India

Ex-Post Evaluation of Japanese ODA Loan
West Bengal Transmission System Project (I) (II)

External Evaluator: Keishi Miyazaki and Junko Fujiwara, OPMAC Corporation

0. Summary

This project was implemented to enhance the reliability of the transmission network system, to reduce transmission losses and voltage fluctuations, and to make intra-state electricity transmissions efficient through the provision of a competent electricity transmission network, the construction of new substations and the expansion of existing substations in West Bengal State. It has been highly relevant to India's development plan and development needs. Facilities provided under the project have been operated well, and the project has highly improved the reliability of the transmission network system, and has promoted reductions in transmission losses and in voltage fluctuation. The project has thus largely achieved its objectives, and its effectiveness is high. It is judged that the project has contributed directly indirectly to industrial development, employment creation and the improvement of people's living standards in the State. The project cost was within the plan, although the project period exceeded the plan, therefore the project efficiency is fair. The project sustainability is deemed high in the organizational, technological and financial aspects, and the O&M condition of project facilities and equipment is good.

In light of the above, this project is evaluated to be highly satisfactory.

1. Project Description

Project Location

Overview of Equipment
at Arambag 400 kV Substation

1.1 Background

The West Bengal State, with Kolkata as its capital, is one of the major states in the Eastern Region of India. Electricity demand in the State grew by approximately 7.3% per year on average from 1994/95 to 1998/99, and it was projected that it would keep growing at 6.5% on an annual basis from 1999/2000 to 2012/13. However, the State had seen apparent gaps between electricity demand and supply in 1990s: peak demand reached 2,749 MW in 1997/98, whereas the then installed generation capacity accommodated only 2,329 MW. In 1999/2000, the peak demand was 3,161 MW against the installed capacity of 2,577 MW. Although an adequate transmission network system in the State was a condition for a stable electricity supply

in the Eastern grid[1] as well as in the North Eastern grid, the transmission capacity was not well enough developed to sustain the required load. With failures in the metering system, a low rate of payment, unauthorized connections and power theft, the State suffered from huge commercial losses. The communication systems at substations all over the State, in the hands of the executing agency of this project, the West Bengal State Electricity Board (WBSEB), were also not well developed, which made it difficult for the West Bengal State Dispatch Centre (WBSLDC) to discern the transmission status in real time.

1.2 Project Outline

The objective of this project was to enhance the reliability of the transmission network system, to reduce transmission losses and voltage fluctuations in West Bengal State. This was to be achieved through the provision of a competent electricity transmission network, the construction of new substations and the expansion of existing substations, thereby contributing to industrial development, employment creation and the improvement of people's living standards through rural electrification and promotion of home electric appliances in the State.

	First Phase	Second Phase
Loan Approved Amount / Disbursed Amount	11,087 million yen / 10,485 million yen	3,127 million yen / 2,251 million yen
Exchange of Notes Date / Loan Agreement Signing Date	Jan 1997 / Feb 1997	Mar 2002 / May 2002
Terms and Conditions Interest rate Repayment period (Grace period) Condition of procurement	2.3 % 30 years (10 years) General untied	1.8% 30 years (10 years) General untied
Borrower / Executing Agency	President of India / West Bengal State Electricity Transmission Company Ltd.	
Final Disbursement Date	May 2004	Aug 2009
Main Contractor (Over 1 billion yen)	RPG Transmission Ltd. (India), KEC International Ltd. (India), BHEL (India), Crompton Greaves Ltd. (India), W.S. Industries Ltd. (India), NELCO Ltd. (India)	
Main Consultant (Over 100 million yen)	Power Grid Corporation of India Ltd. (India) / Electric Power Development Company Ltd. (Japan) / Tokyo Electric Power Services Company Ltd. (Japan)	
Feasibility Studies, etc.	N/A	
Related Projects	Purulia Pumped Storage Project (I)(II)(III) (ODA Loan Project) Bakreswar Thermal Power Project (I)(II) / Bakreswar Thermal Power Station Unit 3 Extension Project (I)(II) / Bakreswar Thermal Power Station Units Extension Project (ODA Loan Project)	

Note: the West Bengal State Electricity Board (WBSEB) was unbundled on 1 April 2007 to become the West Bengal State Electricity Transmission Company Ltd. (WBSETCL) and the West Bengal State Electricity Distribution Company Ltd. (WBSEDCL).

[1] The Eastern grid was then comprised of West Bengal, Orissa, Bihar and Sikkim. As the southern part of Bihar became independent, as Jharkhand State, in 2000, the grid is now comprised of five states.

2. Outline of the Evaluation Study

2.1 External Evaluator

Keishi Miyazaki and Junko Fujiwara, OPMAC Corporation

2.2 Duration of Evaluation Study

Duration of the Study: August, 2011 – June, 2012
Duration of the Field Study: November 20 – December 19, 2011, March 11 - 21, 2012

2.3 Constraints during the Evaluation Study

Out of 31 intervened substations under this project, the Evaluators visited only four stations located in the Southern part of West Bengal State due to the fact that the substations are interspersed throughout the State and the Evaluators encountered severe time constraints during the evaluation study.

And it was also unable for the Evaluators to collect quantitative data at 26 substations out of 31 due to the fact that the intervened substations have not installed the data acquisition system for recording and monitoring the operation and effect indicators except the five pilot substations.

3. Results of the Evaluation (Overall Rating: A[2])

3.1 Relevance (Rating: ③[3])

3.1.1 Relevance with the Development Plan of India

The Eighth Five Year Plan of India, 1992/93 to 1996/97, laid emphasis on: i) improvements in the operation of existing thermal generation units and other plant and equipment, ii) reductions in the technical losses of the power system, iii) improvements in the financial performance of Central and State electricity, iv) the promotion of capacity additions to the existing installed generation capacity, v) the attracting of private investment in power development[4]. Out of the total investment in the public sector, 4,341 billion Indian rupees, the biggest proportion was investment in the energy sector, which at 1,155.6 billion rupees was at 26.6%. The share of electricity in the energy sector was 795.9 billion rupees, which amounted 18.3%[5].

The Government of India's Eleventh Five Year Plan, 2007/08 to 2011/12, was in place at the time of this ex-post evaluation study. In the Plan, the Government projected that the gross electricity requirement by the end of the Eleventh Plan on power would be 1,097 GWh; the estimation for peak demand was 158,000 MW. To fulfill the estimated electricity demand requirement, a capacity addition program was planned to secure an increase of 78,577 MW during the period[6]. The Plan also focused on the provision of an adequate inter-regional and intra-regional transmission capacity so as to consolidate and strengthen the national grid network towards a strong all-India grid. All distribution companies were urged to target a reduction of 3% per annum of their aggregate technical and commercial losses during the Plan period. The Government allocated 8,541.2 billion rupees for the energy sector, which comprised 23.4% of the public sector investment in the Plan. It was the social sector that shared the biggest amount: 1,123.4 rupees (30.2%), in the Plan.

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[2] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[3] ③: High, ② Fair, ① Low
[4] Planning Commission, Government of India. "Eighth Five Year Plan" (1992).
[5] Oil (240 billion rupees: 5.5%), coal (105.1 rupees: 2.4%) and renewable energy (14.7 rupees: 0.3%) were also part of the energy sector.
[6] Planning Commission, Government of India. "Eleventh Five Year Plan (2007-2012), Volume I Inclusive Growth" (2008).

The investment amount spent for West Bengal State was 97.6 billion rupees in the Eighth Five Year Plan, out of which 30.25 billion rupees were for the energy sector. In the Eleventh Plan, however, 176.3 billion rupees were allocated for energy sector investment out of 637.8 billion, which is the second to the social sector (237.8 billion).

It is thus concluded that this project was highly relevant to India's development plan and its power sector development plan at the time of project appraisal as well as at the time of the ex-post evaluation study.

3.1.2 Relevance with the Development Needs of India

The electricity demand of West Bengal increased approximately 7.3% per annum on average from 1994/95 to 1998/99, and it was projected that it would keep growing in the following years. Peak demand in 1997/98 reached 2,749 MW, while the then installed generation capacity was 2,329 MW, which left a peaking shortage of 420 MW. In order to reduce this demand/supply gap, an augmentation of transmission facilities was top priority. Frequent voltage fluctuation was also admitted as a problem, and it was urgently necessary to reinforce the transmission capacity and improve the reliability of the transmission network system in the State in order to provide a growing amount of electricity to consumers.

Since the project launch, power shortages in the State have remained severe: the power supply as of 2003/04 was 8,787.41 GWh against 13,807 GWh of power demand, while supply versus demand was 11,724 GWh against 17,840 GWh in 2006/07, and 15,497 GWh against 24,711 GWh in 2009/10. The State Government projects that power demand will continue to grow in the industry, agriculture and domestic sectors, and that the need to develop in order to cope with power demand and to improve the transmission system is high.

It is thus concluded that this project was highly relevant to the development needs for the reinforcement of transmission capacity in West Bengal State at the time of project appraisal as well as at the time of the ex-post evaluation study.

3.1.3 Relevance with Japan's ODA Policy

At the time of the first appraisal in 1996, economic infrastructure development, particularly for power and transport infrastructure, was a priority area in Japan's ODA strategy to India[7]. Later, in 1999/2000, implementation policy for JICA's overseas economic cooperation focused on assistance in the poverty sector, the environmental sector, and in economic and social infrastructure development for sustainable economic development.

In the current Country Assistance Program for India formulated by the Government of Japan in 2006/07 there is also an emphasis on economic infrastructure development, of which power sector is the highest priority[8] along with transportation sector.

It is thus concluded that the selection of this project was highly appropriate and relevant to Japan's assistance strategy.

This project was highly relevant to India's development plan, and to its development needs, as well as to Japan's ODA policy, therefore its relevance is high.

3.2 Effectiveness[9] (Rating: ③)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

In order to assess the degree of attainment of this project's objectives: that is, to enhance the reliability of the transmission network system, to reduce transmission losses and voltage fluctuation, WBSETCL and JICA agreed to choose five substations out of the 31 under the

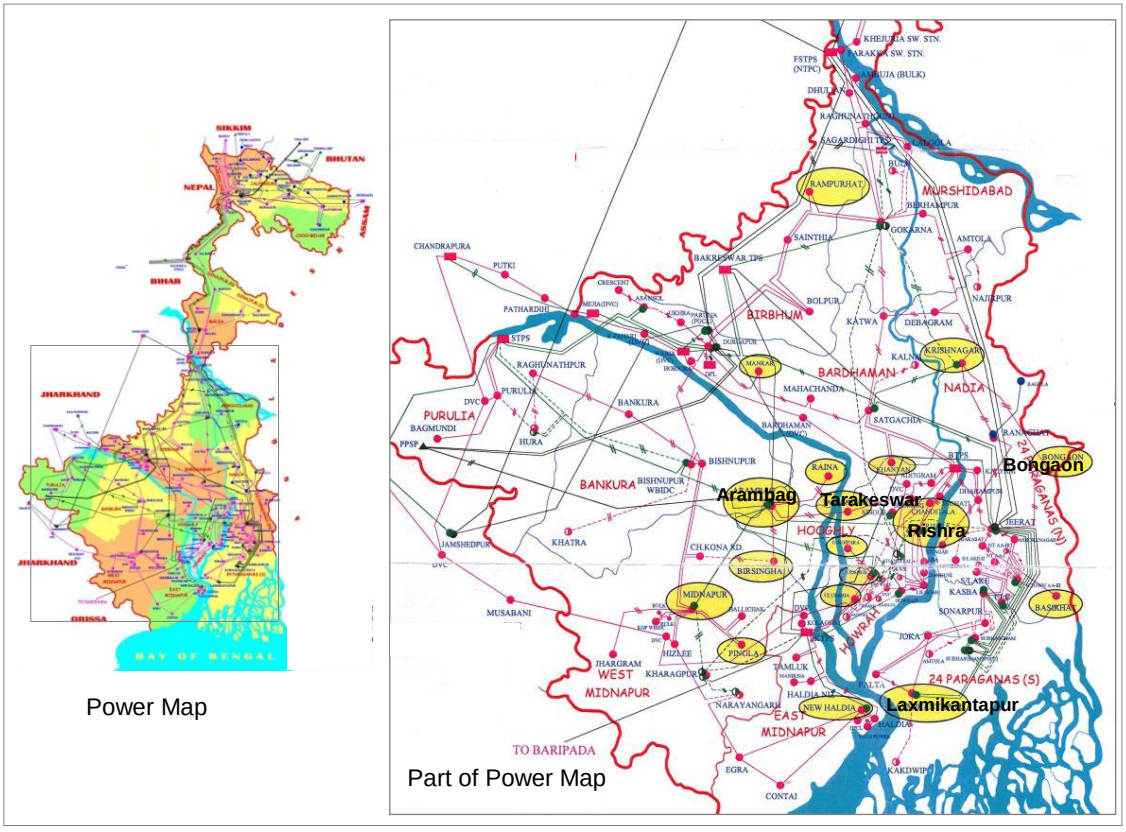
[7] The Ministry of Foreign Affairs. "Japan's ODA White Paper" (1998).
[8] The Ministry of Foreign Affairs. "Japan's Country Assistance Program for India" (2006).
[9] Rating for "effectiveness" also includes " impact".

project[10] to monitor specific measurable indicators. Their locations and details are shown in Table 1and Figure 1.

Table 1: Outline of Five Substations for Monitoring Operation & Effect Indicators

Substation	kV Ratio	Capacity in MVA	Actions under the Project
Arambag	400/220	315.0 x 3	Transformer (315 MVA, 400/220 kV) x 2, Transformer (160 MVA, 220/132 kV) x 1, 400 kV Bay x 7, 220kV Bay x 9, 132 kV Bay x 7
	220/132	160.0 x 3	
	132/33	31.5 x 2, 50.0 x 1	
Laxmikantapur	220/132	160.0 x 2	Transformer (160 MVA, 220/132 kV) x 2, 220 kV Bay x 5, 132 kV Bay x 4
	132/33	31.5 x 3	
Rishra	220/132	160.0 x 3	Transformer (160 MVA, 220/132kV) x 2, 220 kV Bay x 7, 132 kV Bay x 2
	132/33	50.0 x 3	
Bongaon	132/33	31.5 x 2	Transformer (31.5 MVA, 132/33 kV) x 2, Transformer (6.3 MVA, 33/11 kV) x 2, 132 kV Bay x 7
Tarakeswar	132/33	50.0 x 1	Transformer (31.5 MVA, 132/33 kV) x 2, Transformer (6.3 MVA, 33/11 kV) x 2, 132kV Bay x 7
	132/33	31.5 x 1	

Source: WBSETCL.
Note: kV Ratio and Capacity in MVA are those as of March 2011. Some substations were augmented with additional transformers or had a replacement of transformers due to heavy loading after the Project was complete.



Source: WBSETCL.
Note: Power map is as of March 2011. Substations circled in yellow are the ones under the Project, and the five substations are Arambag, Tarakeswar, Rishra, Bongaon and Laxmikantapur.

Figure 1: Power Map of West Bengal

[10] Electricity supply, electricity demand, availability factor, transmission loss, station use electricity, and peak load at sending point were recorded for monitoring when WBSETCL and JICA agreed to apply them as the operation and effect indicators in 2001. In this ex-post evaluation study, the evaluators also recorded planned outage hours, forced outage hours, outage rate for S/S, and outage rate in addition to the above indicators for T/L for a more comprehensive analysis on project effectiveness.

(1) Enhancement of Reliability of the Transmission Network System

WBSETCL owned 103 substations throughout West Bengal State as of November 2011, out of which 31 were newly constructed or augmented under the project. This large scale of intervention has brought more reliability to the transmission network in the State. The extension of major transmission lines has also increased the transmission capacity to a large extent.

The current condition of the five pilot substations and progress up to present are described below:

i) Arambag Substation

Arambag Substation was initially commissioned in 1995 as a 200 kV substation to connect with Santaldihi Thermal Power Plant - Arambag of 220 kV bay level transmission line and Arambag - Howrah line.

Arambag was then expanded with 400kV, 220 kV and 132 kV circuits along with 400/220 kV and 220/132 kV transformers under the project. The construction of 220 kV and a 132 kV switchyard was achieved through internal funding from WBSETCL. However, the construction of the 400 kV switchyard was achieved through JICA financial assistance. The Substation is the second 400 kV substation of WBSETCL and the largest in the State considering switchyard area.

Source: Study Team

Picture 1: Control Panels at Arambag S/S

The Substation sends out over 800 MW of energy from Kolaghat Thermal Power Plant, Bakreshwar TPT[11], Santaldihi TPT and Purulia Pumped Storage Hydro Power Plant[12] as shown in Table 2. Power demand was 200 MW in 2000/01, becoming four times this in 2009/10. At the 220 kV level, the station is connected through Midnapur S/S[13], Bishnupur S/S and Domjur S/S[14] through double circuit lines and the single circuit Rishra line[15]. At the 132 kV level, the station is connected in ring main with Birsingha S/S[16], Raina S/S[17] and Tarakeswar S/S through double circuit lines. Both electricity supply and electricity demand have reached the target, and it currently handles over 4,000 GWh of electricity per year (Table 2).

According to WBSETCL, the Substation will be augmented with additional transformers (315MVA, 400/220 kV x 1, and 37MVA, 132/33 kV x 1) in 2012/13 since the availability factor hit over 100% in 2010/11[18].

[11] JICA has extended its ODA assistance loan to Bakreshwar Thermal Power Project (I) (approved amount: 27,069 million yen, approved date: 1993/94), Bakreshwar Thermal Power Project (II)(34,151 million yen, 1997/98), Bakreshwar Thermal Power Station Unit 3 Extension Project (I) (8,659 million yen, 1994/95), Bakreshwar Thermal Power Station Unit 3 Extension Project (II) (11,537 million yen, 1998/99), Bakreshwar Thermal Power Station Units Extension Project (36,771 million yen, 2002/03).

[12] JICA also extended ODA assistance loans to the engineering service for the Purulia Pumped Storage Project in FY 1987 (approved amount: JPY 628 mil), PPSP (I) in FY 1994 (JPY 20,520 mil), PPSP (II) in FY 2003 (JPY 23,578 mil), and PPSP (III) in FY2005 (JPY 17,963 mil).

[13] The substation was one of 31 substations under the project.

[14] Ditto.

[15] The line was extended under the project.

[16] Ditto.

[17] Ditto.

[18] Relevant data were provided by WBSETCL during the country survey in December 2011.

Table 2: Operation & Effect Indicators at Arambag Substation

Indicators	Target (2010/11)	Actual		
		(2008/09)	(2009/10)	(2010/11)
Electricity Supply (GWh)	2,939	2,541	3,526	3,909
Electricity Demand (GWh)	2,895	2,522	3,529	4,173
Availability Factor (%)	66.36	57.43	61.73	105.50
Transmission Loss (%)	□0.5	0.73	0.11	0.10
Station Use Electricity (GWh)	29.393	N/A	N/A	N/A
Peak Load at Sending Point (MW)	533.07	726.20	791.77	876.35
Planned Outage Hours (Hours)	-	N/A	N/A	245:41
Forced Outage Hours (Hours)	-	N/A	N/A	327:10
Outage Rate for S/S (Nos/MVA)	-	N/A	N/A	0.117
Outage Rate for T/L (Nos/km)	-	N/A	N/A	N/A

Source: WBSETCL.

ii) Laxmikantapur Substation

Laxmikantapur is one of the oldest and most important substations of WBSETCL. Earlier, the Substation was comprised of 132 kV, 33 kV and 11 kV switchyards, then with JICA finance it was upgraded to 220 kV. According to WBSETCL, upgrading of the Substation enabled WBSEDCL to serve nearby rural areas which have witnessed a major growth in agriculture consumers in the last 5 years.

Both electricity supply and demand have reached, and far exceeded the target figures as shown in the table below, and the substation will also be augmented with an additional transformer (160MVA, 220/132 kV x 1) in 2012, adding to the two existing ones, as the availability factor hit 90% in 2010/11.

Table 3: Operation & Effect Indicators at Laxmikantapur Substation

Indicators	Target (2010/11)	Actual		
		(2008/09)	(2009/10)	(2010/11)
Electricity Supply (GWh)	803	760	1,233	1,152
Electricity Demand (GWh)	791	759	1,180	1,116
Availability Factor (%)	53.56	80.92	88.53	90.02
Transmission Loss (%)	0.5	N/A	2.08	2.10
Station Use Electricity (GWh)	8.033	3.94	4.38	5.52
Peak Load at Sending Point (MW)	145.69	233.57	255.82	266.73
Planned Outage Hours (Hours)	-	N/A	N/A	120:01
Forced Outage Hours (Hours)	-	N/A	N/A	63:49
Outage Rate for S/S (Nos/MVA)	-	N/A	N/A	0.075
Outage Rate for T/L (Nos/km)	-	N/A	N/A	1.11

Source: WBSETCL.

iii) Rishra Substation

Earlier, the Rishra Substation had 132 kV and 33 kV switchyards, then with JICA funding the substation was upgraded to 220 kV level. Rishra is currently charged from one single circuit 220 kV feeder from the Arambag S/S and also directly fed from 220 kV T/L originating from the Bandel Thermal Power Station. The electricity supply has reached target, and the availability factor and peak load far exceed the target figures catering for the energy needs of industrial consumers in the vicinity of around 50 to 60 km (See Table 4). Forced outage hours have been on decrease.

Table 4: Operation & Effect Indicators at Rishra Substation

Indicators	Target (2010/11)	Actual		
		(2008/09)	(2009/10)	(2010/11)
Electricity Supply (GWh)	651	241	652	655
Electricity Demand (GWh)	641	222	606	598
Availability Factor (%)	43.41	50.34	59.37	66.33
Transmission Loss (%)	0.5	1.9	1.12	1.02
Station Use Electricity (GWh)	6.510	5.6	6.1	7.0
Peak Load at Sending Point (MW)	118.07	114.38	157.70	172.13
Planned Outage Hours (Hours)	-	N/A	1034:33	444:06
Forced Outage Hours (Hours)	-	N/A	357:12	277:46
Outage Rate for S/S (Nos/MVA)	-	N/A	0.055	0.0698
Outage Rate for T/L (Nos/km)	-	N/A	1.536	1.0267

Source: WBSETCL.

iv) Bongaon Substation

The Bongaon Substation was newly constructed under the project at 132 kV Bay level. Bongaon is currently charged from the Jeerat 400 kV S/S[19] and from Krishnagar 132 kV S/S[20] through 132 kV feeders. The electricity supply, availability factor and peak load have almost reached target, and the number of forced outage hours, and planned outage hours have slightly improved in the past three years (See Table 5).

Table 5: Operation & Effect Indicators at Bongaon Substation

Indicators	Target (2010/11)	Actual		
		(2008/09)	(2009/10)	(2010/11)
Electricity Supply (GWh)	255	148.5	165	227
Electricity Demand (GWh)	251	145	163.7	232
Availability Factor (%)	86.48	76.12	81.95	83.30
Transmission Loss (%)	0.5	0.11	5.39	0.27
Station Use Electricity (GWh)	2.553	0.936	0.960	0.948
Peak Load at Sending Point (MW)	46.31	42.05	45.90	48.07
Planned Outage Hours (Hours)	-	85	72	70
Forced Outage Hours (Hours)	-	55	50	46
Outage Rate for S/S (Nos/MVA)	-	0.34	0.27	0.29
Outage Rate for T/L (Nos/km)	-	0.06	0.07	0.06

Source: WBSETCL.

v) Tarakeswar Substation

Like the Bongaon Substation, the Tarakeswar Substation was also newly constructed under the project at 132 kV Bay level. Tarakeswar is charged from the Arambag 400 kV S/S through 132 kV transmission line. The main activities in its catchment are agricultural and so the demand for electricity in the area remains low compared with the industrial area where the Rishra Substation is located. The electricity supply and peak load thus remain lower than target. However, the availability factor exceeds target (See Table 6).

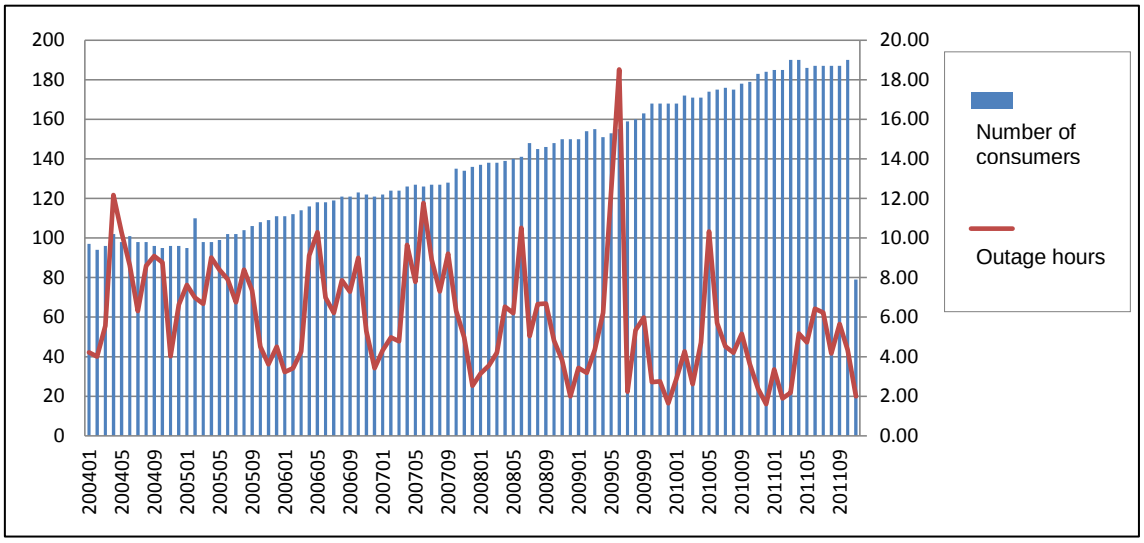
[19] The substation was under the project.
[20] Ditto.

Table 6: Operation & Effect Indicators at Tarakeswar Substation

Indicators	Target (2010/11)	Actual		
		(2008/09)	(2009/10)	(2010/11)
Electricity Supply (GWh)	340	116	185	218
Electricity Demand (GWh)	335	115	184	218
Availability Factor (%)	64.29	60.00	66.81	73.39
Transmission Loss (%)	0.5	0.37	0.37	0.18
Station Use Electricity (GWh)	3.405	0.143	0.09	0.07
Peak Load at Sending Point (MW)	61.75	43.23	48.84	54.91
Planned Outage Hours (Hours)	-	N/A	N/A	153
Forced Outage Hours (Hours)	-	N/A	N/A	866
Outage Rate for S/S (Nos/MVA)	-	N/A	N/A	0.294
Outage Rate for T/L (Nos/km)	-	N/A	N/A	0.117

Source: WBSETCL.

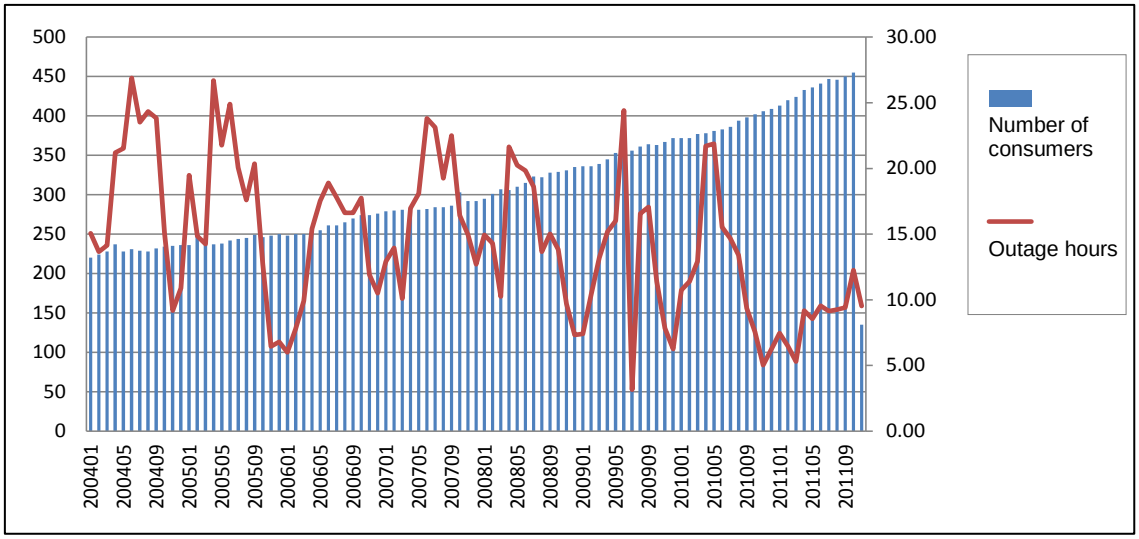
According to information obtained from WBSEDCL, the electricity supply in West Bengal State has improved to a large extent, and number of outages has sharply decreased in the past four years. In the State, approximately 5,000 consumers have contracts with WBSEDCL for over a 500 kVA contract demand. Out of these, 30 consumers are connected to 132 kV feeders, 200 consumers are connected to 33kV feeders, and 460 are connected to 11 kV feeders[21]. The trends in numbers of consumers over 500kVA CD and the lengths of outage hours per consumer from January 2004 to December 2011 are shown by feeder in Figure 2 and Figure 3. The number of consumers with over 500 kVA CD on 33 kV and 11 kV feeders have doubled in the period, and the lengths of outage hours per consumer have decreased year by year although there have been seasonal fluctuations. As of the end of 2011, the average outage hours per consumer on 33 kV feeders were five hours per month, and that for 11 kV feeders was ten hours.



Source: Data collected at WBSEDCL.

Figure 2: Trends in the Number of Consumers over 500 kVA CD and the Length of Outage Hours per Consumer (33 kV Feeder)

[21] WBSETCL prioritizes electricity supply to large consumers connected to 132 kV or over, and they rarely experience power outages throughout a year. Consumers on 33 kV and 11 kV feeders, on the contrary, are affected most by power outages and voltage fluctuation.



Source: Data collected at WBSEDCL.

Figure 3: Trends in the Number of Consumers over 500 kVA CD and the Length of Outage Hours per Consumer (11 kV Feeder)

Several 33 kV substations experienced outages over 100 times in October 2011, whereas the rest saw outages 30 to 50 times at the most in the same moth. Many did not experience any outage. Outages on some 11 kV substations exceeded 200 times a month, while others experienced none or just a few[22].

Data collection was made possible at five pilot substations in a precise manner and in real time through computerization with a data acquisition system (DAS) procured under the project. Prior to the project, data had been manually recorded on log-sheets (See Picture 2). Thus the DAS has made it possible to continue the precise monitoring of power outage time and hours, and of outage points (See Picture 3). This will help WBSETCL improve their countermeasures in future for unplanned power outages and to promote the efficiency of recovery works. The microwave communication system installed at ten stations also helped WBSETCL to effectively communicate with WBSLDC.

Source: taken at Domjur S/S by the Study Team.

Picture 2: Log-sheet used at Substations without DAS

Source: taken at Rishra S/S by the Study Team.

Picture 3: Chief Engineer Operating DAS procured under the Project

[22] Data was collected at WBSEDCL during the country survey in December 2011.

As of March 2012 there are five substations where DAS is available. In 2012 WBSETCL will launch other pilot schemes at a substation to install DAS on a digital basis together with optical fiber communication systems. And they plan to install it in other substations if it is found successful.

(2) Reduction of Transmission Losses and Voltage Fluctuation

As of 2007/08 when unbundling took place, the transmission loss was 4.0% in the transmission network of WBSETCL. This has shown improvement year by year reaching 3.8% in 2009/10, and projected to be 3.5% in 2012/13[23]. This shows that West Bengal State has been doing better compared to the average for the whole country which is around 5 to 5.5%.

As for transmission losses at the five pilot substations, Arambag (0.1%), Bongaon (0.27%) and Tarakeswar (0.18%) were less than the target figure of 0.5% in 2010/11. Laxmikantapur hit 2.1% and Rishra 1.02%, which exceed the target, but are still less than the State average.

Apart from transmission loss, distribution loss in the State was improved from 24.6% in 2007/08 to 24.3% in 2009/10, and this is projected to improve up to 22.0% in 2012/13. However, there remains much to improve, such as technical and non-technical losses, unauthorized connection and power theft.

(3) Efficient Transmission of Intra-state Electricity

The bus voltages of 33 kV distribution feeders of substations show that voltage fluctuation stays at a minimum between the worst case 25 kV and the best case 32 kV. For 11 kV feeders, the worst case was 8.36 and best case 10 to 11 kV.

3.2.2 Qualitative Effects

The Evaluators conducted interviews with bulk industry consumers connecting to 11 kV, 33 kV and 132 kV feeders during the country survey in December 2011. They said that they were content with the quality of services provided by WBSEDCL and the conditions of the electricity supply, as shown in the boxes below.

Interview with bulk industry consumer (1)	
Date	2 December 2011
Name	Mr. Sapan Kumar Ghosh, President
Corporate name	Khadagpur Metal Reforming Industries Ltd. (manufacturing of steel and other metals) Interview venue was WBSEDCL.
Supply voltage	11 kV
Contract demand	N/A
Monthly energy consumption	Approximately 50,000 kWh per month
Monthly energy charge	3.2 mil to 3.5 mil rupees per month
Contents	“There are frequent unscheduled interruptions faced at the premises, ranging from 35 minutes to one hour; at least 4 to 5 times in a day. Such frequent disruptions in the power supply not only affect the production cycle but also damage the raw materials.” “Due to the lengthier transmission lines from WBSEDCL sub-stations, the tail end voltage at his premises was low and to match the low voltage with a standard operating voltage level, he had installed automatic voltage boosters.”

Mr. Sapan Kumar Ghosh. The company is located in Khadagpur, 120 km away from Kolkata.

[23] Data obtained at WBSETCL in December 2011.

Interview with bulk industry consumer (2)	
Date	2 December 2011
Name	Mr. Sunil Gawande, President Mr. Mitra, General Manager (Electrical and Automation)
Corporate name	Bhushan Power & Steel Ltd. (manufacturing steel and other metals)
Supply voltage	33 kV
Contract demand	50,000 kVA
Monthly energy consumption	N/A
Contents	"Efforts made by WBSETCL in upgrading the existing 132 kV Rishra S/S to 220 kV level, helped them transfer the load and enabled them to have better load management. This has contributed to a reduction in such interruptions in power supply to a great extent in last three years." "Satisfied with the availability of power and with the reliability and quality of the services of WBSEDCL." "There are occasional momentary disruptions in power supply. This kind of disruption is more particularly observed during the night and this affects his entire production cycle.

Inside the factory. The company is located in the Rishra Industrial area (around 60 km from Kolkata), directly connected to Rishra Substation. They produce 35,000 tons of steel per month

Mr. Sunil Gawande

Interview with bulk industry consumer (3)	
Date	2 December 2011
Name	Mr. V. K. Goenka, Senior vice president
Corporate name	Jaya Shree Textiles (manufacturing textile)
Supply voltage	132 kV
Contract demand	10,000 kVA
Monthly energy consumption	N/A
Contents	"Jaya Shree Textiles in its existing form was founded 60 years ago, and has been connected by 33 kV transmission line from the Rishra EHV substation of WBSETCL. With the progress of the company in recent years, Jaya Shree Textiles chose a 132 kV level during 1999. Earlier, the annual turnover of the company was around 3.5 billion rupees and the total work force was less than 2,000 people. At present, however, the annual turnover has reached around 10 billion rupees, and there are close to 3,700 employees. The company has made remarkable progress over the years." "Much worried about rising electricity tariffs; especially for industrial consumers. He expressed his opinion that if the same trend continues in near future, most of the industries would migrate to other states. He was also worried about the generation mix in the State (comprising of 90% thermal power generation). The State Government should look for cheaper sources of power generation, such as hydro power and renewables and should strive to reduce the power tariffs as electricity is the major input source for industries.

Mr. V. K. Goenka. The company is located at the Rishra Industrial Area (around 60 km from Kolkata), and is connected to Rishra substation.

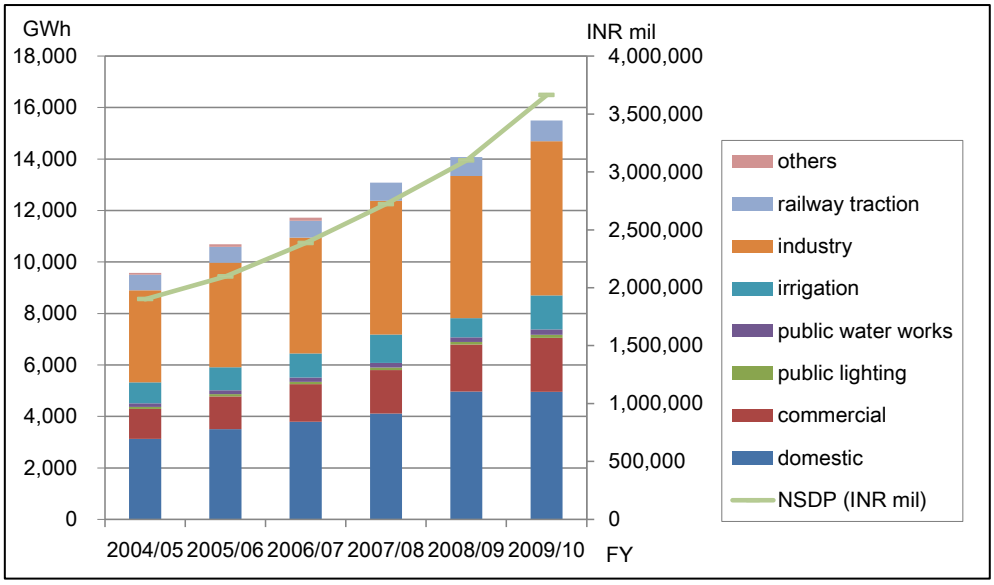
3.3 Impact

3.3.1 Intended Impacts

(1) Contribution to Industrial Development

The net state domestic product (NSDP) of West Bengal State has shown an annual steady growth from 1,900,730 million rupees in 2004/05 to 3,663,180 million rupees in 2009/10[24] (Figure 4). Energy consumption in the State, except the supply to CESC Ltd.[25] and DPSC Ltd.[26] also increased during the same period in line with NSDP from 9,581 GWh to 15,497 GWh. It is industrial and domestic consumers who have been the major sources of increasing consumption. Energy consumption b industrial consumers increased from 3,581 GWh to 5,995.3 GWh, and that of domestic consumers from 3,128 GWh to 4,595 GWh.

It is considered that this project has contributed to sustainment of the energy consumption required by rapidly increasing consumers while the State has seen industrial development through the improvement of the transmission network system, including the construction and augmentation of 31 substations.



Source: Data obtained at WBSETCL, Reserve Bank of India. "Handbook of Statistics on Indian Economy 2010-2011" (2011).

Note: Energy consumption excludes supply to CESC Ltd. and DPSC Ltd.

Figure 4: Growth of Net State Domestic Product and Energy Consumption

(2) Employment Creation through Industrial Development

Energy consumption has kept growing as NSDP of the State has shown steady growth as stated above, for which this project is deemed to have contributed. However, the Evaluators encountered constraints to examine the degree of impact on employment creation brought by the project as a whole. Although some companies such as Jaya Shree Textiles (See above 3.2.2) have increased the number of staff they expanded their business and increased the input voltage level as substations nearby were augmented under the project, quantitative analysis on the degree of direct and indirect impact on job creation was not possible.

[24] Reserve Bank of India. "Handbook of Statistics on Indian Economy 2010-2011" (2011).

[25] Begun as India's first fully integrated electrical utility, CESC Ltd. has generated and distributed electrical power in Kolkata and Howrah since 1899. It solely serves electricity to 2.5 million consumers in Kolkata and Howrah. CESC owns and operates four thermal power plants generating 1,225 MW of power, as well as a transmission and distribution system to supply electricity to consumers.

[26] Established in 1919, DPSC Ltd. is a power utility company whose main business is the distribution of electricity for public and private purposes in West Bengal and the generation and procurement of electrical energy.

(3) Improvement of People's Living Standards through Rural Electrification and the Promotion of Home Appliances

The Ministry of Power started rural electrification by launching *Rajiv Gandhi Grameen Vidhyutikaran Yojana* (RGGVY) in April 2005, targeting the completion of rural electrification within four years. As of March 2009, the rural electrification rate[27] in West Bengal State was 97.3% - a remarkable outcome achieved by implementation of the program.

This project did not intervene directly in rural electrification as it extended its finance up to 132 kV bay level transmission lines. This meant that the evaluators had difficulty in identifying any impact brought by the project to rural electrification and the promotion of home appliances. It was also not possible either to assess the improvement of people's living standards.

However, it is noteworthy that the census conducted in 2011 indicated a large population increase from 80.17 million in 2001 to 91.35 million in 2011[28], and that the number of domestic consumers increased from 3,128 GWh in 2004/05 to 4,959 GWh in 2009/10[29]. Energy consumption for public lighting, public water works, irrigation and railway traction is also on the increase[30]. This project has contributed to a great extent to the utilization of infrastructure necessary for people's lives and to improvements in their living environment.

3.3.2 Other Impacts

(1) Impacts on the Natural Environment

There was no major negative impact on the natural environment by this project.

(2) Land Acquisition and Resettlement

No land was acquired for the extension of transmission lines, while WBSETCL provided cash compensation for agricultural products, trees and so on which were affected by the right of way (ROW), based on Indian laws and regulations.

There was 109 ha area of private land acquired for the construction of substations, for which the State Government of West Bengal took responsibility. There were no forests acquired, and no involuntarily resettlement occurred for the construction of substations.

(3) Unintended Positive/Negative Impacts

Not applicable.

This project has largely achieved its objectives, therefore its effectiveness is high.

3.4 Efficiency (Rating:②)

3.4.1 Project Outputs

This project was to provide a competent electricity transmission network, constructing new substations and expanding the existing substations throughout West Bengal State.

The project outputs planned at the first appraisal in 1996 were: the extension of transmission lines (400 kV level: one double circuit line for 12 km, 220 kV level: one single circuit line for 60 km and three double circuit lines for 14 km in total, 132 kV level: three single

[27] According to the new definition of 2004, a village would be classified if: 1) basic infrastructure such as distribution transformers and distribution lines were provided in the inhabited locality; 2) electricity were provided to public places like schools, local government offices, health centers, dispensaries, community centers etc, and; 3) the number of households electrified made up at least ten% of the total number of households in the village. The village electrification rate is thus different from the population or household electrification rate.
http://www.iea.org/country/Poverty_India/Electrification.pdf (Accessed in May 2012)

[28] http://www.censusindia.gov.in/ (Accessed in May 2012)

[29] Data obtained at WBSETCL in December 2011.

[30] Energy consumption for public lighting, public water works, irrigation and railway traction increased from 82.39 GWh, 140.29 GWh, 814.59 GWh, and 602.62 GWh respectively in 2004 to 117.38 GWh, 207.07 GWh, 1,322.97 GWh, and 801.59 GWh in 2009.

circuit lines for 360 km and eighteen double circuit lines for 524 km), the construction and augmentation of substations (400 kV level: one, 220 kV level: eight, 132 kV level: 23), the installation of microwave communication systems at eleven substations, and the implementation of consultancy services (assistance in procurement, project progress review and monitoring, reporting: 100 M/M in total).

Resulting from the detailed survey, there were changes in the number of transmission lines for more effective and smooth inter connections, in the design of type of tower foundations and structures following the results of detailed soil surveys, and in the routing of transmission lines to mitigate adverse impact. The actual project outputs were: transmission lines (400 kV level: one double circuit line for 10.56 km, 220 kV level: one single circuit line for 73 km and two double circuit lines for 4.56 km in total, 132 kV level: 19 double circuit lines for 690.8 km with two single circuit lines associated), the construction and augmentation of substations (400 kV level: one extension, 220 kV level: six constructions, 132 kV level: 16 constructions and eight bay extensions), the installation of microwave communication systems was reduced at ten substations, the establishment of DAS at five substations including the procurement of equipment and materials, and the implementation of consultancy services for 110 M/M in total with additional assignment for monitoring the project impacts through the operation and effect indicators at five substations and drawing recommendations on monitoring methods.

Source: Study Team

Picture 4: Microwave communication system at Howrah substation / WBSDCL

3.4.2 Project Inputs

3.4.2.1 Project Cost

The actual project cost was 13,385 Japanese million yen, against the 28,322 million yen planned project cost, which is 47.3% of the planned cost. The disbursed amount of the Japanese ODA assistance loan was 12,736 million yen against the approved amount of 14,214 million, which was also within the planned budget (89.6%).

Table 7: Planned and Actual Project Cost

Items		Plan			Actual
		Foreign Currency (Mil. Yen)	Local Currency (Mil. Yen)	Total (Mil. Yen)	Total (Mil. Yen)
1	Transmission lines	1,651	789	4,128	2,788
2	Substations	7,595	1,613	12,659	8,704
3	Land acquisition	0	63	198	130
4	Taxes and duties	0	765	2,402	792
5	Administration	0	652	2,049	
6	Contingencies	694	239	1,445	
7	Consulting services	294	6	314	130
8	Price escalation	665	1,016	3,854	247
9	Interest during construction	1,274	0	1,274	594
Total		12,174	5,143	28,322	13,385

Source: JICA appraisal documents and WBSETCL.

Note 1: The planned project cost estimated at the first appraisal in 1996 was the planned cost for the plan-actual comparison in this ex-post evaluation. The exchange rate was INR 1= JPY 3.14 (May 1996).

Note 2: Taking into consideration the fact that there was a wide range of fluctuation between the INR and USD, and

the JPY and USD exchange rates during the project period, the exchange rates applied for converting the actual cost into Japanese yen were taken from the average annual rates issued by IMF in the International Financial Statistics; Yearbook from 1995 to 2009.

Note 3: As there was no common definition for the expenditures of foreign currency and local currency, a comparison between the planned and actual costs in two currencies was not viable.

Based upon interviews with WBSETCL, it was seen that some components originally planned for international competitive biddings (ICB) were carried out through local competitive biddings (LCB), which contributed to the reduction in the bidding prices. Also, the yen value steadily appreciated against the Indian rupee throughout the project implementation period, which resulted in far lower costs converted into yen.

The actual project cost was thus lower than planned.

3.4.2.2 Project Period

The actual project implementation period was 153 months from February 1997 (project start[31]) to October 2009 (project completion[32]) against the 55 months planned project period from February 1997 to August 2001. This was far longer than planned (278%).

Table 8: Comparison of the Planned and Actual Project Periods

	Plan	Actual
Signing of the loan agreement of IP-P117	Feb 1997	Feb 1997
Procurement of equipment and construction	Mar 1997 to Feb1999	Jun 1997 to Jul 2004
Transmission lines	Mar 1999 to Aug2001	Aug 1999 to Dec2004
Substations	Mar 1999 to Aug 2001	Mar 2000 to Dec2005
Electrical works	Mar 1999 to Aug 2001	Mar 2000 to Mar 2006
Microwave communication	-	Jun 2003 to Nov2006
Operation and effect indicators	-	Jan2008 to Oct 2009
Project completion	Aug 2001	Oct 2009

Source: JICA appraisal documents and WBSETCL.

Major causes of delay in project implementation were: i) due to dialog with local residents taking longer than expected; ii) the fact that WBSETCL had to change the transmission route; ii) the type of tower foundations and structures had to be changed following the results of detailed soil surveys; iii) the fact that land filling work could not be carried out as scheduled during the monsoon months; iv) the commencement of construction work for substations was delayed because it took longer for land acquisition and bidding process. It took approximately four years from the signing of the loan agreement until the commencement of construction work. Substations and transmission lines commenced operations one after another between 2003 and 2007, but it was 2009 when WBSETCL completed all the project components including the launch of the microwave communication package, the planning and implementation of TQM and the procurement of equipment and materials for the operation and effect indicators.

The project period was thus significantly longer than planned.

3.4.3 Results of Calculations of Internal Rates of Return (IRR)

3.4.3.1 Financial Internal Rate of Return

The original FIRR was 13% at the time of the first project appraisal in 1996, and this was updated to 10.4% in the second appraisal in 2001. Due to the fact that data needed for quantitative analysis was not available at WBSETCL, analysis for FIRR was not possible in this

[31] The project start was defined as the signing of the loan agreement of ID-P117.

[32] The project completion was defined as the actual completion of the entire scope of work as per the General Condition of Contract.

ex-post evaluation.

The FIRR calculation at appraisal was based upon the pre-conditions below:

- Cost: project cost (including interest) during construction, operation and maintenance cost.
- Benefit: reduction in transmission losses, additional units of electricity transmitted.
- Project life: 35 years after commencement of commercial operation.

3.4.3.2 Economic Internal Rate of Return

The original EIRR was 15% at the time of the first appraisal, and this was also updated, to 29.5% in the second appraisal. Due to the fact that data needed for quantitative analysis was not available at WBSETCL, analysis for EIRR was not possible in this ex-post evaluation.

The EIRR calculation at appraisal was based upon the pre-conditions below:

- Cost: initial investment cost and operation and maintenance cost, excluding taxes and duties
- Benefit: energy saving effects, induced effects, and alternative effects
- Project life: 35 years after commencement of commercial operation

Although the project cost was within the plan, the project cost exceeded it. Therefore the efficiency of the project is fair.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

The West Bengal State Electricity Board (WBSEB), which was this project's executing agency, was unbundled into the West Bengal State Electricity Transmission Company Ltd. (WBSETCL) and the West Bengal State Electricity Distribution Company Ltd. (WBSEDCL) in April 2007[33].

With this unbundling, WBSETCL succeeded this project. Since its establishment, WBSETCL has standardized policies, procedures and manuals, with which they have improved corporate management. The total quality management program (TQM) introduced under this project remains active at WBSETCL and 'quality circles' have been formed at substation level and compete each other to solve work-related problems through the identification of root causes and solutions, and the review and follow-up of activities. TQM has contributed greatly to the improvement of WBSETCL's management, and it was awarded ISO9001:2000[34] in 2009.

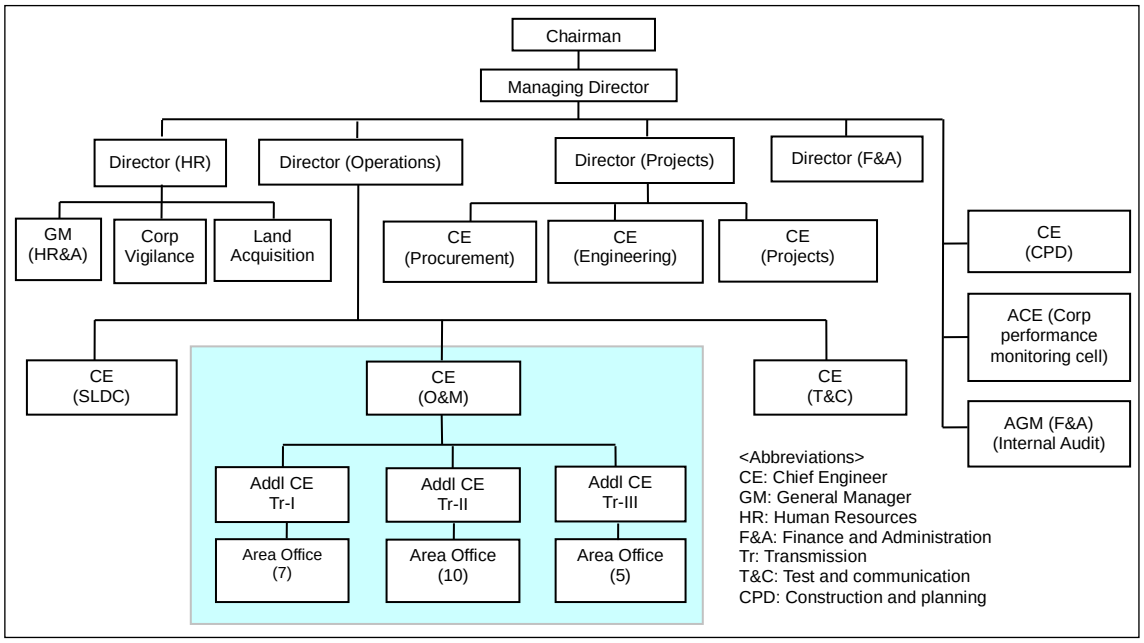
Source: Study Team
Note: The quality policy is also kept at other stations.

Picture 5: Quality Policy kept at Arambag Substation

[33] The Government of India and the State Governments have worked since the late 1990s on the establishment of the state electricity regulatory commissions, the establishment and disclosure of tariff regulations for transparency, the corporate reform of distribution companies through private investments, and the abolition of state subsidies. Unbundling WBSEB was part of a nation-wide power sector reform, and fourteen states had already completed the separation of power generation, transmission and distribution into separate corporations. It became obligatory to establish electricity regulation commissions at state level each with the role of regulating the tariff policies of public and private utilities by each state. Central Government initiated the Accelerated Power Development and Reform Programme (APDRP) in 2001 for the improvement of transmission and distribution network systems and the reduction of T & D commercial losses. The APDRP has been implemented up to present.

[34] A qualification for an organization to establish, document, implement and sustain the Quality Management System

As of 2011, there were 343 engineers at all levels, 18 staff at manager level, 156 staff at supervisor level 1,154 technicians, 203 supporting staff, 309 office staff, and 50 office attendants[35]. The monitoring of scheduled maintenance is conducted by the Chief Engineer for Transmission (O&M) and the staff at area offices underneath him (See Figure 5).



Source: WBSETCL. "Annual Report & Accounts 2010-2011 (2011).

Figure 5: Organization Chart of WBSETCL

WBSETCL has been better established since unbundling in 2007 and no particular problem has been observed in its structural aspects.

3.5.2 Technical Aspects of Operation and Maintenance

WBSETCL received the Best Power Availability Award in 2007/2008 as the sole power transmission utility, and its 13 EHV substations were awarded ISO9001:2000. WBSETCL has provided internal and external training opportunities to its staff. Consultation with staff to understand their training needs has often been conducted since establishment.

Data acquisition systems (DAS) have been installed at five monitoring substations under this project, with which the occurrence, frequency, time and place of power outages are precisely recorded, for instance, to analyze ways to solve problems. WBSETCL will launch another pilot activity in which they will introduce DAS at a substation in 2012, and there is no particular problem seen in the technical aspects of WBSETCL.

3.5.3 Financial Aspects of Operation and Maintenance

The operation and maintenance budget of WBSETCL as a whole for transmission and substation utilities has increased each year. The depreciation budget has been firmly secured in the total O&M budget and has been used to keep the facilities and equipment in good condition (Table 9).

(QMS). Process-approach is applied, and tangible processes in organizations are established, to understand mutual relations in order to improve the effectiveness of QMS. Certification is made for ISO9001:2000 when organizations are deemed to have applied a series of processes as a system in an appropriate way.

[35] Data obtained at WBSETCL in December 2011.

Table 9: Operation and Maintenance Budget of WBSETCL after Unbundling

Unit: Million Rs

	2007/08		2008/09		2009/10		2010/11		2011/12		2012/13	
	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual
1. Transmission Expenses	127.18	126.92	138.10	175.00	169.00	191.12	191.10	239.99	229.72	-	244.36	-
2. Remuneration	483.90	550.30	774.00	1,081.96	849.00	930.59	1,269.15	1,150.13	1,256.55	-	1,380.60	-
3. Depreciation	871.70	817.02	1,057.10	897.53	1,230.20	1,118.93	1,403.30	1,200.12	1,260.34	-	1,567.39	-
4.Interest & Financial Charges	1,275.27	1,551.37	1,990.30	1,767.31	1,852.30	1,966.83	1,808.70	1,828.73	2,520.31	-	2,610.72	-
5.Provisions	2.90	6.48	124.50	245.59	137.10	541.28	144.20	420.75	983.44	-	758.83	-
6. Prior Period Adjustments (net)	-	-	-	(62.50)	-	30.40	-	0.64	-	-	-	-
7. Capital Expenses	8,398.40	6,711.18	7,165.40	5,118.42	8,729.30	2,851.94	9,278.60	4,363.02	8,104.76	-	9,245.03	-
8. Rebate on Prompt Payments	-	-	-	5.44	-	7.18	-	7.51	-	-	-	-
Total	11,159.35	9,763.207	11,249.40	9,228.75	12,966.90	7,638.27	14,095.05	9,210.89	14,355.12	0.00	15,806.93	0.00

Source: WBSETCL.

Regarding the profits and losses of WBSETCL, Table 10 shows the revenue from operations firmly increasing year by year. The financial self-sufficiency of WBSETCL is high as expenditure on transmission charges has been kept well below the revenue from operations. Depreciation has been sensibly spent on replacing and/or improving facilities and equipment for transmission lines and substations. Profit before tax and prior period adjustments have been secured at over 2,000 million rupees since 2008, and WBSETCL is deemed to have been in a favorable condition in terms of profit making since unbundling.

Table 10: Profit and Loss of WBSETCL

Unit: Million Rs

	2007/08	2008/09	2009/10	2010/11	2011/12
Income	4,369.4	6,740.2	7,295.6	7,655.4	N/A
Revenue from operations	*4,280.4*	*6,664.4*	*7,212.8*	*7,485.3*	*N/A*
Expenditure	3,549.6	4,538.2	5,177.7	5,490.4	N/A
Transmission charges	*353.1*	*423.7*	*661.3*	*588.7*	*N/A*
Depreciation	*817.0*	*897.5*	*1,118.9*	*1,200.1*	*N/A*
Profit before Tax and Prior Period Adjustments	819.7	2,202.1	2,117.9	2,165.0	
Profit before Tax	819.7	2,139.6	2,148.3	2,165.6	N/A
Profit after Tax (Net Profit)	813.2	1,894.3	1,746.8	1,744.9	N/A

Source: WBSETCL. Annual Report & Accounts (2010-2011, 2009-2010, 2008-2009, 2007-2008)

Table 11 shows that the net cash from operating activities between 2007 and 2010 remained stable (at more or less 5 billion rupees). Net cash flow has been on the increase since 2009, and no particular cash flow problems have been observed at WBSETCL.

Table 11: Cash Flow of WBSETCL

Unit: Million Rs

	2007/08	2008/09	2009/10	2010/11	2011/12
Net Cash from Operating Activities (A)	5,406.7	4,966.3	4,618.3	5,940.9	N/A
Net Cash Generated from Investment Activities (B)	-6,700.3	-4,568.2	-2,819.5	-4,249.7	N/A
Net Cash from Finance Activities (C)	1,511.4	-639.8	-1,295.9	-1,599.7	N/A
Net Increase (Decrease) in Cash & Cash (A+B+C)	217.8	-241.7	502.9	91.5	N/A
Cash & Cash Equivalents at the Beginning of the Year	231.8	449.6	207.9	710.8	N/A
Cash & Cash Equivalents at the End of the Year	4,49.6	207.9	710.8	802.3	N/A

Source: WBSETCL. Annual Report & Accounts (2010-2011, 2009-2010, 2008-2009, 2007-2008)

Regarding the financial status of WBSETCL (Table 12), fixed assets and fixed liabilities far exceeded current assets and current liabilities respectively, which reflects the nature of power transmission utilities that own a large amount of fixed assets and require long-term investment. Although liabilities stayed significantly larger than equity since unbundling, the analysis is that WBSETCL will continue to grow steadily as the equity to assets ratio has remained at approximately 30% every year (see Table 13). The equity growth rate shows an annual increase of over ten%, although it was down in 2010/11, which shows the company's firm growth.

Table 12: Balance Sheet of WBSETCL

Unit: Million Rs

	2007/08	2008/09	2009/10	2010/11	2011/12
Total Assets	33,536.7	38,270.1	41,249.8	43,927.5	N/A
Fixed Assets	*30,497.4*	*34,205.5*	*37,243.0*	*39,838.9*	*N/A*
Current assets, loans & advances	*3,039.3*	*4,064.6*	*4,006.8*	*4,088.6*	*N/A*
Total Liabilities	24,319.6	26,174.0	27,406.9	28,288.4	N/A
Current liabilities and provisions	*3,595.4*	*4,322.3*	*3,579.8*	*4,744.6*	*N/A*
Loan funds	*20,724.2*	*21,851.7*	*23,827.1*	*23,543.7*	*N/A*
Total Equity	9,217.1	12,096.1	13,842.8	15,639.1	N/A
Shared capital	*10140.0*	*11055.2*	*11055.2*	*11,055.20*	*N/A*
Government grants			*0*	*51.4*	*N/A*
Total Liabilities and Equity	33,536.7	38,270.1	41,249.8	43,927.5	N/A

Source: WBSETCL. Annual Report & Accounts (2010-2011, 2009-2010, 2008-2009, 2007-2008)

Table 13: Major Financial Indicators of WBSETCL

Indicators	2007/08	2008/09	2009/10	2010/11	2011/12	Note
Return on Assets (ROA)	2.44%	5.75%	5.13%	4.93%	N/A	Ordinary Profit / Assets
Current Ratio	84.53%	94.04%	111.93%	86.17%	N/A	Current Assets / Current Liabilities
Fixed Ratio	330.88%	282.78%	269.04%	254.74%	N/A	Fixed Assets / Equity
Equity to Assets Ratio	27.48%	31.61%	33.56%	35.60%	N/A	Equity / Assets
Equity Growth Rate	-	31.23%	14.44%	12.98%	N/A	-
Profit Growth Rate	-	168.65%	-3.82%	2.22%	N/A	-

Source: WBSETCL. Annual Report & Accounts (2010-2011, 2009-2010, 2008-2009, 2007-2008)

The financial status of WBSETCL is deemed fair and there is no particularly serious problem with its financial aspect. The operation and maintenance budget is firmly secured for

all the facilities and equipment including those of this project, and the financial condition of WBSETCL since unbundling has shown its growth.

3.5.4 Current Status of Operation and Maintenance

WBSETCL has exercised daily and monthly routine check-ups at each facility. Breakdown maintenance is carried out as and when required for the prompt restoration of the system. Annual maintenance is based upon preventative maintenance following the WBSETCL maintenance manual for all substation facilities and equipment and transmission lines. Condition-based predictive maintenance of EHV equipment is also carried out when scheduled.

The five monitoring substations under this project have been computerized and data acquisition systems (DAS) have replaced log-sheets, which required manual input. Outage hours, both forced and planned, are now recorded at second level, and other various data are recorded in real time and in a precise manner. This helps the analysis of and the solution of problems at substations. No particular problems have been found regarding the present status of the operation and maintenance of the project facilities.

No major problems have been observed in the operation and maintenance system, therefore the sustainability of the project effect is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was implemented to enhance the reliability of the transmission network system, to reduce transmission losses and voltage fluctuations, and to make intra-state electricity transmissions efficient through the provision of a competent electricity transmission network, the construction of new substations and the expansion of existing substations in West Bengal State. It has been highly relevant to India's development plan and development needs. Facilities provided under the project have been operated well, and the project has highly improved the reliability of the transmission network system, and has promoted reductions in transmission losses and in voltage fluctuation. The project has thus largely achieved its objectives, and its effectiveness is high. It is judged that the project has contributed directly indirectly to industrial development, employment creation and the improvement of people's living standards in the State. The project cost was within the plan, although the project period exceeded the plan, therefore the project efficiency is fair. The project sustainability is deemed high in the organizational, technological and financial aspects, and the O&M condition of project facilities and equipment is good.

In light of the above, this project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

In order to manage the transmission network system more efficiently and precisely, it is recommended that DAS be among the facilities pre-requisite to all substations developed near future. As the amount of information grows rapidly, the augmentation and installation of more advanced communication systems than microwave is highly desirable and is for immediate consideration.

4.2.2 Recommendations to JICA

The distribution losses in West Bengal State improved from 24.6% (2007/08) to 22.0% (2012/13 projected). There is still, however, space for improvement in reducing technical and non-technical losses, dealing with unauthorized connections, power theft and so on. It is

recommended that JICA continue dialog with WBSETCL and related power utilities in the State to consider how the output, effectiveness and impact of this project can be further shared for the best interests and benefit of all kinds of consumers.

4.3 Lessons Learned

・ Introduction of pilot activities in an appropriate manner and with the appropriate processes

In addition to the main components of this project, data acquisition systems (DAS) were introduced to five substations in the WBSETCL transmission network system for the measurement of the operation and effect indicators. Prior to that, human errors could have occurred at any time as data recording was less developed. WBSETCL can now analyze problems and examine solutions by detecting any failures in the transmission network. The DAS have helped WBSETCL improve quality management and technology, and have made their work more efficient. This has provided a good lesson for WBSETCL as a pilot activity. It was also realistic and more feasible to limit the number of substations to only five when introducing the DAS, which also helped WBSETCL to minimize costs and human resources in conducting this pilot activity.

It is thus desirable, when similar transmission projects are processed and implemented near future, to provide a comprehensive package with a viable volume of pilot activities for more effective infrastructure development through a thorough analysis of the financial condition and human resource allocation of the executing agency.

・ Assistance for improvement of organizational sustainability

JICA has conducted the Special Assistance for Project Implementation for the West Bengal Transmission System Project (II), in which total quality management (TQM) was introduced and acquired by WBSETCL staff. WBSETCL created “quality circles” at substation level to improve management. The enhancement of the sense of responsibility of staff and increases in their awareness of the necessity of improving operation and maintenance has led to ISO9001:2000 certification and to other Indian awards.

Along with infrastructure development, it is thus desirable that institutional development and O&M improvement for the executing agency is taken into account in future project processing and project implementation.

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
1. Project Outputs	(1) Transmission lines ・400 kV D/C line x 1 (12 km) ・220 kV S/C line x 1 (60km), D/C line x 3 (14km) ・132 kV D/C & S/C line x 19 lines (884 km) (2) Substations ・400 kV S/S: 1 station (expansion) ・220 kV S/S: 6 new stations and 2 stations with expansion ・132 kV S/S: 16 new stations and 7 stations with expansion (3) Microwave Communication System ・11 stations (4) Consultancy service ・Assistance for procurement, project monitoring, and reporting:100 M/M in total	(1) Transmission lines ・400 kV D/C line (10.56km) ・220 kV D/C & S/C line x 3 (77.562km) ・132 kV D/C & S/C line x 19 lines (690.7975km) (2) Substations ・400 kV S/S: as planned ・220 kV S/S: 6 stations ・132 kV S/S 24 stations (3) Microwave Communication System ・10 stations (4) Consultancy service Assistance for procurement, project monitoring, monitoring of the operation and effect indicators and reporting:110 M/M in total
2. Project Period	February 1997 – August 2001 (55 months)	February 1997 - November 2006 (153 months)
3. Project Cost		
Amount paid in Foreign currency	12,174 million yen	Not applicable
Amount paid in Local currency	16,148 million yen	Not applicable
	(5,143 million Indian Rupees)	Not applicable
Total	28,322 million yen	13,385 million yen
Japanese ODA loan portion	14,214 million yen	12,736 million yen
Exchange rate	1INR= 3.14 yen (As of May 1996)	1INR = 2.65 yen (Average between 1995 and 2009)