

India

Ex-Post Evaluation of Japanese ODA Loan

“Rural Electrification Project”

External Evaluator: Keishi Miyazaki, OPMAC Corporation

0. Summary

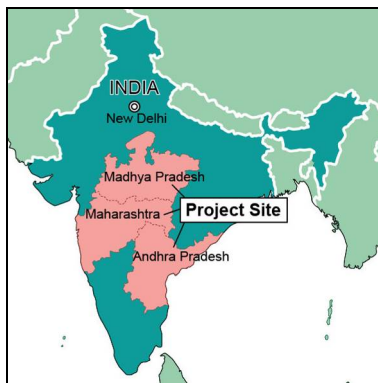
The objective of this project was to stabilize the transmission and distribution system and to expand access to electricity for un-electrified rural households, by constructing and augmenting substations and associated distribution lines in the three target states of India: Andhra Pradesh, Madhya Pradesh and Maharashtra. This project matched the Indian national development policy and development needs as well as Japan's ODA policy at the appraisal, therefore its relevance is high. The project cost was within the plan, but the project period significantly exceeded the plan, therefore the efficiency of the project is fair. The project outputs were altered in response to some situational changes during project implementation.

The operation and effect indicators such as the system average interruption duration index (SAIDI), the household electrification rate, distribution loss, the bill collection rate, and the electricity sales volume attained their respective target values. An estimate of 2.9 million rural households were newly electrified by this project. A large contribution was made to this achievement by some external factors such as the implementation of Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), a rural electrification scheme of the government of India, improvement in distribution losses by each distribution company, improvement in bill collection methods, and the implementation of appropriate maintenance. The beneficiary survey revealed that there were some positive impacts on the economic and social aspects which improved the living standards of local residents such as increased information access, improved safety after dark, education, hygiene and sanitary conditions, public services, vitalized social activities, and decreased poverty. No negative impact on the natural environment was observed, and the land acquisition was executed according to the related Indian domestic laws. There was no resettlement for this project. Therefore, the effectiveness and impacts of this project are high.

As for sustainability of the project effects, no major problems have been observed in the institutional, technical, and financial aspects of the operation and maintenance system, and the project facilities have been maintained in good condition. Therefore, sustainability of the project effect is high.

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

1. Project Description



Project Location



A substation constructed by the project
(Andhra Pradesh State)

1.1 Background

In 2005, urban areas of India had achieved a household electrification rate of 88%. On the other hand, the household electrification rate of rural areas, which make up 72% of the overall population of the country, still remained at 44%, and approximately 78 million households were un-electrified. Each of the three target states of the project, Andhra Pradesh, Madhya Pradesh and Maharashtra, had more than 3 million households (2001) that were un-electrified. This was considered as one of the factors that caused disparity between urban and rural areas, and an improved household electrification rate in rural areas was demanded in order to achieve disparity rectification as well as balanced and continuous development.

1.2 Project Outline

The objective of this project was to stabilize the transmission and distribution system (relieving the existing overloaded system and reducing transmission and distribution losses), and to expand access to electricity for un-electrified rural households by constructing and augmenting substations and associated distribution lines in the three target states¹ of India: Andhra Pradesh, Madhya Pradesh and Maharashtra, thereby contributing to improvement in the living standards of local residents and vitalizing local economic and social activities.

¹ Andhra Pradesh State was divided into two states in June 2014, Telangana State in the north and Andhra Pradesh State in the south, so there were 4 target states at the time of the ex-post evaluation. In the ex-post evaluation report, 3 states were referred to as the project target states in the relevancy and efficiency sections, and 4 states including Telangana State were referred to as necessary in the effectiveness, impacts and sustainability sections.

Loan Approved Amount/ Disbursed Amount	20,629 million yen / 16,949 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2006 / March 2006
Terms and Conditions	<div>Interest rate 0.75 %</div> <div>Payment period 15 years</div> <div>(Grace period: 5 years)</div> <div>Condition for Procurement General untied</div>
Borrower / Executing Agency	Rural Electrification Corporation (REC) / REC
Final Disbursement Date	August 2012
Main Contractor (Over 1 billion yen)	Larsen & Toubro Ltd. (India)
Main Consultant (Over 100 million yen)	-
Feasibility Studies, etc.	<ul style="list-style-type: none"> • Feasibility Study (F/S): REC (May 2005) • Related study: Development study on the improvement of the power distribution system of Andhra Pradesh in India (2001-2003).
Related Projects	-

2. Outline of the Evaluation Study

2.1 External Evaluator

Keishi Miyazaki (OPMAC Corporation)

2.2 Duration of the Evaluation Study

Duration of the Study: August 2014 - September 2015

Duration of the Field Study: November 29 - December 27, 2014, March 8 - 21, 2015

3. Results of the Evaluation (Overall Rating: A²)

3.1 Relevance (Rating: ③³)

3.1.1 Relevance to the Development Plan of India

(1) National Development Plan

At the time of project appraisal (2006), the Tenth Five-Year Plan (2002-2007) stated that electrification in rural areas was one of the most important rural development issues. The New Electricity Act (2003) stated that the promotion of electrification in rural areas was an obligation for the central and local governments. Rajiv Gandhi Grameen Vidyutikaran

² A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

³ ③: High, ②: Fair, ①: Low.

Yojana (RGGVY) which was established in April 2005 aimed to secure electricity access for all rural households in India by 2009. RGGVY was to support the construction or augmentation of distribution lines and substations necessary for household electrification, as well as providing equipment for individual house connections of electricity for the poor at no cost. Financing of 160 billion rupees by RGGVY was planned⁴.

The objective of this project was to expand the electricity access of un-electrified rural households in the three target states of India by constructing or augmenting distribution lines and substations; therefore the project was consistent with the above mentioned Tenth Five-Year Plan, and with the New Electricity Act as well as RGGVY.

At the time of the ex-post evaluation, the Twelfth Five-Year Plan (2012-2017) stated that a stable electricity supply was essential to all economic activities as well as to inclusive growth, and that access to electricity by the nation was one of the most important issues. The Twelfth Plan aims to raise the electrification rate in urban areas from 92% to 94% and in rural areas from 55% to 67.3% during its period. For this reason, the government of India continues to promote RGGVY during the Twelfth Five-Year Plan, which includes the electrification of another 8,299 rural villages, the complete electrification of 153,811 partially electrified villages and the electrification of 8.14 million rural households below the poverty line (BPL households). As of February 2014, 110,000 un-electrified villages and 22.9 million un-electrified rural households below the poverty line had been electrified by RGGVY.

After the regime change in June 2014, Deendayal Upadhyaya Gram Jyoti Yojana⁵ (DDUGJY) which was a new rural electrification scheme replacing RGGVY was endorsed by the Cabinet on November 20, 2014. While the existing RGGVY targeted mainly electrification of villages and BPL households in rural areas, DDUGJY expanded its target to electrification of all households in rural areas including BPL households, in addition to system strengthening and feeder separation for agricultural consumers. All planned projects under RGGVY will be integrated into DDUGJY, and are expected to be implemented.

Rural electrification continues to be a priority in India's national development plan, and it was consistent with the objective of this project at the time of the ex-post evaluation.

3.1.2 Relevance to the Development Needs of India

In 2005, urban areas of India had achieved a household electrification rate of 88%. On the other hand, the household electrification rate in rural areas, which make up 72% of the overall population in the country, still remained at 44% and approximately 78 million households were un-electrified. In each of Andhra Pradesh, Madhya Pradesh and

⁴ 90% of the fund for rural electrification provided by RGGVY was determined to be a subsidy with no repayment obligation and 10% to be a loan.

⁵ The budget for DDUGJY is 430.33 billion rupees, of which the central government provides 334.53 billion rupees.

Maharashtra, the three target states of the project, there were more than 3 million households that were un-electrified (2001). For this reason, the need for the further promotion of rural household electrification and disparity rectification of electrification rate between urban and rural areas were required in order to achieve balanced and sustainable development.

If the household electrification project were to be implemented, it was considered that the three states, Andhra Pradesh, Madhya Pradesh and Maharashtra, would see significantly improved household electrification and high sustainability. For the most part they had achieved rural electrification, their existing loan repayment status from REC was good and there were many un-electrified rural households. For the above reasons, they were chosen by REC as the target states for the project.

The objective of this project was to expand the electricity access of un-electrified rural households in the three target states of India by constructing or augmenting distribution lines and substations; therefore it is consistent with the above mentioned development needs.

At the time of the ex-post evaluation, the household electrification rate of both urban and rural areas in the three target states had improved to 92% in Andhra Pradesh, 67% in Madhya Pradesh and 84% in Maharashtra. As for the electrification of rural areas, this had improved to 90% in Andhra Pradesh, 58% in Madhya Pradesh and 74% in Maharashtra. On the other hand, the electricity supply and demand gap in Andhra Pradesh had slightly expanded, from -4.4% in 2006/07 to -6.9% in 2013/14; however it has greatly improved in Madhya Pradesh from -15.18% in 2006/07 to -0.05% in 2013/14 and in Maharashtra from -18.97% in 2006/07 to -2.07% in 2013/14. Power shortages were alleviated for the latter two states (Figure 1). However, the target set by the government of India, which aimed to bring up the household electrification rate in rural areas to 100% had not been achieved in the three target states at the time of the ex-post evaluation, and the household electrification disparity between urban and rural areas still existed; therefore it is necessary to continue the promotion of rural electrification in the three target states.



Source: Central Electricity Authority, Ministry of Power
 Note: 1 MU (Mega Unit) is equivalent to 1,000,000 KWh.

Figure 1: Demand and Supply Gap in the Three Target States

3.1.3 Relevance to Japan's ODA Policy

At the appraisal, the following three items were listed as priority targets in the Japanese Country Assistance Program for India (established in May 2006): (i) Promoting economic growth through support for power and transportation infrastructures, (ii) Improvement of poverty and environmental issues through support for health and sanitation, regional development, water and sewer services, and afforestation, and (iii) Support for the expansion of human resourced development and personal exchanges. This project was implemented along (i) of the above mentioned priority targets.

The power sector was categorized as a main sector for Japan's ODA loan in JICA's County Assistance Strategy for India 2005, and "Economic vitalization through a stable power supply and developing distribution lines and rural electrification to reduce poverty" was stated as a priority in assistance. From the above, it is clear that this project was consistent with Japan's ODA policy.

In the light of the above, this project has been highly relevant to India's development plan and development needs, as well as to Japan's ODA policy; therefore its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

This project was to newly construct and augment substations for power distribution (33KV/11KV) as well as to construct 33KV/11KV distribution lines in the three target states of Andhra Pradesh, Madhya Pradesh and Maharashtra. The outputs for each component are shown below (Table 1-Table 4).

Initially the project was divided into two phases (Phase 1 and Phase 2) according to the timing of procurement. Meanwhile, since there was an additional outputs in this project, this ex-post evaluation report mentions Phase 3 for additional outputs in order to distinguish the outputs of Phase 1 and Phase 2.

Table 1: Newly Constructed Substations (33KV/11KV) (Plan/Actual)

Unit: number of substations

Service Area of Distribution Company		Plan			Actual				Gap
		Phase 1	Phase 2	Total	Phase 1	Phase 2	Phase 3	Total	
AP State	North	95	90	185	95	90	-	185	0
	Central	42	54	96	41	54	-	95	-1
	East	50	50	100	47	49	-	96	-4
	South	50	50	100	50	49	97	196	+96
	Total	237	244	481	233	242	97	572	+91
MP State	Central	24	12	36	36	0	-	36	0
	West	50	27	77	74	0	-	74	-3
	East	37	35	72	37	35	-	72	0
	Total	111	74	185	147	35	-	182	-3
Maharashtra State		40	57	97	18	0	-	18	-79
Total		388	375	763	398	277	97	772	+9

Source: JICA internal documents and response to questionnaires.

Note 1: AP State: Andhra Pradesh State, MP State: Madhya Pradesh State

Note 2: Phase I is the first procurement package and Phase II is the second procurement package.

Note 3: The output of this project is the 97 substations that were completed by August 2012, which was the expiry date of the loan agreement although the number of newly constructed substations in AP state as an additional output (Phase III) was 124. The remaining 27 substations were implemented with India's own finance, and 24 had been completed as of October 2014, with 3 to be completed in January 2015.

In the overall project, the actual number of newly constructed substations was 772 in comparison to the plan of 763, which was an increase of 9 sites. One noted significant change was that 79 sites were cancelled in Maharashtra. At the appraisal, there were rural electrification schemes supported by the government of India other than this project in Maharashtra. These schemes were Infrastructure Plan I⁶ which constructs and expands substations and develops power distribution networks within the state, and the AG Pump

⁶ 20% of the Infrastructure Plan I (2007-2008) project fund was a subsidy from the Indian government, and 80% was a loan from REC or Power Finance Corporations (PFC). In Maharashtra, 600 newly constructed substations, 501 augmented substations, 70,903 transformers, 43,458 km high-voltage distribution lines and 12,116 km low-voltage distribution lines were developed by Infrastructure Plan I.

Backlog Scheme⁷ which develops the power distribution network to regions that were lagging behind in the electrification of agricultural pumps. For this reason, Maharashtra state implemented a rural electrification scheme of the government of India to construct 79 new substations that were urgent out of the 97 substations that were originally planned, instead of using Japan's ODA loan project which would take a certain amount of time for procedures⁸. Therefore, the newly constructed substations of this project were reduced to 18 sites from the original plan of 97 sites in Maharashtra.

In southern Andhra Pradesh, the new construction of 97 substations was added as Phase 3 using a residual fund of the project that was caused by output changes such as the reduced number of substations and other components as well as fluctuations in the foreign currency exchange rate. For other areas, the target number has been reduced due to difficulties in land acquisition for the construction of substations and adjustment with other rural electrification projects. In addition, many substations have been constructed in different locations from the original plan.

Table 2: Augmented Substations (33KV/11KV) (Plan/Actual)

Unit: number of substations

Service Area of Distribution Company		Plan			Actual				Gap
		Phase 1	Phase 2	Total	Phase 1	Phase 2	Phase 3	Total	
AP State	North	61	0	61	57	0	-	57	-4
	Central	43	44	87	43	44	-	87	0
	East	46	45	91	46	47	-	93	+2
	South	15	15	30	15	15	-	30	0
	Total	165	104	269	161	106	-	267	-2
MP State	Central	12	11	23	21	0	-	21	-2
	West	0	0	0	0	0	-	0	0
	East	16	14	30	16	16		32	+2
	Total	28	25	53	37	16	-	53	0
Maharashtra State		80	53	133	17	0	-	17	-116
Total		273	182	455	215	122	-	337	-118

Source: JICA internal documents and responses to questionnaires.

Note : AP State: Andhra Pradesh State, MP State: Madhya Pradesh State

For the overall project, the number of augmented substations was reduced to 337 sites from the 455 sites of the plan, which was a reduction of 118 sites in total. In Maharashtra,

⁷ The AG Pump Backlog Scheme promotes electrification in 18 districts of Maharashtra state where the electrification of agricultural pumps was delayed, and 100% of the project fund was a subsidy from the Indian government. In Maharashtra, the construction of 46 new substations, the augmentation of 57 substations, 8,866 transformers, 5,211 km of high-voltage distribution lines and 12,811 km of low-voltage distribution lines as well as the electrification of 134,216 agricultural pumps was conducted in the 8 years from 2005/06 to 2013/14 using this scheme.

⁸ Of the 79 cancelled new substations, 52 were developed by Infrastructure Plan I and 27 by the AG Pump Backlog Scheme.

the number of augmented substations of the project was reduced to 17 sites from 133 sites, due to the same reason as for the drastic cut in newly constructed substations⁹. For other areas, the number of target sites fluctuated due to adjustment with other rural electrification projects.

Table 3: 33KV Distribution Lines (Plan/Actual)

Unit: Km

Service Area of Distribution Company		Plan			Actual				Gap
		Phase 1	Phase 2	Total	Phase 1	Phase 2	Phase 3	Total	
AP State	North	744	616	1,360	462	425	-	887	-473
	Central	325	386	710	220	263	-	483	-227
	East	400	400	800	287	257	-	544	-257
	South	275	263	538	208	224	506	938	+400
	Total	1,744	1,665	3,408	1,177	1,169	506	2,852	-556
MP State	Central	188	157	345	378	0	-	378	33
	West	315	319	634	442	42	-	484	-150
	East	340	286	626	400	0	-	400	-226
	Total	843	762	1,605	1,220	42	-	1,262	-343
Maharashtra State		400	570	970	143	0	-	143	-827
Total		2,987	2,997	5,983	2,540	1,211	506	4,257	-1,726

Source: JICA internal documents and responses to questionnaires.

Note : AP State: Andhra Pradesh State, MP State: Madhya Pradesh State

For the overall project, the distance of constructed 33KV distribution line was 4,257 km against the plan of 5,983 km, which was a reduction of 1,726 km. The increase of 400 km in the 33KV distribution line in southern Andhra Pradesh was due to the additional 97 newly constructed substations. The 827 km decrease in Maharashtra was due to the cancellation of the constructions of 79 substations and 116 augmented constructions of substations.

For other areas, there was no significant change in the amount of new and augmented construction of substations. However, many of the new substations were constructed in different locations from the original plan due to difficulties in land acquisition or the construction of a substation near the planned site through other rural electrification projects. Due to this, the route of the 33KV distribution line has been significantly altered. In addition, there were places where obtaining the permit for constructing distribution lines was difficult and in some sections it was necessary to alter the route¹⁰. For these reasons, there was a gap between the planned and actual construction distance of the 33KV distribution line.

⁹ Of those 116 cancelled new substations, 91 were developed by Infrastructure Plan I and 25 by the AG Pump Backlog Scheme.

¹⁰ For example, the target regions in Maharashtra had relatively large urban areas, and there were many places where it was difficult to obtain the right-of-way (ROW) when a distribution line crossed a road or railway. It was also reported that there were some land owners in rural regions who did not agree with distribution lines passing over their sites or fields.

Table 4: 11KV Distribution Lines (Plan/Actual)

Unit: Km

Service Area of Distribution Company		Plan			Actual				Gap
		Phase 1	Phase 2	Total	Phase 1	Phase 2	Phase 3	Total	
AP State	North	279	231	510	515	449	-	964	+454
	Central	227	249	476	139	179	-	318	-158
	East	150	150	300	215	247	-	462	+162
	South	234	249	483	182	213	446	841	+358
	Total	890	879	1,769	1,051	1,088	446	2,585	816
MP State	Central	96	65	161	242	0	-	242	+81
	West	170	126	296	204	15	-	219	-77
	East	112	117	229	126	0	-	126	-103
	Total	378	308	686	572	15	-	587	-99
Maharashtra State		120	171	291	129	0	-	129	-162
Total		1,388	1,358	2,746	1,752	1,103	446	3,301	+555

Source: JICA internal documents and responses to questionnaires.

Note : AP State: Andhra Pradesh State, MP State: Madhya Pradesh State

For the overall project, the distance of the constructed 11KV distribution line was 3,301 km against the plan of 2,746 km, which was an increase of 555 km in length. The reason for the gap between the planned and actual construction distance of the distribution line was the same as that mentioned above for the 33KV distribution line.

According to REC, this project was established based on project plans submitted by each distribution company of the target states in 2005. However, the rural electrification schemes of the government of India were executed in parallel with this project. In addition, some changes in the project scope during project implementation were expected depending on the situation, as there was the possibility of alterations in state policies and priorities after establishment of the plan. The changes in the outputs for each component mentioned above were in response to situation changes that were different from the assumptions made at project planning, and such changes were appropriate when they were referred to the project objectives. Furthermore, the number of beneficiary households newly electrified by this project was estimated based on the plan and actual outputs; the number of beneficiary households for the planned output was 3,063,972 and the number of beneficiary households for the actual output was 2,965,969. As can be seen from the above, however, the project effects were not reduced by the changes in the outputs.

Procurement Methods

In this project, REC was responsible for financing the 8 distribution companies in three target states as well as for the overall project management, while each distribution company was in charge of the procurement of equipment and the supervision of civil works in the

service areas for which they were responsible. No consultant was employed. For the procurement method, a full turn-key contract method covering contract packages for both civil works and equipment was adopted. However, a partial turn-key contract method was applied to some contracts. In total, there were 82 full turn-key contracts and 53¹¹ partial turn-key contracts, all of which were conducted through domestic tender bidding (Table 5).

Table 5: Number of Procurement Packages

Unit: Number of contract

Distribution Company	Number of Procurement Packages	
	Full turn-key	Partial turn-key
Northern Power Distribution Company of Andhra Pradesh Limited (APNPDCL) (Currently Northern Power Distribution Company of Telangana State Limited (TSNPDCL))	10	-
Central Power Distribution Company of Andhra Pradesh Limited (APCPDCL) (Currently Southern Power Distribution Company of Telangana State Limited (TSSPDCL))	17	-
Eastern Power Distribution Company of Andhra Pradesh Limited (APEPDCL)	10	-
Southern Power Distribution Company of Andhra Pradesh Limited (APSPDCL)	12	53
Madhya Pradesh Central Area Distribution Company Limited (MPMKVVCL-Bhopal)	8	-
Madhya Pradesh West Area Distribution Company Limited (MPPKVVCL-Indore)	13	-
Madhya Pradesh East Area Distribution Company Limited (MPPKVVCL-Jabalpur)	4	-
Maharashtra State Electricity Distribution Co. Limited (MSEDCL)	8	-
Total	82	53

Source: Responses to questionnaires

Note: For a breakdown of the partial turn-key contracts of Southern Power Distribution Company of Andhra Pradesh Limited, there were 34 contracts for civil works, and 19 contracts for the procurement of equipment. Both were implemented during Phase 3.

According to the results of interviews with REC and the 8 distribution companies, the above mentioned demarcation of responsibilities between REC and the distribution companies was executed smoothly. On the other hand, for procurement, some issues were found in the implementation capability of the contractors engaged in the Phase 3 package for southern Andhra Pradesh and a package for central and western Madhya Pradesh. In the above cases, when a contractor was awarded several packages, it was difficult for them to execute the several packages at the same time due to limited capacity and this resulted in the delay of the project. As the background to this, many distribution companies usually procure equipment directly by themselves and only civil works are procured through competitive

¹¹ In south Andhra Pradesh, 97 substations were newly constructed as an additional output (Phase 3). However, if the procurement is conducted with a full turn-key contract, the project may not be completed by the expiry date of the loan agreement and therefore a partial turn-key contract was adopted.

bidding¹²; therefore they are not familiar with procurement by the full turn-key contract method as adopted by the project. It might have been possible to avoid cases where a single contractor was awarded multiple contracts beyond its implementation capability had there been, as a requirement for tender, the obligation to check the contractor's existing contracts and remaining implementation capacity for additional contracts.. However, no consultant was employed for assistance in tender for this project. REC organized a workshop on procurement for distribution companies at the beginning of the project. It mainly focused, however, on explanation of the standard procurement guidelines of the Indian government, and did not cover specific issues such as the risks and countermeasures associated with the procurement of a number of contract packages by the full turn-key contract method as was seen in this project.

Implementation Status of RGGVY Related to This Project

This project was implemented in collaboration with RGGVY with a demarcation of responsibilities. On the one hand, the project was responsible for the development of substations and distribution lines between the existing 33KV distribution lines and low voltage transformers at each village. On the other hand, RGGVY took charge of developing individual electrical connections between low voltage transformers and each household (Figure 2). In this framework, by using RGGVY, each distribution company in the three target states was able to implement the development of distribution lines reaching each household as well as low-voltage transformers in each village, individual electrical connections and electricity meters in parallel with this project.

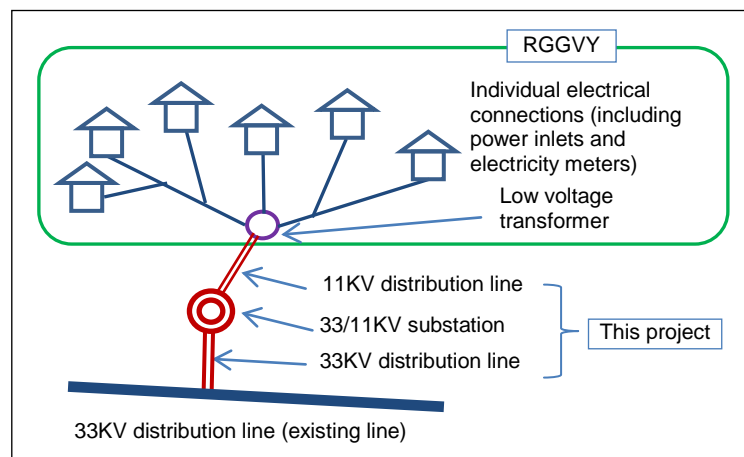


Figure 2: Demarcation between this Project and RGGVY in the target village

¹² The advantages of this method for the distribution companies are: (i) The unit price of equipment can be reduced if distribution companies procure a substantial amount of equipment collectively, (ii) A sufficient and standardized quality of equipment can be secured, (iii) There is the possibility of relatively small-scale contractors participating in the tender, and (iv) Risks of delay in the project implementation schedule caused by delays in the procurement of equipment by the contractor, often seen in full turn-key based procurement, can be reduced. On the other hand, the disadvantage is that a great burden is placed on the distribution company.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The actual project cost amounted to 24,009 million yen (including the 16,949 million yen of Japan's ODA loan) against the planned cost of 24,649 million yen (including the 20,629 million yen of Japan's ODA loan). This was within the plan (equivalent to 97% of the original plan).

There were some changes in the outputs of each component in this project. Although there were some significant changes in Maharashtra, such as the cancellation of 79 new substation constructions and the construction of 116 augmented substations, the residual fund which emerged from the cancelled outputs and foreign currency exchange fluctuation was used for the construction of 97 new substations and the accompanying augmentation of distribution lines in southern Andhra Pradesh¹³. In the end, the actual project cost was lower than planned.

3.2.2.2 Project Period

The planned project period was 29 months, or from March 2006 (signing of the loan agreement) to September 2008 (project completion). The actual project period was 78 months, or from March 2006 (signing of the loan agreement) to August 2012 (project completion), which was significantly longer than planned (equivalent to 252% of the original plan) (Table 6).

Table 6: Project Period (Plan/Actual)

Item	Plan	Actual
Loan Agreement Signing Date	March 2006	March 2006
Phase 1		
• Commencement of tender	June 2006	October 2007
• Commencement of supply of major equipment and materials	November 2006	February 2008
• Commencement of installation of equipment and materials	January 2007	May 2008
• Completion of construction of substations	September 2007	September 2010
Phase 2		
• Commencement of tender	June 2007	March 2008
• Commencement of supply of major equipment and materials	November 2007	June 2008
• Commencement of installation of equipment and materials	January 2008	October 2008
• Completion of construction of substations	September 2008	September 2011

¹³ Due to cancellation of a part of the project output in Maharashtra, a 2,900 million yen residual fund was estimated as of October 2009, and 2,384 million yen was estimated as the project cost of 97 newly constructed substations (Phase 3) in southern Andhra Pradesh.

Item	Plan	Actual
Phase 3		
• Completion of construction of substations	—	August 2012
Project Period	March 2006-September 2008 (29 months)	March 2006-August 2012 (78 months)

Source: JICA internal documents and responses to questionnaires.

Note: Although some of the construction of new substations in south Andhra Pradesh implemented as an additional output (Phase 3) was incomplete, the project was deemed to be completed in August 2012, which was the expiry data of the loan agreement.

Table 7: Actual Project Period of Each Distribution Company

Distribution Company	Actual Project Period
Northern Power Distribution Company of Andhra Pradesh Limited (APNPDCL) (Currently Northern Power Distribution Company of Telangana State Limited (TSNPDCL))	March 2006 - November 2011 (68 months)
Central Power Distribution Company of Andhra Pradesh Limited (APCPDCL) (Currently Southern Power Distribution Company of Telangana State Limited (TSSPDCL))	March 2006 - March 2010 (49 months)
Eastern Power Distribution Company of Andhra Pradesh Limited (APEPDCL)	March 2006 - February 2010 (48 months)
Southern Power Distribution Company of Andhra Pradesh Limited (APSPDCL)	March 2006 - August 2012(78 months)
Madhya Pradesh Central Area Distribution Company Limited (MPMKVVCL-Bhopal)	March 2006 - January 2011 (59 months)
Madhya Pradesh West Area Distribution Company Limited (MPPKVVCL-Indore)	March 2006 - September 2011 (67 months)
Madhya Pradesh East Area Distribution Company Limited (MPPKVVCL-Jabalpur)	March 2006 - August 2011 (66 months)
Maharashtra State Electricity Distribution Co. Limited (MSEDCL)	March 2006 - January 2012 (71 months)

Source: Responses to questionnaires.

A common reason for delays among the eight distribution companies in the three target states was that it took time for land acquisition for substations and for obtaining the right-of-way for distribution lines. Thus all the distribution companies experienced delays of approximately 1.5 - 3.5 years (Table 7). Furthermore, the construction of 97 new substations in southern Andhra Pradesh as an additional output (Phase 3) was also a factor in delays. Re-tender was conducted as there were problems in the implementation capability of some contractors for the contract package in Phase 3. This was another factor leading to the prolonged implementation period for the additional output. Similarly, another delay was observed in central and western Madhya Pradesh due to the issue of the implementation capability of the contractors.

3.2.3 Results of Calculations of Internal Rates of Return

The Economic Internal Rate of Return (EIRR) was 15.4% at the appraisal. The result of the recalculation of EIRR could not be obtained. The calculation of FIRR was not conducted at the appraisal and therefore it was not calculated at the time of the ex-post evaluation.

<Assumptions for calculation of the EIRR at the time of planning>

- Cost: Project cost (tax excluded), operation and maintenance cost, connection fee for each household
- Benefits: Substitution effects of existing energy (candles, lamps, etc.)
- Project life: 25 years

In light of the above, the project cost was within the plan but the project period significantly exceeded the plan; therefore the efficiency of the project is fair.

3.3 Effectiveness¹⁴ (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

(1) System Average Interruption Duration Index (SAIDI)

The System Average Interruption Duration Index (SAIDI) was achieved in all the distribution companies (Table 8). The appropriate implementation of both daily and regular maintenance inspections at each distribution company was considered to be a contributing factor in this achievement. The factors causing interruptions of the power supply were damage to the 33KV/11KV distribution lines, malfunction of the transformers, and meteorological phenomena such as strong wind.

Table 8: System Average Interruption Duration Index (SAIDI)

Unit: Hour/Household per year

Distribution Company	Baseline	Target	Actual		
	2005	2010	2012	2013	2014
	1 year prior to appraisal	2 years after completion	Completion year	1 year after completion	2 years after completion
TSNPDCL (Former APNPDCL)	1,373	1,005	144	129	83
TSSPDCL (Former APCPDCL)	1,320	930	739	746	752
APEPDCL	1,260	870	42	50	33
APSPDCL	1,300	920	1,109	1,051	916
MPMKVVCL-Bhopal	2,328	2,100	2,045	2,045	2,044
MPPKVVCL-Indore	3,000	2,400	2,854	2630	1,970
MPPKVVCL-Jabalpur	15,082	9,600	2,300	1,464	1,305
MSEDCL	3,500	2,600	1,190	1,480	1,160

Source: JICA internal documents and responses to questionnaires.

Note 1: Above index indicates figures for all the districts where the project facilities were developed.

Note 2: **APNPDCL**: Northern Power Distribution Company of Andhra Pradesh Limited, **APCPDCL**: Central Power Distribution Company of Andhra Pradesh Limited, **APEPDCL**: Eastern Power Distribution Company of Andhra Pradesh Limited, **APSPDCL**: Southern Power Distribution Company of Andhra Pradesh Limited, **TSSPDCL**: Southern Power Distribution Company of Telangana State Limited, **TSNPDCL**: Northern Power Distribution Company of Telangana State Limited, **MPMKVVCL-Bhopal**: Madhya Pradesh Central Area Distribution Company Limited, **MPPKVVCL-Indore**: Madhya Pradesh West Area Distribution Company Limited, **MPPKVVCL-Jabalpur**: Madhya Pradesh East Area Distribution Company Limited, **MSEDCL**: Maharashtra State Electricity Distribution Co. Limited.

¹⁴ Sub-rating for Effectiveness is to be put with consideration of Impact

(2) Household Electrification Rate

Regarding the household electrification rate, the actual value in western Madhya Pradesh was 64.7% (76% achievement rate) in 2014 against the target value of 85%. However, the actual values in southern Telangana, eastern and southern Andhra Pradesh, central Madhya Pradesh and Maharashtra exceeded the target values. An achievement rate of 92% was reported against the target value of 100% (92% achievement rate) in northern Telangana, and an actual value of 69.4% (86.7% achievement rate) was reported in 2014 against the target value of 80% in eastern Madhya Pradesh; both achieved more than 80% of the target values (Table 9). From the above, it can be judged that overall, the household electrification rate mostly achieved the target in this project. The above improvement in the household electrification rate was due to the major contribution of RGGVY in addition to the expansion of substations and distribution lines through the project.

Table 9: Household Electrification Rate (Electrified Households/All Households)

Unit: %

Distribution Company	Baseline	Target	Actual		
	2005	2010	2012	2013	2014
	1 year prior to appraisal	2 years after completion	Completion year	1 year after completion	2 years after completion
TSNPDCL (Former APNPDCL)	58	100	72	90	92
TSSPDCL (Former APCPDCL)	70	93	89	91	93
APEPDCL	61	85	90	95	98
APSPDCL	70	91	75	86	96
MPMKVVCL-Bhopal	24	45	45	47	50
MPPKVVCL-Indore	37	85	53.16	60.73	64.65
MPPKVVCL-Jabalpur	39	80	N.A.	66.60	69.36
MSEDCL	66	87	83.97	87.32	89.64

Source: JICA internal documents and responses to questionnaires.

Note 1: Above index indicates figures for all the districts where the project facilities were developed.

Note 2: **APNPDCL**: Northern Power Distribution Company of Andhra Pradesh Limited, **APCPDCL**: Central Power Distribution Company of Andhra Pradesh Limited, **APEPDCL**: Eastern Power Distribution Company of Andhra Pradesh Limited, **APSPDCL**: Southern Power Distribution Company of Andhra Pradesh Limited, **TSSPDCL**: Southern Power Distribution Company of Telangana State Limited, **TSNPDCL**: Northern Power Distribution Company of Telangana State Limited, **MPMKVVCL-Bhopal**: Madhya Pradesh Central Area Distribution Company Limited, **MPPKVVCL-Indore**: Madhya Pradesh West Area Distribution Company Limited, **MPPKVVCL-Jabalpur**: Madhya Pradesh East Area Distribution Company Limited, **MSEDCL**: Maharashtra State Electricity Distribution Co. Limited.

(3) Distribution Loss

All the distribution companies achieved the targets for distribution loss in their respective areas (Table 10). The renewal of old equipment such as transformers, the development of a high-voltage distribution system and the strengthening of monitoring in areas prone to a high level of electricity stealing were conducted concurrently with, and in addition to, the project's augmentation of substations and distribution lines, which greatly contributed to the improvement in distribution loss.

Table 10: Distribution Loss

Unit: %

Distribution Company	Baseline	Target	Actual		
	2005	2010	2012	2013	2014
	1 year prior to appraisal	2 years after completion	Completion year	1 year after completion	2 years after completion
TSNPDCL (Former APNPDCL)	19	18	14.02	13.82	14.18
TSSPDCL (Former APCPDCL)	21	16	13.42	12.03	11.76
APEPDCL	15	12	6.91	6.46	6.33
APSPDCL	22	21	12.40	11.82	10.68
MPMKVVCL-Bhopal	44	38	32.71	30.85	29.60
MPPKVVCL-Indore	38	27	30.30	26.39	24.29
MPPKVVCL-Jabalpur	31	25	25.12	24.48	23.67
MSEDCL	31	24	18.33	17.46	16.40

Source: JICA internal documents and responses to questionnaires.

Note 1: Above index indicates figures for all the districts where the project facilities were developed.

Note 2: **APNPDCL**: Northern Power Distribution Company of Andhra Pradesh Limited, **APCPDCL**: Central Power Distribution Company of Andhra Pradesh Limited, **APEPDCL**: Eastern Power Distribution Company of Andhra Pradesh Limited, **APSPDCL**: Southern Power Distribution Company of Andhra Pradesh Limited, **TSSPDCL**: Southern Power Distribution Company of Telangana State Limited, **TSNPDCL**: Northern Power Distribution Company of Telangana State Limited, **MPMKVVCL-Bhopal**: Madhya Pradesh Central Area Distribution Company Limited, **MPPKVVCL-Indore**: Madhya Pradesh West Area Distribution Company Limited, **MPPKVVCL-Jabalpur**: Madhya Pradesh East Area Distribution Company Limited, **MSEDCL**: Maharashtra State Electricity Distribution Co. Limited.

(4) Bill Collection Rate

The bill collection rate achieved the targets in all areas of the distribution companies (In Maharashtra, the actual value in 2014 was 90.7% against the target of 100% (90.7% achievement), which means that Maharashtra achieved its target) (Table 11). Furthermore, the reason for the decline in the bill collection rate in Maharashtra from 96.4% in 2012 to approximately 90% in 2013 and 2014 was a delinquency of electricity bill payment by farmers due to drought. The improvement in the bill collection rate was due to the countermeasures taken by each distribution company such as improvements in bill collection methods (abolition of bill collection by collection staff visiting individual households, the introduction of a payment method whereby people can pay their electricity bills on the internet or at a village kiosk), strict bill collection for those in arrears, and the prevention of electricity stealing through the development of high-voltage distribution lines. In addition, RGGVY installed electricity meters in each household and there were other schemes.

Table 11: Bill Collection Rate

Unit: %

Distribution Company	Baseline	Target	Actual		
	2005	2010	2012	2013	2014
	1 year prior to appraisal	2 years after completion	Completion year	1 year after completion	2 years after completion
TSNPDCL (Former APNPDCL)	93	97	100	100	100
TSSPDCL (Former APCPDCL)	80	86	97	100	95
APEPDCL	95	95	100	100	99
APSPDCL	95	98	96	97	98
MPMKVVCL-Bhopal	83	86	89.8	100	100
MPPKVVCL-Indore	93	97	97.8	100	100
MPPKVVCL-Jabalpur	91	100	95.6	100	100
MSEDCL	100	100	96.43	89.95	90.71

Source: JICA internal documents and responses to questionnaires.

Note 1: Above index indicates figures for all the districts where the project facilities were developed.

Note 2: **APNPDCL**: Northern Power Distribution Company of Andhra Pradesh Limited, **APCPDCL**: Central Power Distribution Company of Andhra Pradesh Limited, **APEPDCL**: Eastern Power Distribution Company of Andhra Pradesh Limited, **APSPDCL**: Southern Power Distribution Company of Andhra Pradesh Limited, **TSSPDCL**: Southern Power Distribution Company of Telangana State Limited, **TSNPDCL**: Northern Power Distribution Company of Telangana State Limited, **MPMKVVCL-Bhopal**: Madhya Pradesh Central Area Distribution Company Limited, **MPPKVVCL-Indore**: Madhya Pradesh West Area Distribution Company Limited, **MPPKVVCL-Jabalpur**: Madhya Pradesh East Area Distribution Company Limited, **MSEDCL**: Maharashtra State Electricity Distribution Co. Limited.

(5) Electricity Sales Volume

As for the electricity sales volume, all distribution companies achieved their targets in their respective areas (the actual value in southern Telangana was 3,238MWh in 2014 against the target value of 3,547MWh (91.3% achievement)) (Table 12). The increase in the electricity supply volume due to household electrification was the key factor for the increased electricity sales volume.

Table 12: Electricity Sales Volume

Unit: MWh

Distribution Company	Baseline	Target	Actual		
	2005	2010	2012	2013	2014
	1 year prior to appraisal	2 years after completion	Completion year	1 year after completion	2 years after completion
TSNPDCL (Former APNPDCL)	1,142	1,590	10,230	9,671	10,286
TSSPDCL (Former APCPDCL)	2,852	3,547	3,160	3,063	3,238
APEPDCL	6,252	10,252	11,725	11,665	12,900
APSPDCL	1,788	2,536	16,388	16,444	18,024
MPMKVVCL-Bhopal	5,132	6,000	7,100	9,939	11,557
MPPKVVCL-Indore	1,020	1,288	6,849	8,243	9,121
MPPKVVCL-Jabalpur	8,929	10,872	12,225	13,127	13,977
MSEDCL	7,359	9,848	22,809	23,723	26,000

Source: JICA internal documents and responses to questionnaires.

Note 1: Above index indicates figures for all the districts where the project facilities were developed.

Note 2: **APNPDCL**: Northern Power Distribution Company of Andhra Pradesh Limited, **APCPDCL**: Central Power Distribution Company of Andhra Pradesh Limited, **APEPDCL**: Eastern Power Distribution Company of Andhra Pradesh Limited, **APSPDCL**: Southern Power Distribution Company of Andhra Pradesh Limited, **TSSPDCL**: Southern Power Distribution Company of Telangana State Limited, **TSNPDCL**: Northern Power Distribution Company of Telangana State Limited, **MPMKVVCL-Bhopal**: Madhya Pradesh Central Area Distribution Company Limited, **MPPKVVCL-Indore**: Madhya Pradesh West Area Distribution Company Limited, **MPPKVVCL-Jabalpur**: Madhya Pradesh East Area Distribution Company Limited, **MSEDCL**: Maharashtra State Electricity Distribution Co. Limited.

(6) Number of Beneficiary Households

The estimated number of newly electrified rural households (2014) through this project is shown in Table 13. It is estimated that approximately 2.9 million rural households in the four target states were newly electrified by the project. This is equivalent to 6.5% of the total electrified households in the four target states. On the other hand, although this is not included among the above beneficiary households, each substation provides electricity to agricultural pumps and commercial establishments in addition to ordinary households; thus the target beneficiaries expand further if these are included.

Table 13: Estimated Number of Newly Electrified Households through the Project
(Beneficiary Households) (2014)

Unit: Number of Households

State	Distribution Company	Entire Service Area of Distribution Company	Beneficiary Households of the Project	
		Households	Households	Percentage
Telangana	TSNPDCL (Former APNPDCL)	3,393,494	823,702	24.3%
	TSSPDCL (Former APCPDCL)	4,243,291	354,060	8.3%
	Subtotal	7,636,785	1,177,762	15.4%
Andhra Pradesh	APEPDCL	6,108,451	542,058	8.9%
	APSPDCL	7,610,667	636,300	8.4%
	Subtotal	13,719,118	1,178,358	8.6%
Madhya Pradesh	MPMKVVCL-Bhopal	2,268,092	96,480	4.3%
	MPPKVVCL-Indore	3,147,916	188,034	6.0%
	MPPKVVCL-Jabalpur	2,832,070	247,954	8.8%
	Subtotal	8,248,078	532,468	6.5%
Maharashtra	MSEDCL	16,246,589	77,382	0.5%
	Total	45,850,570	2,965,970	6.5%

Source: Responses to questionnaires.

Note 1: The beneficiary households of this project were estimated based on the number of newly constructed and augmented substations and an average taken of the electrified households per substation in rural areas of each distribution company. When there were 20% of newly electrified households (beneficiary households) through the project within all the electrified households of each substation, this was taken as an augmented station.

Note 2: **APNPDCL**: Northern Power Distribution Company of Andhra Pradesh Limited, **APCPDCL**: Central Power Distribution Company of Andhra Pradesh Limited, **APEPDCL**: Eastern Power Distribution Company of Andhra Pradesh Limited, **APSPDCL**: Southern Power Distribution Company of Andhra Pradesh Limited, **TSSPDCL**: Southern Power Distribution Company of Telangana State Limited, **TSNPDCL**: Northern Power Distribution Company of Telangana State Limited, **MPMKVVCL-Bhopal**: Madhya Pradesh Central Area Distribution Company Limited, **MPPKVVCL-Indore**: Madhya Pradesh West Area Distribution Company Limited, **MPPKVVCL-Jabalpur**: Madhya Pradesh East Area Distribution Company Limited, **MSEDCL**: Maharashtra State Electricity Distribution Co. Limited.

3.3.2 Qualitative Effects

The beneficiary survey with rural households newly electrified by this project revealed that 84% of the respondents had realized a stable power supply and 94% were satisfied with the power supply reliability and quality (70% highly satisfied and 24% satisfied) (See 3.4.1 Intended Impacts for the beneficiary survey). In Madhya Pradesh, electricity is supplied 24 hours in most rural households; for other states, electricity is supplied for 12-24 hours depending on the status of each distribution company. In addition, there were improvements in the system average interruption duration index (SAIDI) and distribution loss in the project target states as mentioned earlier, and it is considered that it is such improvements that have led to the high satisfaction level.

From the above, it can be seen that the operation and effect indicators such as the system average interruption duration index (SAIDI), the household electrification rate, distribution loss, the bill collection rate, and the electricity sales volume have attained their target values and it is estimated that approximately 2.9 million rural households in the four target states have been newly electrified by this project. Furthermore, it was confirmed from the results of the beneficiary survey that the electricity supply to each household is stable. Thus, the objectives of this project, which were to stabilize the transmission and distribution system (to relieve the existing overloaded system and reduce transmission and distribution losses) and to expand access to electricity for un-electrified rural households have been achieved. Some external factors also greatly contributed to this achievement. Each distribution company conducted projects concurrently with this project, such as the improvement of transmission and distribution losses, improvement of bill collection methods and the implementation of appropriate maintenance. In addition there was the provision of individual electrical connections to each household from the project facilities by the project and RGGVY.

3.4 Impacts

3.4.1 Intended Impacts

At the time of the ex-post evaluation, a beneficiary survey was conducted with 150 rural households which were newly electrified by this project in 6 villages¹⁵ from the four project target states¹⁶ in order that the socio-economic impacts of this project might be comprehended. In addition, an interview was conducted with each village head to understand the impacts from the village point of view. The results of the beneficiary survey are shown in Table 14 below.

¹⁵ See the box “The Results of the Beneficiary Survey (A Case of Improvement in Hygiene and Sanitary Conditions”).

¹⁶ Andhra Pradesh was divided into two states in June 2014, Telangana state in the north and Andhra Pradesh state in the south, and there were 4 target states at the time of the ex-post evaluation.

Table 14: Results of the Beneficiary Survey

Impacts	Results	Main responses
Increased access to information	Significantly increased: 12% Increased: 86% Same: 2%	Increased access to various types of information such as domestic/international news and the latest market values of agricultural products as the use of TV at home or cell phones became available.
Improvement in safety after dark	Improved: 92% Same: 8%	Installation of streetlights has improved safety after dark. It has also contributed to a reduction in the crime rates.
Improvement in child education	Improved: 85% Same: 15%	Outcomes in children's education has improved since they can study at night. In addition, children can concentrate on their academic work better with the use of electric fan in a hot weather.
Improvement in hygiene and sanitary conditions	Significantly improved: 2% Improved: 97% Same: 1%	People's awareness of household cleanliness has improved. The use of electric appliances such as refrigerators made it possible to keep fresh food such as milk, and hygiene and sanitary conditions have improved.
Reduced labor	Same: 92% Reduced: 8%	There was no change in domestic labor at home after electrification.
Improvement in public services such as schools and hospitals	Improved: 85% Same: 15%	Public services have been improved by computerized works and improved information access. The stable electricity supply made it possible to provide education using labs at school.
Increase in social activities	Increased: 90% Same: 10%	The bond between families and communities has been strengthened. More community events such as movie-viewings take place.
Reduced poverty	Reduced: 72% Same: 27%	Increased agricultural production and income through the use of electric agricultural pumps. New employment opportunities found such as tailors using electric sawing machines, sales of electric appliances, or the repair of electric appliances. This has led to income generation.

Source: Results of the beneficiary survey

For changes in the living environment, the increased access to information, improved safety after dark and better education and hygiene and sanitary conditions have been highly evaluated. In addition, the improvement in public services such as schools and hospitals has also been highly evaluated. The public facilities of each village apparently received an electricity supply from village electrification prior to project implementation. However, since project implementation they received a more stable electricity supply and it is considered that this has led to the more efficient and improved services. On the other hand, no change was observed in the amount of domestic labor at home.

Social activities in each village have been activated by the electrification. Because of the increased safety after dark, there were more opportunities for night outings or events; furthermore, there were more opportunities for residents to communicate with each other using cell phones. Some said a sense of solidarity had been strengthened among villagers. There were improvements in economic aspects such as increased opportunities for income generation and a reduction in poverty. In rural areas where agriculture is the main industry, agricultural production activities became more active, and employment opportunities in the agricultural sector have increased along with incomes after farmers became able to use

agricultural pumps. In Bineca Dob village in Madhya Pradesh, double cropping became possible after electrification. In Melegaon village in Maharashtra, the expansion of agricultural production through the introduction of irrigation agriculture meant that there were more opportunities for agricultural labor in the region, and that the migration of laborers during the harvest was reduced. Furthermore, an improvement in the sales and incomes of shops and small-scale business (self-employed) were observed because of extended operation hours due to electrification.

Positive impacts such as the improved living environment of residents and the activation of local economic and social activities were observed from this project.

Box: The Results of the Beneficiary Survey
(A case of improvement in Hygiene and Sanitary Conditions)

1. Targets and methods of the beneficiary survey

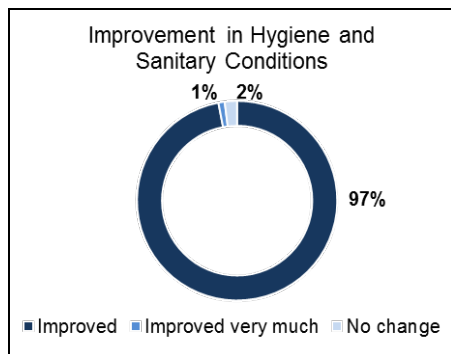
For the survey, six districts from the four target states were selected first, then a newly constructed substation from each of the 6 districts was chosen. Next, 25 households that receive their electricity supply from each of the substations were selected, totaling 150 households (25 households x 6 districts=150 households). Target households (samples) were randomly selected from each village, and interviews were conducted based on questionnaires. Occupationally, 60% of the respondents were directly involved in agriculture, while 12% ran small business, and 11% were daily laborers (mainly involved in agriculture). In terms of gender, 70% were males and 30% were females. In addition, interviews were conducted with six village heads as a supplement to the beneficiary survey.

Distribution Company	State/District	Prefecture	Substation
Northern Power Distribution Company of Telangana State Limited (TSNPDCL)	Telangana	Warangal	Nagapuri
Southern Power Distribution Company of Telangana State Limited (TSSPDCL)	Telangana	Ranga-reddy (South)	Moinabad
Eastern Power Distribution Company of Andhra Pradesh Limited (APEPDCL)	Andhra Pradesh	Vishakhapatnam	Boni
Madhya Pradesh Central Area Distribution Company Limited (MPMKVVCL-Bhopal)	Madhya Pradesh	Bhopal	Bineca
Madhya Pradesh East Area Distribution Company Limited (MPPKVVCL-Jabalpur)	Madhya Pradesh	Narsingpur	Khursipar
Maharashtra State Electricity Distribution Co. Limited (MSDCL)	Maharashtra	Pune	Malegaon

2. Impacts on Improvement in Hygiene and Sanitary Conditions

The beneficiary survey revealed that there were significant positive impacts on the living environment such as increased access to information, improved safety after dark, and improvement in education. In addition to these, improvement in hygiene and sanitary conditions had the highest mark and 98% of the respondents acknowledged this improvement. After electrification, many families were able to preserve fresh or cooked foods more hygienically by using a refrigerator. In Malegaon village in Maharashtra, the awareness of people about hygiene and sanitation has been changing as fresh water from the well became available at any time by the use of an electrical pump. People have started cleaning their bathrooms and floors to keep their houses clean by using the water. In Khursipar village in Madhya Pradesh, there were many incidents of waterborne infectious diseases and malaria, but since electrification people have using electric run mosquito repellents for the prevention of malaria.

Thus it can be seen that the use of electric appliances such as refrigerators or electrical mosquito repellents and the use of sufficient water drawn by an electrical pump for cleaning have become available since electrification. These changes have led to the improvement of hygiene and sanitary conditions in each household.



Beneficiary Survey Result



Bineca Village, Bhopal District, Madhya Pradesh State

3.4.2 Other impacts

(1) Impacts on the Natural Environment

At the time of appraisal of the project, this project was categorized as type B in the Japan Bank for International Cooperation (JBIC) Guidelines for the Confirmation of Environmental and Social Considerations (established in April 2002) since the project did not correspond to a sector or area that was likely to be influenced and no major negative impacts on the natural environment were foreseen. For this reason, no Environmental Impact Assessment (EIA) was conducted for this project, and there was no obligation to do so in the related Indian domestic laws.

Although there is no department specializing in environmental monitoring in any of the distribution companies, their operation departments usually conduct the environmental monitoring of power distribution facilities as a part of their duties. In this project, permission was required from the Forest Department for the installation of distribution lines in some locations and this was carried out appropriately by following the necessary procedures in related Indian domestic laws. In the beneficiary survey, all the respondents said that there had been no negative impacts on the natural environment due to the implementation of this project.

From the above, it is clear that no negative impacts on the natural environment through the implementation of this project were observed.

(2) Land Acquisition and Resettlement

At the appraisal, approximately 13 ha of land acquisition was expected for substation building sites. However the actual land acquisition was 182.45 ha (1,824,505 m³) (Table 15). The reason for the actual value expanding 14 times against the planned value could not be verified since the grounds for the estimation at the appraisal was unclear. Land acquisition

was appropriately executed according to related Indian domestic laws. In the beneficiary survey, 96% of respondents said there had been no negative impacts from land acquisition. There was no resettlement for this project.

From the above, it can be seen that no negative social impacts occurred due to land acquisition.

In the light of the above, the project has largely achieved its objectives. Therefore effectiveness and impact of the project are high.

Table 15: Area of Land Acquisition

Unit: m³

Distribution Company	Area of Acquisition
TSNPDCL (Former APNPDCL)	129,991
TSSPDCL (Former APCPDCL)	485,622
APEPDCL	21,456
APSPDCL	660,000
MPMKVVCL-Bhopal	72,843
MPPKVVCL-Indore	266,400
MPPKVVCL-Jabalpur	58,000
MSEDCL	130,193
Total	1,824,505

Source: Responses to questionnaires.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

The eight distribution companies from each state are in charge of operation and maintenance (O&M) of the project facilities. In June 2014, Andhra Pradesh State was divided into Telangana State (northern part) and Andhra Pradesh State (southern part); the former Andhra Pradesh North Power Distribution Company Limited (APNPDCL) and the former Andhra Pradesh Central Power Distribution Company Limited (APCPDCL) have changed their names into Telangana State Northern Power Distribution Company Limited (TSNPDCL) and Telangana State Southern Power Distribution Company Limited (TSSPDCL), respectively. Other than the name changes mentioned above, there were no significant changes in the institutional setting and service areas of the four distribution companies in Telangana and Andhra Pradesh.

The number of employees in the eight distribution companies are shown in Table 16 below. No significant issue has been noted regarding the sufficiency level of staff numbers in each department of the eight distribution companies. However, there tends to be a shortage of staff who are in charge of daily O&M duties in the facilities. For this reason, each distribution company outsources the O&M of substations to private operators. For example, in APEPDCL, 40% of O&M is directly taken care of by internal staff, while the remaining 60% is outsourced. In Madhya Pradesh Central Area Distribution Company Limited (MPMKVVCL-Bhopal), 80% of the substation O&M is outsourced. Private operators conduct the operation of substations and routine maintenance while the zone engineers of distribution companies conduct the monitoring of substation and distribution lines in the zones for which they are responsible (the distribution area of each distribution company consists of several zones). The zone engineers also conduct the O&M of the distribution

facilities and equipment that is beyond the capacity of the private operators¹⁷. Each distribution company takes responsibility for the O&M of the individual electrical connections from the project facilities to each household implemented by RGGVY.

Table 16: Operation and Maintenance Agencies of the Project Facility and the Number of Employees

Unit: Number of employees

State	Service Area	Distribution Company	Number of Employees
Telangana	North	Northern Power Distribution Company of Telangana State Limited (TSNPDCL)	8,273
	South	Southern Power Distribution Company of Telangana State Limited (TSSPDCL)	9,841
Andhra Pradesh	East	Eastern Power Distribution Company of Andhra Pradesh Limited (APEPDCL)	7,915
	South	Southern Power Distribution Company of Andhra Pradesh Limited (APSPDCL)	17,086
Madhya Pradesh	Central	Madhya Pradesh Central Area Distribution Company Limited (MPMKVVCL-Bhopal)	8,212
	West	Madhya Pradesh West Area Distribution Company Limited (MPPKVVCL-Indore)	13,322
	East	Madhya Pradesh East Area Distribution Company Limited (MPPKVVCL-Jabalpur)	17,170
Maharashtra	All	Maharashtra State Electricity Distribution Co. Limited (MSEDCL)	76,534

Source: Questionnaire responses

In order to promote rural electrification, the New Electricity Act and RGGVY have encouraged distribution companies to introduce “franchise schemes” in which a part of the operation of distribution services are subcontracted to community-based organizations and NGOs. There are actual cases where franchise schemes have been introduced in some distribution companies. For example, in MSEDCL, meter reading and bill collection were subcontracted to a women’s organization called Mahila Bhachat Gut¹⁸ in all service areas from 2009. Madhya Pradesh East Area Distribution Company Limited (MPPKVVCL-Jabalpur) also introduced a franchise scheme in Gagar prefecture.

From the above, it can be seen that there were no issues in the institutional aspects of operation and maintenance.

3.5.2 Technical Aspects of Operation and Maintenance

The staff of each distribution company hold a certain level of technical ability with a

¹⁷ There are two types of O&M of substations and distribution lines in the areas with bad traffic access, conducted by the distribution company or outsourced to non-government operators.

¹⁸ A women’s self-help group helping poor and needy women earn their livelihood through the production and marketing of home products.

degree or certification in their respective technical field, such as electrical engineering. There is a performance evaluation system for employees which regularly evaluates their technical abilities. Each distribution company has an in-house training center and conducts staff trainings according to the training program. Furthermore, REC has a training center (the Central Institute for Rural Electrification) in Hyderabad, where technical training for rural electrification is conducted for domestic and international trainees. The eight distribution companies send their staff to the REC training center in Hyderabad on a regular basis to learn and update their knowledge and skills for rural electrification. On the other hand, it is required that private operators who are contracted for O&M duties in the substations have a certification from a government vocational training school such as an Industrial Training Institute (ITI).

The substations and distribution lines developed by this project were the same as the existing facilities, and the staff from each distribution company possessed sufficient experience and knowledge on their operation and maintenance; therefore no issues were found from the technical aspects.

3.5.3 Financial Aspects of Operation and Maintenance

The O&M cost for each distribution company is shown in Table 17. According to the distribution companies, the necessary budget for O&M is secured. The bill collection rates for each distribution company were as high as 95-100%, as shown in the operation and effect index.

Table 17: Operation and Maintenance Costs of Distribution Companies (All)

Unit: Ten million rupee

Distribution Company	Item	2011/12		2012/13		2013/14	
		Plan	Actual	Plan	Actual	Plan	Actual
TSNPDCL	Labor	244.04	345.24	288.93	432.89	324.08	491.46
	Maintenance	27.68	40.41	29.48	48.60	29.75	53.89
	O&M	45.51	57.86	49.61	78.59	54.08	101.00
	Total	317.23	443.51	368.02	560.08	407.91	646.35
TSSPDCL	O&M	231.37	166.23	321.29	254.80	391.80	288.41
APEPDCL	Labor	338.27	408.68	338.27	502.58	402.84	482.60
	Maintenance	47.59	52.59	47.59	53.83	58.56	56.86
	O&M	23.07	31.37	23.07	51.30	36.80	70.47
	Total	640.30	658.87	730.22	862.51	890.00	898.34
APSPDCL	O&M	727.00	727.00	1,003.80	1,003.80	1,217.53	1,217.53
MPMKVVCL-Bhopal	Labor	N.A.	508.41	590.00	497.33	610.00	644.42
	Maintenance	N.A.	84.53	78.00	75.15	114.00	66.47
	O&M	N.A.	26.68	80.00	344.66	82.00	49.00
	Total	N.A.	619.62	748.00	607.14	806.00	759.89

Distribution Company	Item	2011/12		2012/13		2013/14	
		Plan	Actual	Plan	Actual	Plan	Actual
MPPKVVCL-Indore	Labor	N.A.	622.99	N.A.	671.62	N.A.	750.91
	Maintenance	N.A.	124.67	N.A.	128.37	N.A.	130.93
	O&M	N.A.	44.86	N.A.	52.85	N.A.	86.50
	Total	N.A.	792.52	N.A.	852.84	N.A.	968.34
MPPKVVCL-Jabalpur	O&M	N.A.	64.30	N.A.	85.90	N.A.	110.10
MSEDCL	Labor	568.10	723.10	803.50	817.30	903.90	833.80
	Maintenance	70.60	113.60	79.50	120.00	115.50	116.60
	O&M	121.30	145.60	115.40	121.10	116.40	201.70
	Total	760.00	982.30	998.40	1,058.40	1,135.80	1,152.10

Source: Responses to questionnaires.

Note 1: For TSSPDCL, APSPDCL, MPPKVVCL-Jabalpur, they only provided data on O&M cost.

Note 2: **APNPDCL**: Northern Power Distribution Company of Andhra Pradesh Limited, **APCPDCL**: Central Power Distribution Company of Andhra Pradesh Limited, **APEPDCL**: Eastern Power Distribution Company of Andhra Pradesh Limited, **APSPDCL**: Southern Power Distribution Company of Andhra Pradesh Limited, **TSSPDCL**: Southern Power Distribution Company of Telangana State Limited, **TSNPDCL**: Northern Power Distribution Company of Telangana State Limited, **MPMKVVCL-Bhopal**: Madhya Pradesh Central Area Distribution Company Limited, **MPPKVVCL-Indore**: Madhya Pradesh West Area Distribution Company Limited, **MPPKVVCL-Jabalpur**: Madhya Pradesh East Area Distribution Company Limited, **MSEDCL**: Maharashtra State Electricity Distribution Co. Limited.

On the other hand, there are financial losses almost every year, as shown in Table 18. This is because there is a policy in India to keep the electricity tariff low, set to approximately 70-80% of the electricity purchase cost (generation and transmission cost) from a transmission company to a distribution company. For this reason, it is difficult for distribution companies to recover the cost from electricity sales revenue. The subsidy from the state government is not sufficient to cover the above gap, and the annual financial losses are a result of this.

Table 18: Income and Expenditure of Distribution Companies

Unit: million rupee

	TSNPDCL			TSSPDCL		
	2011/12	2012/13	2013/14	2011/12	2012/13	2013/14
Sales	54,331	53,113	62,915	151,322	158,981	170,614
Profit	41	-34,918	-338	-79	-78,229	-9,281
Profit after tax	32	-34,361	-310	-40	-77,183	-8,112
	APEPDCL			APSPDCL		
	2011/12	2012/13	2013/14	2011/12	2012/13	2013/14
Sales	55,083	50,914	63,507	79,143	82,273	95,605
Profit	54,898	-16,805	-1,358	75	-46,729	-4,008
Profit after tax	252	-16,805	-1,358	34	-46,753	-4,031
	MPMKVVCL-Bhopal			MPPKVVCL-Jabalpur		
	2011/12	2012/13	2013/14	2011/12	2012/13	2013/14
Sales	43,518	52,798	39,601	55,406	67,389	N.A.
Profit	-6,322	-14,149	-11,668	-6,241	-14,250	N.A.
Profit after tax	-6,322	-14,149	-11,668	N.A.	N.A.	N.A.

	MPPKVCL-Indore			MSEDCL		
	2011/12	2012/13	2013/14	2011/12	2012/13	2013/14
Sales	39,601	52,681	58,453	408,064	470,151	522,621
Profit	-11,668	-14,322	-18,872	-18	-5,762	-11,666
Profit after tax	-11,668	-14,322	-18,872	-8,079	-8,714	-2,804

Source: Responses to questionnaires.

Note : **APNPDCL**: Northern Power Distribution Company of Andhra Pradesh Limited, **APCPDCL**: Central Power Distribution Company of Andhra Pradesh Limited, **APEPDCL**: Eastern Power Distribution Company of Andhra Pradesh Limited, **APSPDCL**: Southern Power Distribution Company of Andhra Pradesh Limited, **TSSPDCL**: Southern Power Distribution Company of Telangana State Limited, **TSNPDCL**: Northern Power Distribution Company of Telangana State Limited, **MPMKVVCL-Bhopal**: Madhya Pradesh Central Area Distribution Company Limited, **MPPKVCL-Indore**: Madhya Pradesh West Area Distribution Company Limited, **MPPKVCL-Jabalpur**: Madhya Pradesh East Area Distribution Company Limited, **MSEDCL**: Maharashtra State Electricity Distribution Co. Limited.

In March 2013, the Ministry of Power announced the performance ratings¹⁹ of the transmission and distribution companies nationwide, mainly their financial capacity. According to the ratings, MSEDCL was rated “Grade A”²⁰, APEPDCL, APSPDCL, and TSSPDCL (known as Andhra Pradesh Central Power Distribution Company Limited in 2013) were rated “Grade B”²¹, and the three distribution companies in Madhya Pradesh and TSNPDCL (known as Andhra Pradesh Northern Power Distribution Company Limited in 2013) were rated “Grade B”²².

The Ministry of Power established the Financial Restructuring Scheme of State Distribution Companies²³ in 2012 in order to support the financial restoration of each distribution company. Under this scheme, the state government takes over 50% of the distribution company's short-term liabilities (the state government purchases the 50% of the securitized short-term liabilities in 2-5 years), while the remaining 50% has a moratorium on the capital for 3 years, with the state government supporting the interest payment during the moratorium period. Meanwhile, the state government and distribution companies are required to improve profitability by promoting the efficiency of distribution companies by raising the electricity tariff and reducing distribution loss during the moratorium period. The Ministry of Power has selected seven states, including Andhra Pradesh and Madhya Pradesh as targets for the scheme.

In Andhra Pradesh, the budget necessary for the financial restructuring scheme has been secured and the state government has begun support for the financial restoration of two distribution companies in the state for five-years starting in 2014. Telangana state, which

¹⁹ “State Distribution Utilities First Annual Integrated Rating” Ministry of Power (March 2013). The Ministry of Power implemented the performance rating of transmission and distribution companies nationwide in order to understand their financial status and specify their needs for future financing. The actual evaluation was conducted by India's Power Finance Corporation Ltd. and the rating was conducted by Investment Information and Credit Rating Agency of India Limited and Credit Analysis and Research Ltd.

²⁰ Grade A: Very high operational and financial performance capability (Score distribution: 80-100).

²¹ Grade B⁺: Moderate operational and financial performance capability (Score distribution:50-65).

²² Grade B: Below average operational and financial performance capability (Score distribution:35-50).

²³ Scheme for Financial Restructuring of State Distribution Utilities, No. 20/112012-APDRP, Government of India, Ministry of Power, October 5th, 2012.

came into existence in June 2014, has taken over the policy from Andhra Pradesh, and it supports the financial restoration of the two distribution companies within the state using the financial restructuring scheme. Madhya Pradesh did not participate in this scheme since the distribution companies did not possess any short-term liabilities. Instead, the Madhya Pradesh state government established its own financial restoration scheme for distribution companies. That is, the state government has converted the outstanding working capital loans of distribution companies borrowed from the state government into perpetual loans. Also, the state government exempts interest payments on the above loan for three years. Through this, the three distribution companies in the state have been able to maintain a cash flow for a certain period of time. On the other hand, MSEDCL, which possesses the highest financial capacity of all the eight distribution companies, has been working on improving its profitability by reducing the average power purchase unit price by a long-term Power Purchase Agreement and promoting efficiencies such as reductions of distribution loss. The Maharashtra government is executing a pilot scheme which compensates a part of the state's electricity bill for agriculture. From this, it is expected that MSEDCL's liabilities will be reduced for the agricultural sector. Maharashtra state is planning to expand the pilot scheme statewide, based on the outcome of the above mentioned pilot project.

Although the eight distribution companies operate at a financial loss, the necessary budget is more or less secured for the operation and maintenance of the project facilities; they are working on mid-long term financial restoration with the support of the central and state governments. Therefore, it is considered that there is no specific problem in the financial sustainability of this project.

3.5.4 Current Status of Operation and Maintenance

The O&M of the project facilities is properly conducted according to the O&M plan of each distribution company and the manual and standard operating procedures (SOP), and the facilities were in operation without a significant problem at the time of the ex-post evaluation. There was no specific problem reported regarding the current status of O&M of the individual electrical connections from the project facilities to each household implemented by RGGVY. Furthermore, SAIDI and distribution losses are improving as seen in the operation and effect indicators. In the beneficiary survey, 90% of the respondents said that the substations and distribution lines were operating properly, and that their O&M status was satisfactory. Spare parts can be procured domestically. Therefore, it is considered that there is no specific problem in the current O&M status of this project.

From the above, no major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance system, and the project facilities have been maintained in good condition. Therefore sustainability of the project effect is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The objective of this project was to stabilize the transmission and distribution system and to expand access to electricity for un-electrified rural households through the construction and augmentation of substations and associated distribution lines in the three target states of India, Andhra Pradesh, Madhya Pradesh and Maharashtra. This project matched the Indian national development policy and its development needs as well as Japan's ODA policy at the appraisal, therefore its relevance is high. The project cost was within the plan, but the project period significantly exceeded the plan, therefore the efficiency of the project is fair. The project outputs were altered in response to some situational changes during project implementation.

The operation and effect indicators such as the system average interruption duration index (SAIDI), the household electrification rate, distribution loss, the bill collection rate, and the electricity sales volume attained their respective target values. An estimate of 2.9 million rural households were newly electrified by this project. This achievement was greatly helped by some external factors such as the implementation of RGGVY, which was a rural electrification scheme of the government of India, improvements in the distribution losses of each distribution company, improvements in bill collection methods, and the implementation of appropriate maintenance. The beneficiary survey revealed that there were some positive impacts on the economic and social aspects and that the living standards of local residents had seen such improvements as increased information access, improved safety after dark, education, hygiene and sanitary conditions, and public services, vitalized social activities, and decreased poverty. No negative impact on the natural environment was observed, and the land acquisition was executed according to the related Indian domestic laws. There was no resettlement for this project. Therefore, the effectiveness and impacts of this project are high.

As for sustainability of the project effects, no major problems were observed in the institutional, technical, and financial aspects of the operation and maintenance system, and the project facilities have been maintained in good condition. Therefore, sustainability of the project effect is high.

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

4.2 Recommendations

4.2.1 Recommendations to the executing agency

None.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

(1) Project Design to Secure Realization of Project Effects

At the appraisal, the three states, Andhra Pradesh, Madhya Pradesh and Maharashtra were selected based on 4 selection criteria for the target states: (i) An almost 100% achievement of village electrification, (ii) Power sector reform has been introduced, (iii) The repayment status of the existing loan from REC is good, and (iv) There is a substantial number of un-electrified rural households. These selection criteria were based on the premise that the outcome of the household electrification would be large, and that project sustainability would be high in a state where the necessity for and usefulness of electricity are recognized by the people through the use of electrified public facilities, and where, if a household electrification project was conducted, there would be a high village electrification rate with a large potential household electrification demand. This project was implemented in collaboration with RGGVY through the mutual demarcation of responsibilities. That is, on the one hand, this project was responsible for the development of substations and distribution lines between the existing 33KV distribution lines and low voltage transformers at each village, while, RGGVY took charge of developing individual electrical connections between low voltage transformers and each household. The above mentioned selection method for the target states and the project design to supplement the rural electrification scheme by the government of India was effective in terms of securing the realization of project effects.

In similar future cases, it is expected that even higher project effects would be realised by designing a project to link and supplement the government scheme of partner countries at the planning stage if there is an existing support scheme on the part of the government of the partner country in the said sector. Furthermore, there is a high possibility of securing the realization of project effects by selecting project target areas strategically, noting conditions such as the development status of the said sector or the ability of the executing agency.

(2) Confirmation of the Implementation Capability of Contractors

Basically the procurement method of this project applied a full turn-key contract method in which the procurement of civil works and equipment was packaged into one contract. The number of contracts was extremely high with a total of 82 full turn-key contracts and 53 partial turn-key contracts. On the other hand, there was a delay in the project and poor performance of contractors in some distribution companies as a single contractor was awarded multiple contract packages, thus exceeding its implementation capacity. When bidding is carried out with conditions described above, it is typical that the contractor's existing contracts are checked as well as the contractor's remaining capacity for additional contracts in order to avoid a case where the contractor takes orders beyond its capacity and performance. However some distribution companies did not take such countermeasures. In addition, a consultant who could support the project management and procurement management of the distribution companies

was not employed for this project, and there is the possibility that the above problem could have been avoided had there been the support of a consultant. Furthermore, although REC organized a workshop on procurement for distribution companies at the beginning of the project, it mainly focused on an explanation of the standard procurement guidelines of the Indian government, and it did not cover the specific issues associated with a procurement.

Therefore, it is required that JICA and the executing agency have discussions on the number of potential contractors participating in the bidding, their capacity and past performance records, as well as the possibility of introducing the bidding conditions prior to project implementation so that a contractor cannot take an order beyond its capacity in a case like this project where there are many contract packages but no consultant to support procurement management.

Comparison of Original and Actual Scope of the Project

Item	Plan	Actual
(1) Project Outputs		
1. Target states	Andhra Pradesh Mahdya Pradesh Maharashtra	As planned
2. Construction of 33KV/11KV substation	763 locations (3 states)	772 locations (3 states)
3. Augmentation of 33KV/11KV substation	455 locations (3 states)	337 locations (3 states)
4. Construction of 33KV distribution line	5,983km (3 states)	4,257km (3 states)
5. Construction of 11KV distribution line	2,746km (3 states)	3,301km (3 states)
(2) Project Period	March 2006- September 2008 (29 months)	March 2006- August 2012 (78 months)
(3) Project Cost		
Amount paid in foreign currency	13,853 million yen	Unknown
Amount paid in local currency	10,796 million yen (26,882 million rupee)	Unknown
Total Japanese ODA loan portion	24,649 million yen 20,629 million yen	24,009 million yen 16,949 million yen
Exchange rate	1 rupee = 2.49 yen (As of July 2005)	Unknown