilities	15,397	17,994	24,795
Shareholders' Equity	14,794	15,811	14,865

2.5.2 Operation and Maintenance Status

All facilities and machinery covered by the project are in good operating condition without any defects or faults. Also, no particular problem has arisen concerning operation and maintenance.

In summary, the facilities constructed under the project are performing sufficiently, and there is no

[11] Prices of electricity sold by APTRANSCO are calculated and determined as follows:
Pool power purchase cost + Transmission (Network) cost + Return to APTRANSCO (206.97 paise per unit as of the evaluation time)
This unit price is adjusted for each distribution company taking into account the composition of customers and geographical conditions.

physical problem at this moment. Also, the appropriate organizations and personnel for their operation and maintenance are in place and the budget for operation and maintenance activities is secured. Therefore, this project is highly sustainable.

3. Feedback

3.1 Lessons Learned

None.

3.2 Recommendations

None.

Comparison of Original and Actual Scope

Item	Planned	Actual
1. Output		
(1) Transmission Lines		
Power station - Hyderabad	400kV 2 lines 138km	400kV 2 lines 147km
Power station - Kurnool	400kV 1 line 104km	400kV 1 line 103km
Power station - Vijayawada	400kV 2 lines 217km	400kV 2 lines 221km
Hyderabad - Ganapur	400kV 1 line 46km	400kV 1 line 46km
(2) Substations		
Hyderabad (construction)	400/220kV, 630MVA	As planned
Kurnool (construction)	400/220kV, 630MVA	As planned
Vijayawada (expansion)	400kV, 2 bays added	400kV, 3 bays added
Ganapur (expansion)	400kV, 1 bay added	As planned
(3) Consultant Service	Bidding evaluation, design review, etc.	As planned
2. Project Period		
(1) Transmission Lines (procurement and construction)	Jul. 1992 – Jun. 1996	Oct. 1997 – Feb. 2001
(2) Substations (procurement and construction)	Jul. 1992 – Jun. 1996	Aug. 1998 – Jun. 2001
(3) Consultants	Jan. 1993 – Jun. 1996	Mar. 1994 – Mar. 2002
3. Project Cost		
Foreign Currency	10,692 million yen	8,187 million yen
Local Currency (local currency conversion)	5,835 million yen (1,736.7 million Rs)	4,337 million yen (1,399.1 million Rs)
Total		
ODA Loan Portion	16,527 million yen	12,525 million yen
Exchange Rate	13,352 million yen 1 rupee = 3.36 yen (December 1992)	10,121 million yen 1 rupee = 3.10 yen (February 2003)

Third Party Evaluator's Opinion on
Srisailam Power Transmission System Project (1) (2)

Dr.S.Narayan
Retired Economic Advisor to Prime Minister

Relevance
The project, as planned, was consistent with the national development plan of the Government of India, which sought to increase power supply at the time the project was planned, that is during the 8th FYP. It has remained highly relevant even at the present as it conforms to the State Development Plan Towards 2020 for the electricity sector in AP, which envisages increasing power generation capacity and improving electricity system efficiency.

Effectiveness
The project has been highly effective in alleviating power shortages along with reinforcing power transmission network in the region and reducing T & D losses. The average capacity utilization of over 99 % indicates that all the four sub-stations continue to be in good condition and are maintained well. By increasing supply and improving quality of power, the project has helped the State of AP to become a favoured investment destination, especially by the international IT companies. It also helped the city of Hyderabad to become a high-tech city as planned by the State government.

Efficiency
The project was executed as planned but with a delay of six years on account of delay in forestland clearance and permission to acquire substitution land at construction site of transmission lines. However, instead of cost escalation, overall cost of project was brought down by efficient contracting by more than 25 % from the initial estimate, despite delays. Though no particular problem was encountered while implementing the project, time delays, caused by external factors, affected to some extent, the efficiency of the project.

Impact
No detrimental or negative impact has been observed either on environment or on residents, as it did not mean any displacement of residential area. Special care was also taken not to disrupt telephone service while constructing transmission lines.

Sustainability
Though the executing agency has been making losses, the amount of loss has been reduced considerably by 2002 as compared to the previous year. This is significant, as the agency did not receive any subsidy from 2002 onwards. Financial situation is expected to improve further due to focus on cost-cutting, improved sales collection and increase in sales due to reduction in transmission loss. Adding more substations as planned for the future would also help in improving transmission and sales and thus finances.

Overall, the project appears viable and relevant for meeting beneficiaries' needs for increased power supply with better quality.