

1. Project Profile and Japan's ODA Loan



Site Map : Ecuador Nationwide



Site Photo : OTAVALO Substation

1.1 Background

During the 1980s, the Government of Ecuador promoted the development of power generation facilities: the Paute Hydroelectric Power Station (Capacity : 500MW) started operation in 1983 and the national grid which would be connected to the power station was expected to be completed in 1986. The distribution network had been installed by regional power distribution companies, and electrification was almost attained in the areas with more than 500 in population. Nonetheless, these distribution networks were dispersed and isolated from the Inter-connected National Grid System in many cases. Therefore, some of the regional distribution networks, particularly in mountainous areas, had to depend on the power generated by inefficient and decrepit small-scale diesel or gas turbines. Because of this situation, electric power supply was instable in the regional distribution networks and the construction of sub-transmissions was urgently required in order to connect them to the national grid¹.

The construction of sub-transmission system was supposed to be undertaken by regional power company. However, most of the construction was seriously delayed due to financial difficulty. In 1981, the construction of sub-transmission lines with a total 690 km length and substations with a total capacity of 156 MVA was implemented using supplier's credit, but this was not sufficient. Therefore, in the same year, the Ministry of Natural Resource instructed the National Institute of Electricity (Instituto Ecuatoriano de Electrificación : INECEL) to implement the construction of sub-transmission lines with a total 1,422 km length and substations with total capacity of 564 MVA, and assistance to this project was requested by the Government of Ecuador to the Government of Japan.

1.2 Objectives

This project aims at constructing sub-transmission lines (69KV, 46KV, 34.5KV) of a total 815 km in length throughout Ecuador and substations with a total capacity of 407KVA, and to connect the Inter-connected National Grid System and local distribution networks in order to improve electrification rate and reliability of the power supply system.

1.3 Project Scope

A. Construction of sub-transmission lines

¹ To supply electricity to the final consumer in Ecuador, at the same time as the construction of power plants, it was necessary to organize and develop the Inter-connected National Grid System as the primary transmission line, with sub-transmission lines which transmit the power transformed at substations in the National Grid to secondary substations, and then a regional power distribution network which transmits the power transformed at secondary substations to the final consumer.

New construction	31 lines, 535 km
Upgrading 4 lines, 227 km	
<u>Continued construction²</u>	<u>2 lines, 53 km</u>
Total	37 lines, 815 km

B. Construction of substations

New construction	40 substations
<u>Upgrading 16 substations</u>	
Total	56 substations (Total substation capacity: 407MW)

C. Consulting Service

Detail design, bid document revision, bidding evaluation, and schedule control assistance

1.4 Borrower / Executing Agency

Ecuadorian Institute for Electrification (Instituto Ecuatoriano de Electrificación: INECEL)
(In 2002, National Company of Electric Transmission (Compañía Nacional de Transmisión Eléctrica:TRANSELECTRIC S.A.))

1.5 Outline of Loan Agreement

Loan Amount	9,499 million yen
Loan Disbursed Amount	9,307 million yen
Date of Exchange of Notes	December, 1984
Date of Loan Agreement	August, 1985
Terms and Conditions	
Interest Rate	4.25%
Repayment Period (Grace Period)	25 years (7 years)
Procurement	Partially untied
Final Disbursement Date	August, 1990

2. Results and Evaluation

2.1 Relevance

At appraisal time, the national development plan (1980–1984) adopted a policy to shift from conventional thermal power generation to hydroelectric power generation in order to save oil consumption. This project was therefore in line with this policy in terms of connecting the regional distribution networks to the National Grid which was transmitted power from Paute hydroelectric power station. Relevance of this project was considered to be high.

According to the electrification master plan (1981–1985) formulated by the INECEL based on the national electrification plan, the improvement of the quality and reliability of power supply was regarded as important to promote socio-economic development. The construction of 69kv sub-transmission lines was therefore set as one of the major objectives. Since the regional distribution networks unconnected to the National Grid depended on small-scale diesel and thermal power generation, which made power supply unstable and inefficient, this project was indispensable in improving electric service and efficiency. In this regard, the project has relevancy.

Currently, in year 2002, the Paute Hydroelectric Power Station has upgraded its installed capacity to 1,000MW. The national electrification plan (2002–2011) at this evaluation also states the extension of the Inter-connected National Grid System as one of the basic objectives, while promoting the continuous provision of high quality power services, according to the law regulating the power sector (Ley Regimen del Setor Eléctrico: LRSE) which was enacted in 1996. Thus, at the time of this evaluation, the relevancy of this project is still sustained.

² "Continued construction" is to complete the construction that was started with Ecuadorian finance but left unfinished for the financial difficulties.

2.2 Efficiency

2.2.1 Project Scope

Project scope, compared with that originally planned, had two major modifications: i) total length of sub-transmission line was decreased by 20 km and targeted lines changed; ii) the number of substations increased to 65 from 56 (Total capacity was decreased to 390MVA from 407MVA). This is because, since it took three years to implement the project after formulating the project plan, it became necessary to revise the initial plan according to power demand and supply at the time of project implementation. No problems are seen with this revision since it facilitated efficient project implementation based on the situation at the time.

2.2.2 Implementation Schedule

There were delays in the project process at each stage from bid calling to construction. The overall completion of construction delayed five-years compared to the original plan. The delay was mainly due to the difficulty in fund raising for the local costs for the project (local currency expenditure) by the Ecuadorian Government. The installation of equipment and materials was to be covered by local cost, and budget allocation for it was considerably delayed. This was because: i) inflation raised construction costs and ii) the 1987 earthquake damaged oil pipelines, decreasing major national revenues. As the Ecuadorian government expected the allocation of local costs for this project to come through revenue on oil sales, this disaster meant serious damage. There was also a delay in the delivery of equipments due to long bid preparation and the response to import tax, which was imposed on the equipment procured under the project during the course of project implementation. Since the tax levy and the delay in local cost allocation emerged after the 1987 Ecuador earthquake, and were not predictable, the delay was unavoidable.

2.2.3 Project Cost

Despite adjustment in project scope, the yen-based project cost remained within the scope of the original plan. Actual project cost was 13,513 million yen, while the planned cost was 14,128 million yen. Both foreign and local currency costs resulted in slightly cost under-run.

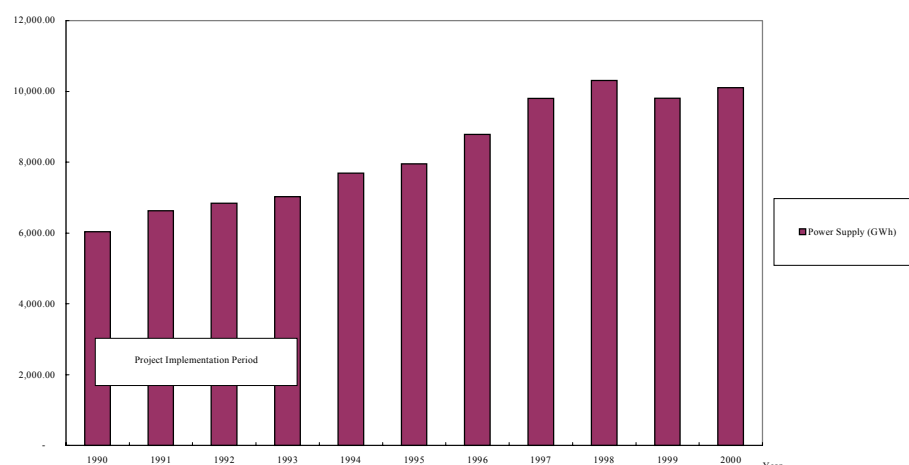
2.3 Effectiveness

2.3.1 Increase in Power Supply in the Inter-connected National Grid System

This project ultimately constructed sub-transmission lines with a total 796.1 km length and 65 substations with about 390 MVA capacity in total. They were equivalent to about 32 % of the sub-transmission line length and 27 % of the substation capacity in Ecuador at the time of project commencement in 1986. Currently, in 2000, they account for about 23 % of the total length of sub-transmission lines and about 15 % of the total capacity of substations.

Power supply to sub-transmission lines from the Inter-connected National Grid has been on an upward trend (since all regional power companies operate the facilities sub-transmission and distribution networks, the total power supply from the Inter-connected National Grid System to regional power companies in figure 1 can be considered as the total power supply to sub-transmission lines). The increase during and just after the project completion reflects the effect of this project.

Figure 1: Ecuador: Power Supply to Regional Electric Companies (12 Companies) ¹⁾



Source: Document of CONELEC.

Note: ¹⁾ Data of power supply refers to power supplied to all local power companies, and data of power demand is power demand at each substation.

2.3.2 Improvement of Power System

Regional distribution networks connected to the Inter-connected National Grid System by the project sub-transmission line gained access to inexpensive but better quality and stable power supply in the place of power supply from independent thermal power stations.

- (1) Transmission loss shown in table 1 is recently about 3–4 %, which is within an acceptable level. If taking a look at the performance of two individual regional power companies, the Cotopaxi Province Electric Company (Empresa Eletrica Provincial Cotopaxi: ELEPCO), which we visited at field survey at this evaluation, amongst 18.79 % (in September 2001) of system loss in this area, non-technical loss such as power stealing by illegal connection, occupied 8 %. Among technical loss, most is caused by distribution loss. The loss of sub-transmission lines and substations related to this project occupied about 0.99 %, which is not a critical figure.
- (2) According to other detailed information on power failure derived from the National Council of Electricity (Consejo Nacional de Electricidad: CONELEC), which supervises and regulates the power sector in Ecuador, power shortage and power failure through accidents had frequently occurred before the project, but at present the situation is much improved except for a few networks. Power failure occurs at any stage of power generation, transmission, and distribution, but this project is considered to have contributed to the decrease of number of power failure through the improvement of transmission systems.

Table 1: Power Loss and Load Factor (Inter-connected National Grid System)

Year	Power Loss by Distribution (%)	Power Loss by Transmission (%)	Load Factor (%)
1990	20.4	N.A.	58.2
1991	20.3		58.4
1992	19.8	3.3	58.2
1993	21.1	3.9	58.2
1994	21.0	4.4	56.9
1995	19.4	4.3	54.2
1996	19.5	8.0	56.0
1997	20.2	4.1	57.5
1998	20.4	3.9	59.3
1999	20.9	3.2	58.3
2000	22.0	3.3	59.3

Source: Document of CONELEC.

2.4 Impact

2.4.1 Contribution to Improvement in Electrification Rate

This project was to construct sub-transmission lines and therefore its direct impact on the improvement of the electrification rate is not considered to be remarkable. Nonetheless, because projects for distribution network construction (such as Rural Electrification Project assisted by Inter-American Development Bank) were implemented at the same time, the electrification rate improved nation-wide both before and after the implementation of this project (see table 2). This project may have an indirect contribution to this improvement, since sub-transmission line is generally prerequisite for the distribution network construction. An increase in both national electrification rate and power supply to regional power supply companies also support this assumption.

Table 2: Electrification Rate in Ecuador

Year	1985	1990	1995	2000
Electrification Rate	59.3%	77.7%	78.8%	82%

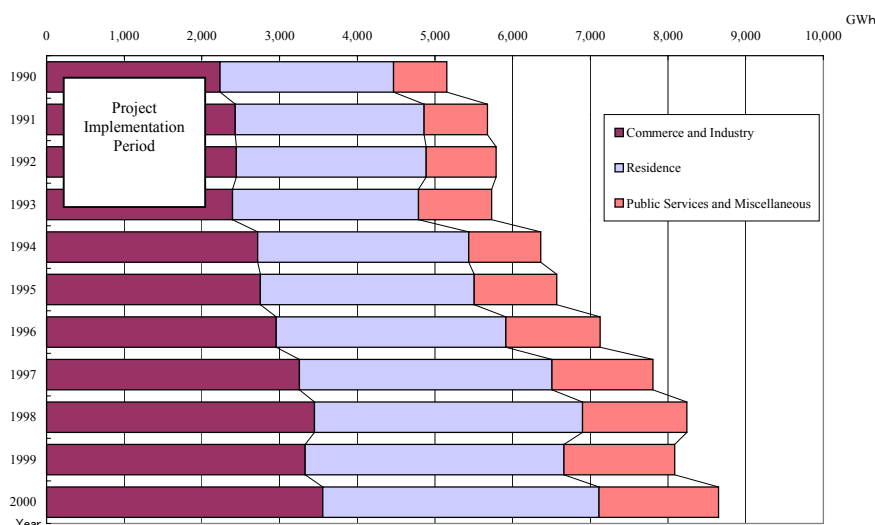
Source: Data for 1985 is from INECCEL "Master Plan for Electrification in Ecuador Period: 1990-1991 (Plan Maestro de Electrificación del Ecuador)", 1990,95. Data for 2000 is from the documents of CONELEC.

2.4.2 Power Consumption Increase and Regional Economic Development

Between 1990 and 1997, Ecuador's real economic growth rate recorded an annual 2–4 %, while power consumption related with commerce and industry grew after the project implementation. This illustrates that this project supported the stimulated economic activities through the improvement in power supply and service.

For example, in the field survey at this evaluation, there were reports that the production of flowers and ornamental plants (power being necessary at night-time to adjust efflorescence timing) as well as dairy products (power being necessary for processing machinery) grew due to the increase of power supply in the areas served by the North Region Electric Company (Empresa Eléctrica Regional Norte S.A.:EMELNORTE S.A.) and ELEPCO.

Figure 2: Trends in Power Consumption by Sectors



Source: Document of CONELEC.

2.4.3 Termination of operation at the existing power plants

Although detailed data was not available, according to TRANSELECTRICS S.A., some thermal power stations stopped operation because the substations and sub-transmission lines constructed under the project connected distribution networks to National Grid. These power stations, having stopped the operation, were able to save the consumption of oil and reduce an environmental negative impact. Some of the thermal power plants that formally supplied power to distribution networks, however, are still utilized for emergency standby or private use since power demand has greatly increased. Examining the share of the source of power generation in the country, therefore, the decrease in the share of thermal power generation was not remarkable.

2.4.4 Impacts on Environments and Society

This project was not accompanied by resettlement of local residents. The executing agency reports that transmission lines were constructed avoiding major woods, vegetation and farms; thus there was hardly any influence on the environment.

At the stage of project planning, there were no regulations for environment impact assessment in Ecuador³, thus assessment in the form of an integrated environmental impact study was hardly undertaken. Upon implementing this project, however, the Environment Unit of the Energy Sector (Unidad Medio Ambiente Sector Energía: UMASE) in the INECEL examined the environmental aspect of the project. They paid attention to environmental aspects by making reparation for farmers if their farms were affected and also by suggesting a change in cultivated varieties if their height exceeds more than three meters.

2.5 Sustainability

2.5.1 Operation and Maintenance System

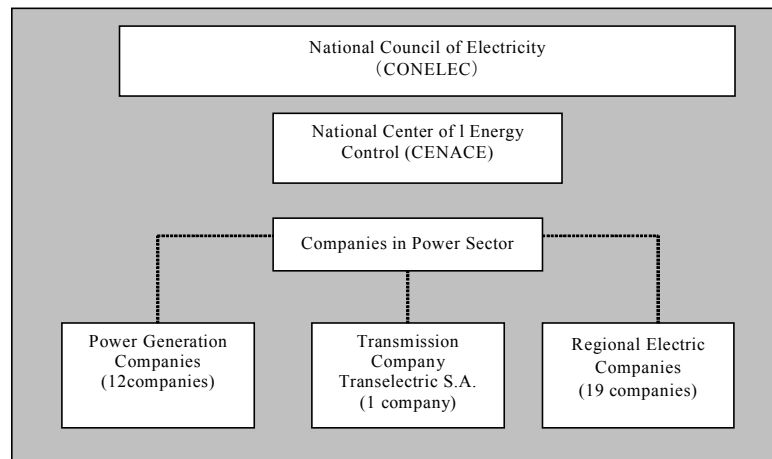
Based on the reform of the law regulating power sector in 1999, Ecuador has implemented power sector reform by mobilizing the participation of the private sector including that of foreign capital. The current administration of the Inter-connected National Grid System is shown in figure 3. The CONELEC sets regulations and standards for the whole power sector, and supervises the sector. The National Center of Energy Control (Centro Nacional de Control de Energía: CENACE) controls supply in the national power market. Below this exist state-owned⁴ power companies, power transmission companies (TRANSELECTRIC S.A.), and local power companies.

In 1999, INECAL, which was a government organization, was dissolved. In the place of INECEL, TRANSELECTRIC S.A. was established as the company in charge of investment, control and the operation of transmission lines. Currently, the operation and maintenance of all 130v and 138v transmission lines are undertaken by the TRANSELECTRIC S.A. Sub-transmission lines and facilities under 69vt, including ones constructed by this project, are operated and maintained by the respective regional power companies. The privatization of these companies is planned in the future.

³ In Ecuador, regulations at a national level for environmental assessment started to be stipulated after 1996. Currently, all projects undertake environmental impact studies.

⁴ Strictly speaking, TRANSELECTRIC S.A. is a company limited by shares which are owned by the 'Solidarity Fund', an organization of the Ecuadorian government. The 'Solidarity Fund' also owns the share of 6 power generation companies and 18 regional power companies.

Figure 3: Power Sector in Ecuador



Source: TRANSELECTRIC S.A., CONELEC

2.5.2 Current condition of project facilities

According to reports from TRANSELETRIC S.A., the facilities constructed under this project are properly operated by the regional companies and no accidents have happened. In a field survey interview at this evaluation on the maintenance conditions related to this project with CONELEC and two regional power companies (ELEPCO S.A., and EMELNORTE S.A.), all reported that there were no problems regarding personnel issues or any others in particular. As regards the two companies which the survey mission visited, responsible persons were deployed to every substation, and trained staff of local power companies undertook maintenance services. Engineers were appropriately allocated according to the increased number of facilities.

2.5.3 Financial Conditions

(1) Regional Power Companies

As regards the regional companies in charge of maintenance of this project, two companies which were visited (EMELNORTE S.A. and ELEPCO S.A.) for this evaluation did not have any particular financial problems which might create a maintenance fund shortages. TRANSELETRIC S.A. also mentioned no serious financial problems in the maintenance of facilities constructed by this project.

(2) Tariff System in the power sector

The electric tariff has been regulated since 1999 by the CONELEC. In recent years, in order to prepare for privatization, low tariff rates set by policy are gradually rising to the level equivalent to cost⁵. However, the electric tariff has not still fully covered the cost⁶. Support to institutional reform for power sector privatization by the World Bank is still ongoing. Although no conclusion has been seen yet, a further effort to improve financial operations in the power sector as a whole is still necessary.

⁵ The Ecuadorian government abolished subsidies for the electric tariff applied to the residence in 1998 and implemented a 25 % increase (CONELEC "Electrification Plan in Ecuador 1998-2007").

⁶ In 2000, the indicators of generation cost and electric tariff per unit (Cent US\$/kWh) in electric service, and power generation cost (including all generation, transmission and distribution costs) was 8.24, while the electric tariff (average in all categories) was 4.28.

Comparison of Original Plan and Actual Scope

Item	Plan	Actual
①Project Scope		
A. Construction of Sub-transmission Lines	New construction 31 lines, 535km Capacity upgrade 4 lines, 227km Continued construction 2 lines, 53km Total 37 lines, 815km	New construction 32 lines, 581.7km Capacity upgrade 3 lines, 214.4km Total 35 lines, 796.1km
B. Construction of Substations	New and upgrade construction Total 56 substations Total substation capacity: 407MW	New and upgrade construction Total 65 substations Total substation capacity: 471.5MW
②Implementation Schedule		
• Bidding	September, 1985～November, 1985	June, 1986～August, 1986
• Evaluation	December, 1985～February, 1986	September, 1986
• Contract	March, 1986	February, 1987 & September, 1988
• Delivery of local materials	April, 1986～January, 1987	February, 1987～September, 1989
• Construction	July, 1986～February, 1988	May, 1988～March, 1993
③Project Cost		
Foreign Currency	9,499 million yen	9,364 million yen
Local Currency	4,629 million yen	4,149 million yen
Total	14,128 million yen	13,513 million yen
ODA Loan	9,499 million yen	9,364 million yen
Exchange Rate	1 sucre = 4.74 yen (1983)	1 sucre = 0.02938yen (1997)