India

Anpara Power Transmission System Project (1) (2)

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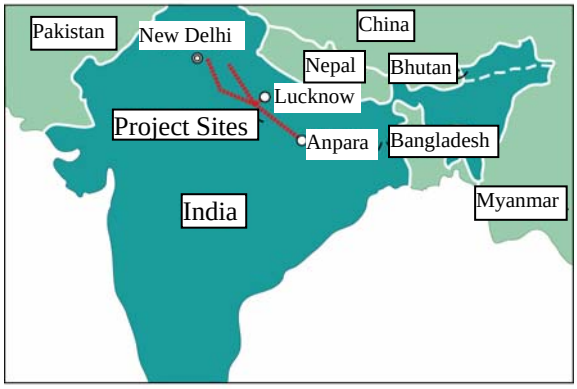
Field Survey: November 2005

1. Project Profile and Japan's ODA Loan



Map of project area

800 kV transmission lines

1.1 Background

Although the Government of India has promoted long-term structural reform in the industrial, public and trading sectors on the basis of its economic liberalization policy from the 1990s onwards and has strengthened the foreign competitiveness of industry, the electric power sector (one of the most important sectors and the key to the entire industrial infrastructure) still has a constant electric power shortage problem on a nationwide scale. This is a factor restricting economic-industrial activity.

Uttar Pradesh (UP), whose area is equal to 60% of Japan, has a population a little larger than that of Japan (about 148 million). UP experienced large electricity shortfalls at peak hours, with shortages reaching 30% in FY1987, because of the low rate of operation of thermal power plants, which contribute 70% of the power generation capacity in UP. Consequently, the electric power supply was constantly restricted, which caused a serious influence on society and economy in UP. Thermal power plants were concentrated in the coal mining area in eastern UP, and long-distance electricity transmission capacity to the major electricity consumption areas in central and western UP was lacking. In 1988, the peak electricity demand in UP was forecast to increase at an annual rate of about 10%, and more serious supply deficiencies were predicted for subsequent years.

For improvement of the electric power shortage, UP has implemented the Anpara B Power Plant Construction Project (Japanese ODA loan project) since 1984 and has been

constructing the 1,000MW thermal power plant in Anpara in eastern UP, due to be completed in 1993. Furthermore, UP planned to construct Anpara C Power Plant (1,000-1,500MW), which was to be completed by 2000. This project was planned to increase the capacity of the transmission of electricity from the Anpara Power Station to the main consumption areas in central and western UP. Japan's ODA loans were provided twice between June 1991 and May 2001.

1.2 Objective

The objective of this project was to provide a stable supply of electricity to meet the growing demand for electricity in central and western Uttar Pradesh (UP), which is the main consumption area of electric power generated by the Anpara Thermal Power Station in southeastern UP, by constructing high-voltage electric transmission and transformer facilities, thereby improving the electric power service in UP and contributing to industrial promotion and increased employment opportunities in the region.

1.3 Borrower/Executing Agency

The President of India/Uttar Pradesh Power Corporation Limited (UPPCL)[1]

1.4 Outline of Loan Agreement

	Phase I
Loan Amount/ Disbursed Amount	19,318 million yen/19,318 million yen
Date of Exchange of Notes Date of Loan Agreement	November 1989 June 1991
Terms and Conditions - Interest Rate - Repayment Period (Grace Period) - Procurement	 2.7%/year 30 years 10 years General untied (Consultancy: Partially untied)
Final Disbursement Date	January 1999

[1] The unbundling of the State Electric Board in January 2000 resulted in its respective divisions becoming independent entities. The present executing agency (transmission and supply operations sector) is Uttar Pradesh Power Corporation Limited (UPPCL).

Main Contractor	Mitsui & Co., Ltd., MMTC (India), PRG Transmission Ltd. (India), Bharat Heavy Electronics (India), KEC International (India), ASEA Brown Boveri (India), APAR Industries Ltd. (India), Hyundai Engineering & Construction (South Korea), MIDAL Cables Ltd. (Bahrain), etc.
Consulting Services	Tokyo Electric Power Services Co., Ltd. (TEPSCO), TATA Consultancy (India)

	Phase II
Loan Amount/ Disbursed Amount	12,020 million yen/6,270 million yen
Date of Exchange of Notes Date of Loan Agreement	January 1996 December 1996
Terms and Conditions - Interest Rate - Repayment Period (Grace Period) - Procurement	 2.75%/year 30 years 10 years General untied (Consultancy: Partially untied)
Final Disbursement Date	March 2001
Main Contractor	The same as Phase I
Consulting Services	The same as Phase I

2. Evaluation Result

2.1 Relevance

2.1.1 Relevance at the time of appraisal

In India's five-year plans,the electric power sector was one of the major steps towards achieving economic development, and its priority has remained consistently high. The Seventh Five-Year Plan (1985-90) emphasizes on public investment in the electric power sector because it was one of the most important sectors for the sound development of domestic industry.

UP experienced chronic electric power shortfalls at peak hours, and the per capita electric power consumption was low at two-thirds of the national average, so continual upgrading of electric power facilities was necessary. At the time of appraisal, UP had

been constructing Anpara B Power Plant in southeastern UP near the coal mining area, aiming to start operations in 1993. Furthermore, UP planned to construct Anpara C Power Plant, due to be completed by 2000. Long-distance electricity transmission facilities were needed to transmit the electric power generated by the plants to the major electricity consumption area which is central and western state around Delhi, and it was judged as appropriate that the 800kV super-high voltage transmission line would be along part of the section for economic and efficient transmission.

2.1.2 Relevance at the time of ex-post evaluation

In the 10th Five-Year Plan (2002-2007), the electric power sector is allocated 13% of the whole budget; it thus remains an important sector. The nationwide electric power shortage has not been resolved. Important issues are boosting electric power generation capacity with new power plant construction, strengthening of existing facilities, improvement of plant load factor (PLF), and organizational reform of the electric power sector[2].

In UP's 10th Five-Year Plan (2002-2007), highest priority is given to agricultural development, and the electric power sector's proportion of the budget is less than in the previous plan. Large shortfalls continue in both the electricity production and peak supply in UP[3], with unavoidable planned blackouts, as well as frequent blackouts and voltage fluctuations. Electric power demand and peak demand are forecast to increase at an annual rate of 6% to 8%. Thus, strengthening of the transmission network will be an important issue, together with boosting the electric power generation capacity. The initially assumed transmission from Anpara C Power Plant has not been actualized, but this project forms the backbone of the electricity transmission network in UP, and so its importance remains high[4].

2.2 Efficiency

2.2.1 Outputs

In this project, the construction of one 800 kV transmission line and five 400kV transmission lines, the construction of three new transformer substations, and the

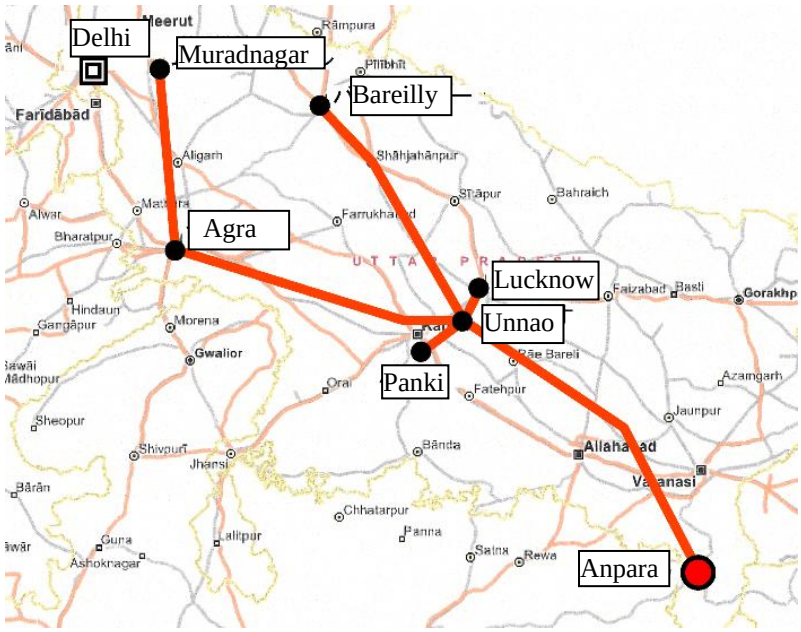
[2] Since the 1990s, new important issues have been raised, such as entry of private companies into the electric power sector and the organizational reform of the State Electricity Board (SEB) (i.e., dealing with distortions in the pricing system, large losses, and low fee collection rate, etc., promoting entry of private companies into electric power generation and electric power supply by means of splitting the electric power generation, transmission, and supply operations, and progressively privatizing the electric power supply).

[3] In UP, the supply capacity is increasing due to improvement in the capacity operating rate of thermal power plants. However, UP must purchase much of its electric power from the central government or other states because in addition to no new power plants being constructed since Anpara B was completed in 1994, Uttar Anchal (which has hydroelectric power plants) became an independent state in 2000.

[4] Anpara C power station has been delayed due to fund procurement difficulties, but construction with private funds is being studied, with a target date of 2010. Currently, this project is being used solely for transmission of electricity from Anpara B.

extension of three existing transformer substations were completed almost as planned. Although the 800kV super-high voltage transmission line (which enables more efficient transmission) was constructed on Anpara-Unnao line which transmits the electricity generated by Anpara B and C Power Plant, it is (along the lines of the initial plan) operated as the 400kV transmission line until Anpara C Power Plant is completed.

Fig. 1 Transmission and Transformer Facilities Newly Constructed or Extended through this project



Transmission line		Transformer substation	
800kV double: Anpara-Unnao	409km	Unnao	(400kV)
400kV single : Unnao-Lucknow	39km	Agra	(400kV)
400kV single: Unnao-Panki	49km	Bareilly	(400kV)
400kV single: Unnao-Agra	275km	Lucknow (extended)	(400kV)
400kV single: Agra-Muradnagar	194km	Panki (extended)	(400kV)
400kV double: Unnao-Bareilly	271km	Muradnagar (extended)	(400kV)

2.2.2 Project period

Although the project period was 72 months from June 1991 through May 1997 in the plan, the actual period was 120 months from June 1991 through May 2001. There was a six-year blank from the start of operations of Anpara B Power Plant to the start of operations of the Anpara-Unnao line in July 2000 (the Anpara-Unnao line enables electricity transmission from Anpara B Power Plant, which is the main purpose of this project).

The main reasons for the delay were the time required for the detailed design of the first 800kV transmission line in India, bidding preparation, and acquisition of logging permission[5], time required for adjustment of criteria for consultant selection by the executing agency, time required to acquire land for some substations, and delayed payments due to insufficient local currency.

2.2.3 Project cost

Because it became possible to procure certain materials domestically rather than importing them, the yen portion of this project decreased while the local currency portion increased, and the local currency portion also increased due to inflation. However, the total project cost in yen terms was kept within the planned levels (34,971 million yen or 88% of the planned 39,918 million yen), because the depreciation of the local currency exceeded the inflation and because of orders placed efficiently through competitive bidding.

2.2.4 Summary of evaluation of efficiency

As described above, although the outputs were constructed almost as planned and the project cost was kept within the scope of initial plans, there was a long delay in the project period. Thus, it is judged that the efficiency of implementation of this project was satisfactory on the whole.

2.3 Effectiveness

2.3.1 Transmission from the Anpara Power Station

The Anpara-Unnao line, the main line in this project, started operation at 400kV in July 2000, six years after the start of operations of Anpara B Power Plant (October 1994). UPPCL has decided to start 800kV transmission on the Anpara-Unnao line before the completion of Anpara C and has scheduled to start constructing transformer facilities required for the operation in FY2005.

Given that the availability factor of this project is very high (99% in FY2005) and the transmission loss is sufficiently low (below 2%), it is acknowledged that the operation status is very stisfactory (See Table 1).

Although the planned maximum electricity transmission at 400kV operations was 541MW, the actual performance values exceeded this on the Anpara-Unnao line and Unnao-Lucknow line and approximately the maximum value of the capacity of the

[5] It required more time than had been anticipated because there were no precedents related to the 800kV transmission in terms of technical appraisals of bidding documents, the appraisal for logging permission, the approval and license based on air law; procedures and appraisal criteria were thus not sufficiently developed.

facility was recorded (See table 2).

At appraisal, it was estimated that approximately 57% of electricity power generated in Anpara B Thermal Power station would be transmitted by this project (Anpara-Unnao line). In fact, approximately half of the electricity of the Anpara B Power Plant has been transmitted by this project after FY2002 which was the second year since the start of this project's operation. (See Table 3) Furthermore, when Anpara C is completed, henceforth it will be theoretically possible to transmit nearly four times this amount of electricity and starting the 800kV operation Anpara-Unnao line.

Table 1. Performance of the Availability Factor and Transmission Loss

	Availability factor	Transmission loss
FY2001	96.7%	1.75%
FY2002	97.0%	1.68%
FY2003	98.5%	1.55%
FY2004	98.9%	1.63%

Source: UPPCL
Note: Average of five lines except Agra-Muradnagar line

Table 2. Maximum Electricity Transmission (MW) and Electricity Transmission (GWh) (Performance by transmission line in FY2004)

Transmission line	Maximum electricity transmission	Electricity transmission
Anpara-Unnao	550MW	3.7 GWh
Unnao-Luchnow	560MW	2.5 GWh
Unnao-Panki	520MW	0.8 GWh
Unnao-Agra	430MW	3.0 GWh
Unnao-Bareilly (1)	460MW	1.6 GWh
Unnao-Bareilly (2)	380MW	1.5 GWh
Agra-Muradnagar	220MW	0.8 GWh

Source: UPPCL

Table 3. Electricity Transmission Performance from Anpara B

	Electricity transmission of Anpara B (A)	Electricity transmission of Anpara-Unnao line (B)	Ratio (B / A)
2001	7.7 GWh	2.47 GWh	32 %
2002	7.4 GWh	3.22 GWh	44 %
2003	7.6 GWh	3.66 GWh	48 %

2004	N.A.	3.71 GWh	-

Source: UPPC

2.3.2 Measures for dealing with the growing electricity demand; contribution to a stable electric power supply

The transmission network constructed by this project transmitted 3.7GWh electricity from Anpara Thermal Power Station in FY2004. This is equivalent to 8.4% of UP's total electric power supply, and it can be said that this project has made a great contribution to the electric power supply of UP.

It is thought that transmission loss from Anpara Electric Power Station has decreased because the transmission distance has shortened and the transmission load factor has decreased compared to that of the previously existing transmission network. Further transmission loss is expected when 800kV transmission is started[6].

Control panel of the Unnao Transformer

This project has the newest type of protection system (digital protection relay), and transmission of electricity is being carried out stably. No large-scale blackouts have occurred since the start of operations.

Furthermore, the voltage fluctuation of the Lucknow Transformer Substation, which was 14% at its highest in FY1994, has been decreased to 8-10% in FY2004. This project is also contributing to the decrease in voltage fluctuation.

2.3.3 Recalculation of Financial Internal Rate of Return (FIRR)

At the time of appraisal, on the premise of the total effect exerted in the Anpara B Power Station and the transmission system (this project), the result of 7.2% (FIRR) was calculated by regarding the sales income from electricity of Anpara B as the benefit, the construction, fuel and maintenance costs of Anpara B and the transmission system as the cost, and the project life as 25 years. From the recalculation under the same condition at the time of ex-post evaluation, the value was calculated as 1.9%. The reason for the decrease of value is that the completion of the transmission line was delayed six years compared to that of Anpara B, and the increase of the electricity sales price was lower than that the increase of the construction cost accompanied with inflation.

[6] Theoretically, as transmission voltage is double, transmission loss is one-quarter.

2.3.4 Summary of evaluation result of effectiveness

Although there was six years blank between the start of Anpara B Power Station's operations and the completion of this project, after the Anpara-Unnao transmission line started operations in July 2000, an efficient and stable electric power supply from Anpara Power Station has become possible. This project has played an important role in the electric power supply of UP. Thus, it can be said that the immediate goal of this project has been sufficiently achieved[7]. Furthermore, it is also expected that when Anpara C is completed and 800kV transmission is realized in near future, the project's long-term objective will be sufficiently achieved.

2.4 Impact

2.4.1 Impact on improvement of electric power services in UP

The electric power generation capacity in UP increased in 1996 when Anpara B began operation, but has not increased since then. Half of the electric power supply must be imported from outside the state to meet the increasing demand. For that reason, the shortfall in the electric power supply[8] has grown from 16% in FY1995 to 20% in FY2004. Although the shortfall in the electric power supply at the peak hours[9] has been reduced from 25% in FY1995 to 20% in FY2004, it remains at high level.

As such, notwithstanding the contribution of this project and Anpara B Power Station, the electric power supply and demand in UP has not been sufficiently improved, and the shortage of electric power is still severe. At present, planned blackouts of several hours a day continue in the rural areas and most cities. Reflecting this circumstances, the per capita electricity consumption in UP is low at 316kWh (Figures for FY2002. The national average is 567kWh).

On the other hand, it is thought that this project has contributed towards securing the stability and reliability on the transmission network in UP and northern India. Electricity generated by Anpara B was transmitted by the existing transmission network before the completion of this project, but the transmitted electricity was necessarily close to transmission capacity. In those days, long-time blackouts accidents, which took 7-8 hours until recovery, occurred on the local transmission network in northern India once or twice a year. After the completion of this project, however, stable transmission has been secured and similar blackout accidents have not occurred.

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[7] Although FIRR on this occasion is largely below the value at appraisal, the result was only partially considered in the evaluation of effectiveness because the delay of completion, which is the biggest factor bringing down the value, has been already considered in the evaluation of effectiveness.

[8] The percentage of the amount which was not supplied out of the total annual electricity demand (GWh)

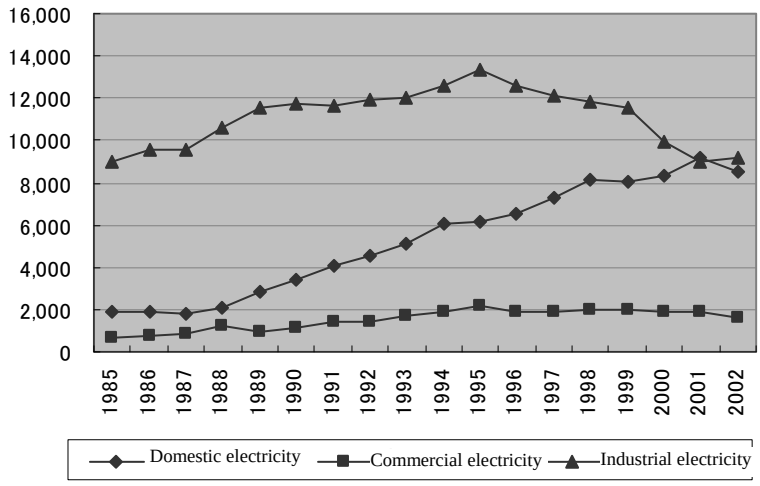
[9] The percentage of the electric power at the peak time (MW) which lacked supply capacity.

Summarizing these facts, although this project has contributed to improvements in stability and reliability of the transmission network, electric power supply services for beneficiaries have not reached the required level yet because of the shortage of electricity supply.

2.4.2 Impact on the promotion of industry and expansion of employment opportunity

As for the transition of electricity consumption in UP, while domestic and commercial electricity consumption has increased or remained steady, industrial electricity consumption peaked in 1995, followed by a downward trend.

Fig. 2 Transition of Electricity Consumption in UP (unit: million KWh)



It is thought that the decrease of electric power use in the industrial sector results from the in-house generation of electricity which companies have adopted because they avoid using low quality electric power services such as frequent blackouts or voltage fluctuation. It is said that one-third of all industrial output is produced with electric power generated in-house in the industry sector of UP, and nearly 10% of industrial output is lost due to blackouts or accidents[10]. Many industries shifted to in-house electricity generation from the second half of 1990, causing increases in production costs. It is thought that the shortage of electric power supply has become one of the key factors preventing industries from improving their competitiveness and increasing

[10] According the World Bank's Investment Climate Assesment in UP (2004), 36% of output is produced with high-cost electric power generated in-house and 9.5% of output is lost due to blackouts (i.e., output that could have been produced if there were no blackouts). Factors obstructing investment: high taxes, political insecurity, lack of skilled labor, lack of land, instability and expense of electric power services, bad traffic conditions, immaturity of local market, etc.

investment. In fact, the manufacturing output share of UP to the national total was decreased from 9.7% in FY1990 to 6.8% in 2000 and UP has lowered its status in the industrial sector in the national rating.

It is conceivable that the low quality of electric power supply services has become a factor behind industrial stagnation in UP and the lack of progress in the promotion of industry and in job creation. Although this project has contributed to the improvement of the stability and reliability of the transmission network at any rate, we were not able to ascertain to what extent it had contributed to the promotion of industry and job creation.

2.4.3 Technological impacts

UPPCL, the executing agency, has had the technology to design and construct 400kV transmission lines themselves. Through this project, UPPCL acquired technology so that it can basically plan and design new 800kV lines themselves.

2.4.4 Environmental and social impacts

There was no resident relocation or particular impact on the environment because the project did not adopt land acquisition in densely-populated areas or deforestation on a scale likely to cause an impact.

2.5 Sustainability

2.5.1 Executing Agency

2.5.2.1 Technical capacity

UPPCL has maintained a high level of transmission line technology, as evidenced by its actualization of the first 400kV lines in India in 1978. Its planning, design, implementation and operation of 400kV transmission lines have no problem. This project will be UPPCL's first opportunity to deal with 800kV lines; however, since the technology is essentially the same as for 400kV lines, there are no particular worries concerning the future.

2.5.2.2 Structure

In January 2000, UPSEB was split into three companies, a thermal power generation company, a hydroelectric generation company, and a transmission/supply company (UPPCL). UPPCL is endeavoring to streamline its staff by cutting back on hiring, but the staffs aging problems and excess staffs (particularly unskilled workers) remain as problems.

2.5.2.3 Financial status

Although UP has undertaken the electric power sector reform aiming at financial strengthening under the initiative of the World Bank, there were no major results[11]. Since 1999 UP had had a policy to entice private investment, etc., by regaining the credibility of the electric power sector through promotion of fee adjustments, reduction of electric power loss, and improvement of the fee collection rate. However, deficits grew due to increase in unprofitable supply of electric power to farm villages[12]. UPPCL was unable to cover the loss, although it received government subsidiy, and its financial situation has been getting worse and worse. (See Table 4) However, the deficit occurred primarily in the electric power supply sector, and the deficit in the transmission sector, which includes this project, was small.

Table 4. Financial Status of UPPCL

	FY2001	FY2004
Subsidiary amount from the government	2.4 billion Rs.	10.3 billion Rs.
Debt amount	30.0 billion Rs.	52.5 billion Rs.
Debt/turnover rate	45%	70%

2.5.3 Sustainability of operation and maintenance

The operation of this project, which maintains operating rate of 99%, is highly satisfactory. This project secured several years' worth of imported spare parts for the transmission lines. Other spare parts can basically be procured domestically. The operation and maintenance budget of the whole UPPCL was sharply reduced in 2003, reflecting the financial condition of UPPCL, but it has shifted to the increase afterward.

[11] The World Bank began reforms of power sector conducting the UP Power Project since 1988. However, there were no major results in the 1990s due to political instability caused by repeated administration changes and lack of will to carry out reforms. UP announced a reform policy centering on the split of the electric power sector into electric power generation, electricity transmission, and electric power supply, and on progressive privatization, the establishment of an independent regulatory body, the promotion of the entry of private companies into electric power generation and electricity transmission, minimization and adjustment of cross-subsidies for electricity fees. UP attempted to promote these reforms using the assistance of the World Bank in the UP Power Sector Restructuring Project (2000-04). According to this project's final report, the issues in the electric power sector that were in 1999 remain unresolved. These include constant political interference in UPSEB by the state government, lack of business orientation, and the weakness of internal controls, accountability, and facility operation and maintenance. Fee revisions were ineffective due to political interference and inefficient operation of facilities. Electricity loss is being reduced by the introduction of meters and automated billing, etc., but losses remain high (in the 30% range). In the transmission sector, the problems of excess staff and unskilled workers remain severe.

[12] The UP administration inaugurated in September 2003 increased electric power supply to farm villages from eight hours to 14 hours for the purpose of social development.

Table 5. Transition of Operation and Maintenance Budget of UPPCL

FY 1999	341 million Rs.
FY 2000	1,855 million Rs.
FY 2001	2,065 million Rs.
FY 2002	2,042 million Rs.
FY 2003	935 million Rs.
FY 2004	2,480 million Rs.

3. Feedback

3.1 Lessons Learned

- When a power generation project and a power transmission project are implemented together as a set, it is necessary to pay adequate attention to progress management so that the projects' completion dates are coordinated and project effectiveness does not suffer.
- When introducing items with new specifications, such as super-high voltage transmission lines, it is necessary to design a realistic implementation plan, with sufficient study of the possibility of difficulties and obstacles occurring in administrative and processing matters that did not occur with the old specifications.

3.2 Recommendations to UP Government

- Because UP currently is experiencing an absolute shortage of electricity, effort should be made to quickly secure a funding source and complete Anpara C Power Station as soon as possible.
- For structural reform of the electric power sector, continued efforts should be made for effective measures such as electricity fee adjustment (revision of excessive cross-subsidies) and privatization of the electricity supply sector.

Comparison of Original and Actual Scope

Item	Plan	Actual
(1) Outputs	(1) Transmission line construction 1) 800kV single: Anpara-Unnao 450km 2) 400kV single : Unnao - Lucknow 55km 3) 400kV single: Unnao-Panki 40km 4) 400kV single: Unnao-Agra 250km 5) 400kV single: Agra-Muradnagar 190km 6) 400kV double: Unnao-Bareilly 250km (2) Transformer substation construction 1) 315MVA x 2 (400kV) at Unnao 2) 315MVA x 1 (400kV) at Agra 3) 315MVA x 2 (400kV) at Bareilly (3) Transformer substation extension 1) Extension of 1 bay (400kV) at Lucknow 2) Extension of 1 bay (400kV) at Panki 3) Extension of 1 bay (400kV) at Muradnagar (4) Consulting services	(1) Almost as planned 1) 800kV single: Anpara-Unnao 2) 400kV single : Unnao-Lucknow 39km 3) 400 kV single: Unnao-Panki 49km 4) 400kV single: Unnao-Agra 275km 5) 400kV single: Agra-Muradnagar 194km 6) 400kV double: Unnao-Bareilly 271km (2) As planned (3) As planned (4) As planned
(2) Project Period 400kV transmission line and transformer substation 800kV transmission line Consultant operations	June 1993-December 1996 September 1994-April 1997 December 1993-March 1997	June 1993-May 2001 December 1994-July 2000 April 1992-May 2001
(3) Project Cost Foreign currency Local currency Total ODA Loan Portion Exchange rate	 24,086 million yen 15,832 million yen (5,478 million Rs.) 39,918 million yen 31,338 million yen 1 rupee = 2.89 yen	 5,373 million yen 29,573 million yen (9,180 million Rs.) 34,946 million yen 25,588 million yen 1 rupee = 3.22 yen