Sri Lanka

Transmission and Substation Development Project

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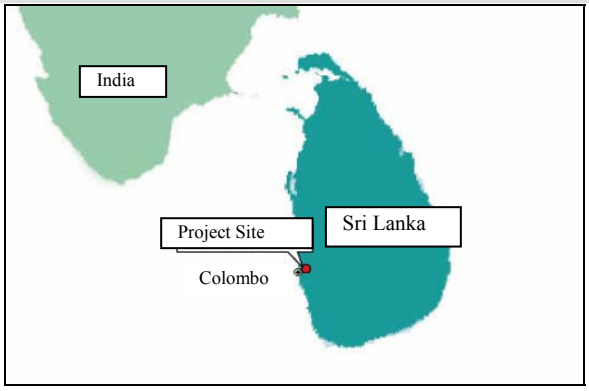
Field Survey: August 2005

1. Project Profile and Japan's ODA Loan



Map of project area

Switching equipment installed through this project

1.1 Background

The demand for electricity had risen in Sri Lanka due to the country's sustained economic growth. Increasing the power supply capacity had become an important issue, but because too much investment was put into the power generation sector, the development of the power transmission and distribution sector had lagged markedly. Various problems had emerged, including insufficient capacities in transmission lines, voltage drops, and electrical transmission losses. Meanwhile, frequent power outages had cost the economy and society dearly (in 1996 there were roughly six months of planned power outages). All these factors made the stable supply of electricity an urgent matter.

In addition, the government of Sri Lanka was aiming to improve its electrification rate which, compared to other South Asian countries, had been remarkably low (in 1991, Sri Lanka's electrification rate was 33% compared to India's 74% and Pakistan's 50%). The government had set its sights on electrification for all villages by the year 2000. From the standpoint of alleviating poverty and developing rural communities, the development of an power transmission and distribution grid had become a major issue.

The fact that the power sector occupied a major position in development policy was something common to all developing countries. To resolve the above problems, in the mid-1990s Sri Lanka allotted a full 8% of the funds in its Public Investment Plan

(1993-1997) to the power sector.

1.2 Objective

The Western Province near Colombo is a major consumer of electricity. This project aims to stabilize the power supply to Colombo and the southern end of the Western province by repairing the Kolonnawa Substation and by increasing the voltage of the transmission line that runs between Biyagama and Pannipitiya from 132kV to 220kV. The project will contribute to improvements in the living environment for local residents and the development of the regional economy.

1.3 Outputs

(1) Kolonnawa substation repairs: replacement of transformers, replacement of switching equipment (with indoor switching equipment), and replacement of control panels, protection relay boards,

(2) Voltage increase on transmission lines between Biyagama and Pannipitiya (from 132kV to 220kV): reinforcement of equipment at the Biyagama and Pannipitiya substations (switching equipment and transformers, etc., rated at 220kV).

1.4 Borrower/Executing Agency

Government of the Democratic Socialist Republic of Sri Lanka/Ceylon Electricity Board (CEB)

1.5 Outline of Loan Agreement

Loan Amount/ Disbursed Amount	3,114 million yen/2,473 million yen
Exchange of Notes Loan Agreement	June 1997 August 1997
Terms and Conditions - Interest Rate - Repayment Period (Grace Period) - Procurement	 2.3%/year 30 years 10 years General untied
Final Disbursement Date	November 2003
Main Contractors	ABB SWITCHGEAR AB (Sweden), Mitsubishi Electric (Japan)
Consulting Services	FICHTNER GMBH & COMPANY KG.

	(Germany) J Power (Japan)
Feasibility Study (F/S), etc.	1994 Study on Nationwide Transmission Grid Development Plan (JICA)

2. Evaluation Result

2.1 Relevance

In the mid-1990s, Sri Lanka's investment in the power sector was heavily focused on the power generation sector, and the development of the power transmission and distribution sector has lagged markedly. The year 1996 saw roughly six months of planned power outages. The frequent blackouts had a serious impact on the economy and society, making the stable supply of electricity an urgent matter. Therefore the objective of this project, the development of an power transmission grid, is judged to have been consistent with the basic socioeconomic needs at that time. Looking at the specific issues surrounding the transmission and distribution sectors, the following two major points were found. Firstly, Sri Lanka's need to improve its electrification rate, which relative to other South Asian countries is very low. The government set its sights on electrification for all villages by the year 2000 in the context of alleviating poverty and developing rural communities. Secondly, the need to stabilize the power supply by addressing structural problems such as low transmission line capacities, voltage drops, and transmission and distribution losses. For this reason, it is felt that the concept of this project was suitable. The greater Colombo area is the largest consumer of electricity in the country, accounting for roughly 40% of Sri Lanka's electricity consumption. For that reason, it makes a lot of sense to increase the stability of the power supply by repairing important substations in the region and raising the transmission voltage from 132kV to 220kV. The project's targets are also relevant.

Development of the power sector is a major development issue. Some 8% of all the funds in the Public Investment Plan (1993-1997) were allocated to the power sector. Moreover, this project is included in the Master Plan for the Development of the Transmission System which was created by JICA in 1997. So it can be concluded that there is no problem concerning the consistency of this project with related government policies. Moreover, in the Public Investment Plan current at the time of this evaluation (2006), 6% of the funds are allocated to the power sector. This sector is the top priority among all infrastructure sectors, and continues to maintain a high level of priority.

The government of Sri Lanka formulated a number of reform plans for the power

sector in cooperation with the international aid community. These included the Power Sector Government Policy guidelines of 1997, and the Reform and Public Utilities Committee Bills of 2002. At the time of the field survey, these plans had come to a halt due to changes of governments and other factors, and so it was unclear in which direction power sector policy was moving. Later on the situation took a turn for the better, and in April 2006 a bill pertaining to reform of the power sector (revised version) was submitted to parliament and was published in government communiques. So a certain degree of improvement is currently expected in the power sector.

2.2 Efficiency

2.2.1 Outputs

(1) Kolonnawa Substation Repairs

For the most part, the replacement of transformers, switching equipment, control panels, protection relay boards, and the like were conducted according to plan but there were minor modifications which are described below.

1) Once the CEB introduced a plan to concentrate the switching equipment indoors in the Kolonnawa substation, the switching equipment for this project was also modified to an indoor type, and the switching equipment for use with the transformers was increased from three lines to five.

2) In accordance with a CEB directive to computerize the substation control devices, the control panel used in this project was also computerized.

(2) Increasing the voltage in transmission lines running between Biyagama and Pannipitiya (from 132kV to 220kV)

Voltage increases for the most part went according to plan; however, there were minor modifications which are described below.

(1) Because the lines between Biyagama and Pannipitiya regions were constructed with a 220kV design, the transmission line suspension towers insulation was not added as initially planned.

(2) In accordance with a CEB directive to computerize the substation control devices, the control panel used in this project was also computerized.

(3) Because it was decided to expand the Pannipitiya Substation in the Transmission and Substation Development Project II, work to expand the control room of this substation was added to this project.

2.2.2 Project period

The project was took a total of 66 months (from August 1997 to February 2003). This was 169% of the planned 39-month period (from August 1997 to November 2000). The major causes of the prolonged delay are as follows:

(1) Following computerization of the substation control devices and expansion of the control room at Pannipitiya Substation, time was needed to change the design and to carry out the work.

(2) During the consultant selection process, the short list approval procedure was delayed.

2.2.3 Project cost

The actual project cost was 2,936 million yen, or just 71.4% of the initially forecast figure of 4,114 million yen. The reduction in the project cost is attributed to competition during the tendering period and a devaluation of the rupee relative to the yen.

2.3 Effectiveness

2.3.1 Stable supply of electricity to Colombo City and the southern part of the Western Province

(1) Number of system-wide failures

Since completion of this project in 2003 there have been no system-wide failures resulting from any failure at the Kolonnawa Substation. Considering the fact that Colombo City suffered four power outages in 1995 and two in 2002, it appears that the project has helped achieve the anticipated increase in power supply stability. But no targets for failure reduction were set at the time of the appraisal.

(2) Voltage drops and transmission loss rates

Prior to completion of this project, the input voltage at the Matugama Substation, situated at the southern end of the Western Province, dropped outside the permissible range (that is, 5% below the designed voltage) eight times in 1995, and once in 2002. By contrast, there were no such voltage drops in 2005. Transmission loss rates likewise saw a striking improvement. Thus, the expected improvements to power supply stability were realized. However, no targets for voltage drops and transmission loss rates were set at the time of the appraisal.

2.3.2 Financial and economic internal rates of return

At the time of the appraisal the internal rates of return for this project were not calculated. At the time of the evaluation both the Financial Internal Rate of Return (FIRR) and Economic Internal Rate of Return (EIRR) were calculated to be 19.3%. See Table 1 for the conditions assumed when calculating these values.

Table 1 Conditions Assumed when Calculating the Internal Rates of Return

Project life	Twenty years from the commencement of operation
Fiscal year	Same as the calendar year
Fixed price calculation method	Costs are converted to fixed prices by taking the year of project completion as the base year and discounting for the consumer price indices for both the local and foreign currencies. Fixed prices expressed in foreign currencies are converted using the exchange rate of the base year.
Cost breakdown	Project cost, operation and maintenance expense
Breakdown of FIRR benefits	(1) Increase of transmission capacity, (2) Reduction of transmission losses Increase in transmission capacity: calculated from the difference in annual energy flow between 220kV and 132kV and the average electricity unit price for 2004 Reduction in transmission losses: calculated from the reduction in energy losses between 2001 and 2004 and the average electricity unit price for 2004
Breakdown of EIRR benefits	Same as above.

2.4 Impact

2.4.1 Increase in the amount of power supplied to the beneficiary region

In the southern districts of the Western Province, key substations like Ratomalana, Panadura, and Matugama were receiving a 132kV power supply from the Pannipitiya substation. After the current project began partial operation at these substations in 2002, they exhibited rates of increase in the amount of power transmitted greater than the national average. This is felt to be due to the increase in supply capacity brought about by raising the voltage between the Biyagama and Pannipitiya substations from 132kV to 220kV.

As for Colombo City, the rate of increase in the amount of power transmitted by the Kolonnawa substation fell short of the national average, but all the other substations

showed growth rates higher than the national average. This suggests that the power supply from the Kelanitissa combined cycle power station (completed in 2003) to substations other than Kolonnawa has increased.

At the time of the appraisal, no target values had been set regarding increases in the amount of power transmitted from key substations.

2.4.2 Impact on the regional economy and local residents

It has been difficult to grasp the precise impact of this project on the regional economy. The responses of local residents and beneficiaries were obtained through an interview survey of consumers in the target region so as to obtain information that might shed light on the impact.

Based on that survey, end-users in the target region responded in overwhelming numbers that since 2003, the year of the project's completion, the power supply conditions had improved. (Some 82% of large companies, 98% of small and medium-sized companies, and 82% of individual consumers felt this way.) One could therefore say that thanks to this project the power supply seems to have greatly stabilized in the greater Colombo region. On the other hand, while it is not a problem peculiar to this project, many expressed the opinion that current electricity charges were too high. (This view was held by 95% of large companies, 98% of small and medium-sized companies, and 91% of individual consumers.) It seems clear that the across-the-board hike in electricity charges has had a significant adverse effect on economic activities and living conditions in the greater Colombo area. This indicates that when the CEB's financial position improves, consideration will need to be given to the ability of consumers to bear these costs.

2.4.3 Impact on the surrounding environment

The repair and expansion work was conducted on the premises of existing substations so there is no problem regarding impact on the surrounding environment. Regarding the treatment of the insulation oil of the transformers slated for removal, which was indicated at the time of the appraisal, the CEB plans to entrust the work to disposal specialists rather than handle the matter directly. There remains concern about whether or not the CEB is able to accurately trace the treatment process, but the outlook is for treatment itself to proceed according to plan.

2.5 Sustainability

2.5.1 Technical capacity

The CEB has the technical capabilities to maintain the outcomes of the current project.

2.5.2 Structure

The CEB has a good enough organizational system to maintain the outcomes of the current project.

2.5.3 Operation and maintenance

No problems have materialized in the area of operation and maintenance. The CEB's operation and maintenance system for the transmission and transformation sector is structured around a head office and the local substations for four regions (including the Colombo district). The current project was managed by the Colombo region, but for equipment installed through this project the manufacturers provided training on operation and maintenance. In addition the CEB regularly provided on-the-job training to key personnel involved in operation and maintenance which is tailored to their skill levels.

However, there is a training center established with grant aid from France which is supposed to be responsible for preserving technical capabilities. Because its facilities are seriously run down, the center is not fulfilling its anticipated functions.

2.5.4 Financial status

The CEB's pretax profit fell into the red starting in FY2000. Under a financial restructuring plan based on the ideas of the international aid community and the government, electricity charges were raised 25% in March 2001, and another 36% in April 2004. Despite the increase in revenue, the CEB's profit and loss situation continued to worsen. At the time of the evaluation, pretax losses of 15.7 billion rupees were forecast for FY2004, which is equal to 30.7% of net sales. The government also has financial issues, and is demanding that the CEB cover a portion of its deficit through bank borrowings. As a result, the increase in the CEB's financial costs is striking (2.42 billion rupees in fiscal year 2000 and 6.64 billion rupees in 2004).

Adding to the increasing severity of the CEB's financial position are structural problems that include the following external constraints.

(1) The government is instructing that the CEB cover a portion of its deficit through bank borrowings.

(2) In order to handle peak demand, the government is instructing that the CEB purchase electricity through short-term contracts with private independent power producers (IPPs).

(3) An increase in various import costs due to the depreciation of the rupee.

The CEB's low profitability leads to budget shortfalls, and there is the concern that it will gradually undermine the CEB's ability to carry out operations. Particular attention needs to be paid to the budget allocation to various areas such as operation and maintenance, training, and environmental management. Fortunately, recently things have taken a turn for the better, and in April 2006, a bill pertaining to reform of the power sector (revised version) was submitted to parliament and was published in government communiques. Moreover, the CEB and the Ministry of Finance have been discussing options for restructuring the CEB's debt, and they have decided to defer repayment on the conditions of a debt-equity-swap for 50% and a reduction or exemption of interest on the remaining 50%. It thus appears that the beginnings of an improvement in financial sustainability can be seen.

3. Feedback

3.1 Recommendations

(1) Mechanism for the improvement of skill levels

Improvement of the capabilities of technicians is important for the smooth implementation of electricity generation, transmission, and distribution. However, the equipment at the training center responsible for that task is seriously run down, and morale at the training site itself is low. Drastic improvements are needed.

(2) Recommendations for JBIC and the government of Sri Lanka

Despite an across-the-board increase in electricity charges, the CEB's worsening profitability has become very serious. The reason for this is that the CEB's structural constraints are too severe to be resolved through self-help efforts by the CEB itself. Recently, there was a progress in discussions among people regarding CEB's debt restructuring. That said, the formulation of comprehensive countermeasures is an urgent matter. For example, there needs to be an examination of burden-sharing for improving the CEB's profitability among the government, the CEB, and consumers.

Comparison of Original and Actual Scope

Item	Plan	Actual
(1) Outputs 1) Kolonnawa Substation repairs	1) Replacement of 132/33kV transformers Three 30MVA units → three 31.5MVA units	1) As planned
	2) Replacement of 132kV switching equipment a) Switching equipment for use with transmission lines: 11 lines b) Switching equipment for use with transformers: 3 lines c) Switching equipment for use with bus ties: 1 type	2) As planned except for the indoor installation of switching equipment
	3) Replacement of 33kV switching equipment (change to indoor installation) a) Switching equipment for use with power distribution: 8 lines b) Switching equipment for use with transformers: 3 lines c) Switching equipment for the bus section: 1 type	3) As planned
	4) Replacement of 132,33kV control panel and protection relay board	4) As planned except for the computerization of control
	5) Removal of 66kV,11kV devices	5) As planned
2) Increase in voltage of transmission lines between Biyagama and Pannipitiya from 132kV to 220kV	1) Addition of insulation to 132kV transmission line suspension towers between Biyagama and Pannipitiya	1) Because the section of line between Biyagama and Pannipitiya was already designed to handle 220kV, insulation for suspension towers was not added
	2) Installation of 220kV switching equipment at the Biyagama substation: 2 lines	2) As planned.

	3) Installation of 220kV equipment at the Pannipitiya substation a) 220/132kV Pannipitiya transformer: two 250MVA units b) 220kV switching equipment: 2 lines	3) Addition of computerization of control systems and expansion work for the control room.
(2) Project period	August 1997-November 2000 39 months	August 1997-February 2003 66 months
(3) Project Cost Foreign currency Local currency Total ODA Loan Portion Exchange rate	 2,761 million yen 1,352 million yen 4,114 million yen 3,114 million yen 1 rupee = 2.09 yen	 2,214 million yen 722 million yen 2,936 million yen 2,473 million yen 1 rupee = 1.377 yen