

Vanuatu

Ex-Post Evaluation of Japanese ODA Grant Aid Project
“The Project for Improvement of Power Generation
in Sarakata River Hydroelectric Power Station”

External Evaluator: Keisuke Nishikawa
Ernst & Young Sustainability Co., Ltd.

0. Summary

This project was implemented to supply stable electricity to Luganville through hydropower generation by strengthening the supply capacity at the Sarakata River Hydroelectric Power Station. This project was highly relevant to the development policy and needs of Vanuatu, which had the goal of ensuring a stable power supply and reducing its dependence on diesel fuel, and also with the ODA policy of Japan having the focus of assistance for economic development. The effectiveness of the project was high as the actual amount of diesel fuel for power generation was reduced more than the planned amount, and the power generation capacity also continually surpassed the electricity demand. With regard to the implementation of the project, the project outputs, costs and periods were all implemented as planned, resulting in a high level of efficiency. In addition, the sustainability of the project can be seen as high since there are no issues regarding the supervising and outsourcing structure, the technical level of the concessionaire and the financial aspects.

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

1. Project Description



Project Location



Generator Unit Provided in the Project

1.1 Background

Up to around 1990, electricity was mainly generated by diesel engine generators using imported diesel oil, constituting a heavy burden on the national economy. Under these circumstances, the Government of Vanuatu adopted a policy to break away from dependence on oil as a priority target, formulated an energy programme primarily featuring a shift to hydroelectric power generation and made a request to the Government of Japan for the implementation of a project to build the Sarakata River Hydroelectric Power Station to supply electricity to Luganville. In response to this request, the Government of Japan implemented the “Project to Construct the Sarakata River Hydroelectric Power Station on Santo Island” in 1994 and 1995 as a grant aid project. Following the construction of this new power station with two 300 kW turbine generators (combined generating capacity of 600 kW), this power station supplied as much as 70% of the electricity to Luganville in 1995, contributing to it breaking away from dependence on oil for some time¹.

However, the conspicuous growth in power demand in the area in the subsequent years made it impossible for the rated generating capacity of this hydroelectric power station to meet the peak power demand. This situation led to renewed dependence on diesel oil generation and the resulting increase in diesel oil procurement costs began to put pressure on the economy of Vanuatu.

In order to alleviate this situation, this project was implemented as a grant aid project to install a new 600 kW hydraulic turbine generator at the Sarakata River Hydroelectric Power Station.

1.2 Project Outline

The objective of the Project is to supply stable electric power to Luganville on Espiritu-Santo (hereinafter referred to as “Santo”) through hydroelectric generation by increasing the capacity of the Sarakata River Hydroelectric Power Station.

| | |
|-----------------------------------|--|
| Grant Limit / Actual Grant Amount | 1,280 million yen / 1,234 million yen |
| Exchange of Notes Date | 26 January, 2007 (Phase 1/2) 6 June, 2007 (Phase 2/2) |
| Executing Agency | Energy Unit, Ministry of Lands, Energy, Environment, Mines and Water Resources |

¹ The area of coverage of electricity supply on Santo is only up to the area around Luganville. The means of power generation until the mid-1990s was only the Luganville Diesel Power Station, and the hydroelectric power supply was added as a result of Japan’s grant aid project. At present, these are the only large-scale power stations.

| | |
|-------------------------|--|
| Project Completion Date | 29 February, 2008 (Phase 1/2) 9 January, 2009 (Phase 2/2) |
| Main Contractor | Construction: Dai Nippon Construction (Phase 1 & 2) Procurement: ITOCHU Corporation (Phase 2) |
| Main Consultant | Yachiyo Engineering Co., Ltd. |
| Basic Design Study | June, 2006 – January, 2007 |
| Related Projects | [Grant Aid] Project to Construct the Sarakata River Hydroelectric Power Station on Santo Island (1994-1995) |

2. Outline of the Evaluation Study

2.1 External Evaluator

Keisuke Nishikawa, Ernst & Young Sustainability Co., Ltd.

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted in the following timeline.

Period of the Study: October 2011 – September 2012

Period of the Field Study: 31 March – 11 April and 24 May – 2 June 2012

2.3 Constraints during the Evaluation Study

As the financial information provided by UNELCO, a concessionaire of the power station until 2010, was not sufficient, it was difficult to analyse the revenues from electricity sales and the structure of the income and expenditure accounts.

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

3.1 Relevance (Rating: ③³)

3.1.1 Relevance with the Development Plan of Vanuatu

At the time of project planning, the Government of Vanuatu had placed strategic priorities on the development of infrastructure such as electricity, water and communications, as specified in the national development plan entitled Priorities and Action Agenda 2006-2015, in which power supply was seen as the most important challenge for the improvement of public services. At the time of ex-post evaluation the Priorities and Action Agenda 2006-2015 was still effective and the importance of power supply has also remained high.

In the electricity sector, a stable supply of electricity in the electrified areas of Port

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

³ ③: High, ②: Fair, ①: Low

Vila (capital) and Luganville (on Santo) and the promotion of electrification in the rural areas where 80% of the total population resided were the key challenges at the time of project planning. A framework to utilise the funds released by savings from the reduction in diesel fuel costs through the implementation of this project was established for this purpose. In Vanuatu, while there had not been any development plans for the electricity sector, an inception report of the roadmap directing the path for energy development in the country was announced in December 2011, in light of the importance of formulating an overarching plan to cover the stable supply, connection to the power supply, tariff controls and so on. A final version of the roadmap is soon to be summarised. In this sector policy, priority focuses are placed on lowering the dependence of Vanuatu on imported diesel fuel, exploring the possibilities of hydroelectric and photovoltaic generation and also increasing the electrification rate, currently standing at 27%. These priorities can be said to be in line with the aim of this project. It is also worthwhile noting that there is a concrete movement in which a plan for a 2MW-class hydroelectric power station in another river basin on Santo has emerged with assistance from another donor agency.

It can therefore be concluded that this project is consistent with the development policy and programmes of Vanuatu at the time of both project planning and the ex-post evaluation.

3.1.2 Relevance with the Development Needs of Vanuatu

With the implementation of the Project to Construct the Sarakata River Hydroelectric Power Station on Santo Island (hereinafter referred to as “the previous project”) in the mid-1990s, a reduction in diesel fuel and improvement of the electrification rate have progressed, but dependence on diesel generation was again on the increase amid the surging electricity demand. In detail, the rate of dependence on the diesel power station, which had dropped to 32% in 1996, returned to 61% in 2005, leading to higher procurement costs for diesel fuel. Under these circumstances, this project was implemented again to strengthen the hydroelectric generation facilities, and the principle of meeting as much demand as possible from hydroelectric generation has been maintained at the time of ex-post evaluation. Based on the above, the need to break away from dependence on diesel fuel has remained high and this project has consistently been in line with this need.

While the volume of power generation has recently been increasing in the Luganville area, the amount of diesel fuel used for power generation was 1.562 million litres (2008), 1.219 million litres (2009) and 0.492 million litres (2010), 0.703 million litres

(2011)⁴, showing a rapid reduction after the completion of this project. The rate of dependence on diesel fuel out of the total generation has been declining, thus demonstrating the considerable importance of hydroelectric power generation as a means of power production.

3.1.3 Relevance with Japan's ODA Policy

Based on the five priority policy targets (Economic growth, Sustainable development, Good governance, Security, People to people communication and exchanges) that Japan expressed at the Fourth Pacific Islands Leaders Meeting (May 2006), Japan had a policy of providing assistance to Vanuatu, one of the Less Developed Countries (LDCs), in a strategic manner in line with the development strategy of the Vanuatu government. Among all these targets, the focuses were placed on economic growth, sustainable development and good governance, and 'economic growth' included cooperation in infrastructure development. In sum, this project, which supported the development of infrastructure leading to the growth of the Vanuatu economy, particularly the economy of Santo, demonstrates high consistency with Japan's aid policy.

This project has been highly relevant with the country's development plan, development needs, as well as Japan's ODA policy, therefore its relevance is high.

3.2 Effectiveness⁵ (Rating: ③)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

The effect of the project expected at the time of planning was a reduction in the amount of diesel fuel used. In this ex-post evaluation study, in addition to the amount of diesel fuel used, generated electricity, electricity sold, generator capacity, maximum demand, and the outage hours were examined as they were the basic indicators to measure the quantitative effects of the project.

3.2.1.1 Amount of Diesel Fuel Used

As stated in "3.1.2 Relevance with the Development Needs of Vanuatu", the amount of diesel used for power generation in the Luganville area decreased substantially after the implementation of this project.

⁴ Data provided by the Department of Energy, Mines & Mineral Resources

⁵ The evaluation result of the project impacts is incorporated into the Effectiveness rating.

Table 1: Amount of Diesel Fuel Used Before and After the Project

| | 2008 | 2009 (Completed) | 2010 | 2011 |
|---|-------------------|---------------------|-------------------|-------------------|
| Diesel Fuel Used for Power Generation in the Luganville Area (Unit: thousand litres) | 1,562 | 1,219 | 492 | 703 |
| Amount of Diesel Imported into Vanuatu (Unit: thousand litres) (Import Value (Unit: million Vatu)) | 70,660 (6,265) | 70,140 (4,346) | 68,740 (4,104) | 75,890 (5,665) |
| Diesel Fuel Used for Power Generation / Amount of Diesel Imported into Vanuatu (%) | 2.21 | 1.74 | 0.72 | 0.93 |

Source: Data Provided by the Department of Energy, Mines & Mineral Resources / Customs and Inland Revenue

At the time of project planning, a reduction of 0.85 million litres of diesel fuel for power generation in 2009 was targeted by implementing this project⁶. The amount of 1.56 million litres used in 2008 reduced to 1.22 million litres in 2009 and down further to 0.49 million litres in 2010. In 2011, the amount of diesel fuel used temporarily rose to 0.7 million litres due to the failure of the No.1 Generator Unit at the Sarakata River Hydroelectric Power Station, provided under the previous project, but the reduction from the 2008 figure was 1.07 million litres in 2010 and 0.86 million litres in 2011, with both of them achieving the target. In comparison with the amount of diesel imported into Vanuatu, hovering around 70 million litres, the amount of diesel fuel for power generation in the Luganville area which decreased in this way, also achieved a level of less than 1% both in 2010 and 2011 from 2.21 % in 2008 in terms of the proportion to the overall amount of imported diesel in Vanuatu.

3.2.1.2 Trend in the Amount of Electricity Generated and Sold, Generator Capacity and the Maximum Demand

The effects of power generation projects are generally considered to be the increase in power generation and the enhancement of generator capacity and the reduction in outage hours, in addition to the reduction in diesel fuel mentioned above. In this ex-post evaluation study, these figures were obtained to make a comparison of the planned and actual outputs as shown in Table 2.

⁶ Although the project was completed in early 2009, actual operation commenced in May 2009 due to the preparatory time required for test runs. As a result, the figures for the comparison of the planned and actual outputs are obtained from 2010, when the generator operated for a full calendar year, and also from 2011, two years after the completion of the project.

Table 2: Project Effect Indicators in the Luganville Area

| | 2008 | 2009 (Completed) | 2010 | 2011 |
|--------------------------------|-------|---------------------|-------|-------|
| Generated Power per year (MWh) | 7,072 | 7,267 | 8,311 | 8,641 |
| Diesel Fuel (MWh) | 5,438 | 4,256 | 1,673 | 2,439 |
| Hydroelectric (MWh) | 1,634 | 3,011 | 6,638 | 6,202 |
| Energy Sold (MWh) | 6,482 | 6,529 | 7,555 | 7,558 |
| Generator Capacity (kW) | 3,450 | 4,050 | 4,050 | 4,050 |
| Diesel Fuel (kW) | 2,850 | 2,850 | 2,850 | 2,850 |
| Hydroelectric (kW) | 600 | 1,200 | 1,200 | 1,200 |
| Maximum Demand (kW) | 1,373 | 1,366 | 1,530 | 1,650 |
| Unplanned Outage Hours (hour) | 1.13 | 3.24 | 1.42 | 4.39 |
| Human error (hour) | 0 | 0.79 | 0.04 | 0.00 |
| Mechanical trouble (hour) | 1.13 | 2.45 | 1.38 | 4.39 |
| Planned Outage (hour) | 0.36 | 7.43 | 7.20 | 0.98 |

Source: Provided by the Department of Energy, Mines and Mineral Resources

As a result of the implementation of the project, the total amount of generation (supply) has increased to a level where the amount of sales (demand) can be met. It is particularly worth noting that the composition of diesel generation and hydroelectric generation reversed after the project implementation and 80% of the total generation was covered by hydroelectric generation in 2010 when the Sarakata River Hydroelectric Station operated for a full year. The overall generation cost has been substantially reduced as the amount of generation by diesel engines decreased through the development of the hydro-generation capacity. The supply capacity is also well above the maximum demand.

Planned and unplanned outages were not frequent or long even before the project, enabling a stable supply generally at all times. A slight increase in the time of outages (planned and unplanned) in recent years is attributed to repairs by the concessionaire when breakdowns of the generator units occurred relatively frequently due to their deterioration. These repairs had mostly been completed by the time of the ex-post evaluation and more stable operation was made possible.

3.2.2 Qualitative Effects

The following qualitative effects were expected at the time of project planning.

- (1) The foundation improvement work to be implemented for the intake water canal zone would help ensure a stable supply of water needed for the hydroelectric power generation, enabling the power station to be run constantly.
- (2) The excess power supply capacity to be realized would ensure a stable power supply even at the time of a generator maintenance shutdown or unexpected failure.

With respect to the qualitative effect (1) above, the foundation improvement work under this project was completed successfully in the intake water canal zone. There have been no major ground collapses, and water is constantly available in the volume required to generate electricity. The ground surface of the worked area has been covered by natural vegetation over the course of several years since project completion. The risk of soil erosion has thus been reduced.



Photo 1: Current Condition of the Intake Water Canal

With respect to the qualitative effect (2) above, the 600 kW power generation unit⁷ under this project was granted at a time when one (Generator No.1) of the two generators (each with a 300 kW capacity) provided under the previous project more than 10 years before and the diesel power generation unit in Luganville had been experiencing various aging troubles. The project has made a major contribution to enhancing the excess supply capacity and ensuring stable operation of the hydroelectric power plant.

3.3 Impact

3.3.1 Intended Impacts

A major indirect impact of the project was the enhancement of the Sarakata Fund (as detailed below) to raise and pool the necessary funds for the electrification of, and stable power supply to, rural areas of Vanuatu, which in turn would improve the standard of living of the people in rural communities.

3.3.1.1 Accumulation of the Sarakata Fund

For a long time a flat-rate consumer electricity tariff system has been applied nationwide in Vanuatu. The flat-rate tariff is determined by the government on the basis of the cost of diesel power generation. Operation of the low-cost hydroelectric power station at Sarakata River generated extra income through the savings in the cost of imported diesel fuel.

At the time of the previous project, accordingly, the governments of Japan and

⁷ The two 300 kW hydroelectric generators granted under the previous project are called Generators No.1 and No.2. The 600 kW generator under this project is called Generator No.3.

Vanuatu agreed with the then concessionaire UNELCO to create the Sarakata Renewal Fund and Sarakata Special Reserve Fund in which the savings in the cost of imported diesel fuel were to be pooled. The Sarakata Special Reserve Fund was to finance rural electrification projects and the Sarakata Renewal Fund was to finance the purchase of equipment and materials required for the maintenance of the facilities.

The Sarakata Special Reserve Fund was instrumental in financing many electrification projects not only in the Luganville region, but also other parts of Santo Island and other islands. The projects consisted of transmission line extensions, branching to households and streetlight installation. More specifically, between 1995 and 2006 the Fund financed 69 projects approved by the government's Technical Committee (42 on Santo Island and 27 on other islands) and some other projects. (See Table 3)

Table 3: Major Projects Funded by the Sarakata Special Reserve Fund (in Santo Island)

| Year | Projects in Santo Island | Total Cost (Unit: 1,000 Vatu) |
|-----------|---|----------------------------------|
| 1996/97 | Grid extensions to Solway Marinacce & Canal 1 / 119 Household connections / Luganville Street Lights maintenance | 11,971 |
| 1997/98 | Grid extensions to Fanafo, Sarakata 4, Leroy, Collet, Chabaud, Procureur, Canal 2, St Louis, Mango, Fanafo & Sarakata 3,4,5 &6 / Luganville Street Lights maintenance | 31,642 |
| 1998/99 | Grid extensions to Paamal, Canal 2, St Michel, Santo East 2, Ballande, Route du General de Gaulle, Quartier Sarakata & Canal du Second 1 / 276 Household connections / Luganville Street Lights maintenance | 46,378 |
| 1999/2000 | High Voltage grid extension to Matevulu College / Chapuis Agriculture / Luganville Street Lights maintenance | 58,640 |
| 2000/01 | High and Low Voltage extensions to Chapuis, Banban, Santo East 1, Sarakata Extension 5,6 & 7, Chabaud, Argrencourt, Cook & Laperouse, Fanafo 2, Natanara School, Peter Colmar & Oyster Island / Luganville Street Lights maintenance / Additional new Street Lights / 177 Household connections | 48,895 |
| 2001 | High and Low Voltage extensions to Lopelope, Suranda & Banban / 96 Household connections in Lopelope, Suranda & Banban / Luganville street lights maintenance / Sanma Provincial Government electricity bills | 24,498 |
| 2002 | Luganville Street Lights maintenance / Electricity tariff subsidy in Luganville / Tariff modification in UNELCO's system to account for the tariff subsidy in Luganville | 17,001 |
| 2003 | Luganville Street Lights maintenance / Sanma Provincial Government electricity bills / Santo Agriculture College / 18 Household connections / Electricity tariff subsidy in Luganville | 32,091 |
| 2004 | Additional new Street Lights / Luganville Street Lights maintenance / Sanma Provincial Government electricity bills / Electricity tariff subsidy in Luganville | 17,569 |
| 2005 | Nitchiku station transformer at Saraoutou / Sravi-Sarabo transformer / Low voltage grid extension at Ballande / Luganville Street Lights maintenance / Sanma Provincial Government electricity bills | 8,784 |
| 2006 | Electrify Ex-Supreme Court Judge House / Port Olry Electrification / Matevulu College electrical meters / Luganville Street Lights maintenance / Sanma Provincial Government electricity bills / Luganville Municipality electricity bills | 10,154 |

Source: Provided by the Department of Energy, Mines and Mineral Resources

The data show that Sarakata River hydroelectric power generation project did produce surplus funds stably every year, which were used to promote rural electrification in Vanuatu.

It must be added, however, that between 2007 and 2010 no electrification projects were financed by the Fund.⁸ While the Fund played a major role in financing many electrification and other projects in the period of a little over a decade since its creation, the Utilities Regulatory Authority (URA) audit revealed some problems in the fund management, and the Sarakata Fund has been frozen since the end of 2010.

3.3.1.2 Promotion of rural electrification and higher living standards

Since even before the project implementation, electric power supply in the Luganville region has been fairly stable. Our simplified beneficiary survey⁹ of the residents showed that 80% of the respondents considered the supply to be “Moderately stable” and another 15% “Very stable.” There was no conspicuous change between before and after the project. Rather, the project produced the significant effect of lowering the risk of scheduled power cuts and unexpected outages caused by insufficient power supply capacity.

The simplified beneficiary survey also showed that the residents of the newly-served communities around Luganville felt that their lives had been improved considerably in terms of food refrigeration and evening studies under lighting. The stable supply of electricity remains unchanged and electrification in the Luganville region has been started anew by the new concessionaire. It is fair to say that there has been an expansion of the area with a comfortable life with electricity services.

Even though the residents are generally content with the supply stability of electric power, many of them expressed in the simplified beneficiary survey that further efforts are needed to prevent the brief supply interruptions (for some minutes) that still occur occasionally.

3.3.2 Other Impacts

3.3.2.1 Impacts on the Natural Environment

The project objective was to enhance the power generation capacity of the hydroelectric power station. It was expected that its implementation would reduce the operation time of the existing diesel fuel-based power station, thus alleviating the

⁸ In 2011, electrification of the communities in the Luganville region was resumed by the new concessionaire using its own funds.

⁹ An interview survey was conducted during the field study by the external evaluator (May 2012). Questions related to power supply stability and changes in lifestyle were asked to 20 respondents in factories, schools, hospitals and stores in the Luganville region.

air pollution and noise problems. As discussed above, the consumption of diesel fuel for the purpose of power generation has been reduced significantly, and the air pollution, carbon dioxide emissions and noise nuisance problems in the neighborhood of the diesel fuel-based power station are believed to have been alleviated.

The assumption at the time of project planning that the increased intake of water from the Sarakata River would cause no major environmental impacts was found to be correct. The water is taken in from the top part of the surface water. Visual inspections, the simplified beneficiary survey and interviews with the authorities concerned all confirmed that there were no adverse environmental impacts.¹⁰ Annual precipitation varied between 2,400 and 3,300 millimeters¹¹ in the period of 2006 – 2010. The river water level does not appear to have been affected adversely, showing only the normal water level decrease during the dry season.

3.3.2.2 Land Acquisition and Resettlement

No direct land acquisition issues exist in this project because it was implemented within the premises acquired for the previous project and no new land acquisitions were made.

No resettlement issues exist because the project site is located deep in an uninhabited mountain area. It should be mentioned that the land acquisition issue that arose after the implementation of the previous project was still pending at the time of this ex-post evaluation. When the previous project was planned, consent was duly obtained from the tribe chief of the planned project site. But the process of determining the landowners took a very long time. Recently four landowners were finally identified and land purchase negotiations began in March 2012 with the government. The negotiations concern the purchase price only and are expected to be successfully concluded soon. There are no issues concerning land use.

Vanuatu consists of many small islands, thus there are few rivers suitable for hydroelectric power generation. Yet the Sarakata River is not the only river on the biggest island of Santo with a potential for hydroelectric power generation. The executing agency feels that the experience gained through the Sarakata Hydroelectric Power Station Project, the only hydroelectric power station in Vanuatu, will provide a benchmark for future projects in the country, in particular in terms of the necessary

¹⁰ No quantitative analysis was possible in this ex-post evaluation due to the absence of water level data for the upstream and downstream reaches of the power station, as confirmed by interviews with the government authorities.

¹¹ Data for Pekoa International Airport on Santo Island, the nearest data point to the Sarakata Power Station (provided by Vanuatu Meteorological Services)

processes involved in land acquisition.

3.3.2.3 Other indirect impacts

A nationwide flat-rate electricity tariff was the tradition in Vanuatu for quite some time. In 2011, however, the tariff applicable to the Luganville region was reduced by 6.8% whilst that applicable to Port Vila was reduced by 4.7%. The URA, which has the authority to determine the electricity tariff, is believed to be continuing to pass on the benefits of the Sarakata River Hydroelectric Power Station to the residents of the Luganville region, even though it is not known at this time whether the Sarakata Fund will be reactivated.

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

3.4 Efficiency (Rating: ③)

3.4.1 Project Outputs

This project was a two-year project, divided into Phase 1/2 which was focused on the repair of the intake water canal and Phase 2/2 focused on capacity expansion of the hydroelectric power station. Tables 4 and 5 show a comparison between the final outputs and those planned.

Table 4: Planned and Actual Outputs (Phase 1/2: Repair of Intake Water Canal, etc.)

| Plan | Actual | Quantity |
|--|---|----------|
| [Repair of Intake Water Canal] Engineering Work of Intake Water Canal (830m) and Access Road (approx. 100m) | [Intake of the water canal] | |
| | Engineering work of foundation and retaining wall | 30m |
| | Installation of gabions | 130m |
| | Lock Bolting | 452 |
| | Surface draining sheet | 130m |
| | [Middle section of the intake water canal] | |
| | Installation of deterrent piles | 40 |
| | Connection of the deterrent pile edges | 81m |
| | Surface draining sheet | 220m |
| | [Head tank section] | |
| | Surface draining sheet | 50m |
| | [Mountain section of the canal] | |
| | Rainwater inlet | 8 |
| | Installation of pipes crossing the canal | 8 |
| | Installation of U-shaped drainage ditch | 830m |
| | Surface draining sheet | 690m |
| | [Safety works of access road] | |
| | Engineering work of foundation and retaining wall | 103m |
| | Installation of gabions | 103m |
| | Lock Bolting | 376 |

Table 5: Planned and Actual Outputs
(Phase 2/2: Extension of Hydroelectric Power Station)

| Plan | Actual |
|---|---|
| Installation of steel pipe (penstock): 40m | Installation of steel pipe (penstock): 40m |
| Tailrace improvement work (for water discharge): 1 set | Tailrace improvement work (for water discharge): 1 set |
| Powerhouse extension work | Powerhouse extension work |
| [Hydraulic turbine equipment] Hydraulic turbine: 660kW or higher Generator: 3.3kV 750kVA Auxiliary equipment (distribution panel, etc.) * 1,200kW capacity will be secured, in conjunction with the existing generators | [Hydraulic turbine equipment] Hydraulic turbine: 674kW Generator: 3.3kV 750kVA Auxiliary equipment (distribution panel, etc.) * 1,200kW capacity will be secured, in conjunction with the existing generators |
| Main step-up transformer (3.3/20 kV, 750kVA) | Main step-up transformer (3.3/20 kV, 750kVA) |
| Step-down transformer for Sarakata River sub-station (20/5.5kV, 1,500kVA) | Step-down transformer for Sarakata River sub-station (20/5.5kV, 1,500kVA) |
| Maintenance tools: 1 set | Maintenance tools: 1 set |
| Spare parts: 1 set | Spare parts: 1 set |

In this ex-post evaluation, various documents related to the project were reviewed and representatives of the project executing agency and of the consultants were interviewed. The review and the interviews confirmed that the repair work of the intake water canal and the capacity expansion of the hydroelectric power station were both executed mostly as planned, as summarised in the above Tables 4 and 5. It was also learned that the construction work for which Vanuatu was responsible was all executed as planned, such as the repair of the interior of the intake water canal, repair of the surface of the access road to the power station (cobble stone pavement, etc.) and the installation of a mudslide prevention fence for the intake water canal.

The field study also confirmed that these outputs were duly obtained as planned (provided that no detailed inspection of the repair work on the intake water canal and access road was made).



Photo 2: Steel Pipe Installed (Left)



Photo 3: Hydroelectric Power Station Overview

3.4.2 Project Inputs

3.4.2.1 Project Cost

The project cost of the Japanese side was 1,234 million yen, below the cost of 1,280 million yen estimated during the project planning (96.4%). The total estimated project cost, including the 39 million yen to be borne by the Vanuatu side, was 1,319 million yen. In this ex-post evaluation, comparison of the actual and estimated total project costs was not possible because no data were available on the actual amount expended by the Vanuatu side. It can be reasonably assumed from the due completion of the planned construction work as described above that an amount very close to the estimate was invested.

Table 6: Planned and Actual Project Cost

(Unit: million yen)

| | Plan | Actual |
|--|-------|-----------|
| Phase 1 (Repair of Intake Water Canal) | 573 | 543 |
| Phase 2 (Extension of Hydroelectric Power Station) | 707 | 691 |
| Japanese portion | 1,280 | 1,234 |
| Vanuatu portion | 39 | No record |
| Grand total | 1,319 | No record |

3.4.2.2 Project Period

The planned project period¹² was 22 months, including the time periods required for detailed design and public tender. Actually, Phase 1/2 took 13 months (March 2007 – February 2008) and Phase 2/2 took 17 months (August 2007 – January 2009). The total project was thus 22 months, as originally planned. The overall

¹² The project period is here defined as the total period covering the detailed design and construction work.

detailed design was made at an early stage of Phase 1/2 and the construction work on the intake water canal and the expansion of the hydroelectric power station were executed in parallel. These work schedules made it possible to complete the project in 22 months as planned.

Both the project cost and project period were within the plan, therefore efficiency of the project is high.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

The executing agency of this project was the Energy Unit of the Ministry of Lands, Energy, Environment and Natural Resources (MOL). The actual operation and maintenance work of power generation and power transmission is performed by a private contractor under the supervision of the Energy Unit. At the time of project planning, the MOL had 134 employees, of which 9 belonged to the Energy Unit.

Subsequently, in September 2011, the Energy Unit became part of the Department of Energy, Mines and Mineral Resources of the Ministry of Lands and Natural Resources to become a unit mainly dealing with policy-related matters. In this restructuring process, the size of the Unit was reduced from the previous 9 members to 5, excluding members responsible for economics, civil engineering and administration.

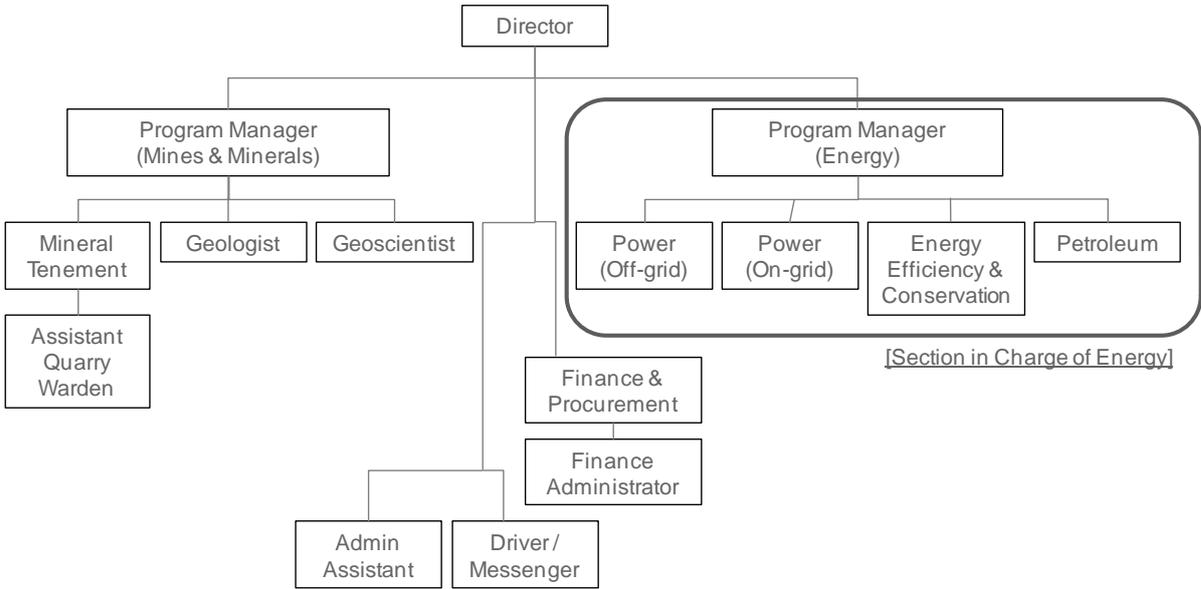


Figure 1: Organisational Structure of the Department of Energy, Mines and Mineral Resources

Since 1990, the power generation and transmission services in the Luganville region have been provided by a private firm under a concession contract. For the two decades until 2010, France-based UNELCO supplied electric power.¹³ For the services starting in 2011, US-based Vanuatu Utilities and Infrastructure (VUI) won the public tender and has since then been in charge of the operation and maintenance of the power supply system in the Luganville region, including the Sarakata River Hydroelectric Power Station.

In practice, the Sarakata River Hydroelectric Power Station is run by eleven nearby villagers who had been working in shifts since the UNELCO days. The engineers are normally based at the diesel power station in the city of Luganville and they visit the site for inspections several times a week. Communications concerning the power generation operations of the hydroelectric and diesel power stations and other necessary topics are conducted on a real-time basis through radio equipment. No particular problems were found in this regard.

UNELCO, who lost the bid for the concession starting in 2011, filed a lawsuit against the government claiming that the selection process was not transparent. The suit was still pending as of the date of this ex-post evaluation. Accordingly, the government has not been able to conclude a long-term concession contract with VUI; the contracted services are performed on the basis of a Memorandum of Understanding (MOU). Even though the absence of a long-term contract has had no adverse effect on the routine work, it has deterred VUI from making decisions on what it deems to be the required investments such as improved staffing, improvement of the intake water canal, renewal of the diesel power generator and further electrification of villages around Luganville. An early resolution of the dispute is desired.

3.5.2 Technical Aspects of Operation and Maintenance

With respect to the technical aspects of power supply in the Luganville region, employees who have many years of experience are engaged in the day-to-day operation, whilst a VUI expatriate handles more sophisticated technical matters. There are no problems with regard to the management of the facilities and the machinery and equipment; most of the needed work is done by VUI alone. Since VUI took over the operation and maintenance in 2011, it has successfully conducted substantial repair work on the No.1 Generator of the hydroelectric power station and has made repairs to the diesel generator as needed.

VUI has started what it calls a “Capacity Building Initiative” to train the

¹³ UNELCO continues to supply electricity in all other electrified regions of Vanuatu (Port Vila, Malekula and Tanna) even after 2011.

hydroelectric power station employees on technical and safety matters. Employees welcomed this programme, saying it provides a good opportunity to learn theoretically and systematically what they have learned on the job.

3.5.3 Financial Aspects of Operation and Maintenance

No specific data on the financial aspects of the power supply in the Luganville region were made available to the evaluator since UNELCO was in a legal dispute with the government. The evaluator learned that the business had made profits in every one of the years under this review. Here, accordingly, the evaluation will be made based on an analysis of the yearly transfer of funds into the Sarakata Fund before and after the implementation of the project.

As was mentioned already, the Sarakata Fund consists of the Sarakata Renewal Fund and the Sarakata Special Reserve Fund. The former fund finances the machinery and equipment maintenance costs, whilst the latter was regarded as revenue and was directed mainly to the financing of rural electrification projects. Every year, 10 million vatu was transferred into the Sarakata Renewal Fund and the amounts shown in Table 7 below were transferred into the Sarakata Special Reserve Fund.

Table 7: Accumulation of the Sarakata Fund (2006 – 2010)

(Unit: 1,000 Vatu (except for the power generated))

| | 2006 | 2007 | 2008 | 2009 | 2010 |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|
| Hydroelectric power generated (MWh) | 3,255.6 | 3,284.6 | 1,590.9 | 2,932.1 | 6,464.4 |
| Total cost saved | 78,523.3 | 73,099.9 | 43,873.6 | 50,979.3 | 154,091.4 |
| Reduction of Fuel | 76,929.5 | 71,181.1 | 43,097.9 | 49,600.8 | 151,052.2 |
| Reduction of Lubricants | 1,593.8 | 1,918.9 | 775.7 | 1,378.5 | 3,039.1 |
| Concession to UNELCO | 20,000.0 | 20,000.0 | 20,000.0 | 20,000.0 | 20,000.0 |
| Transfer to the Sarakata Renewal Fund | 10,000.0 | 10,000.0 | 10,000.0 | 10,000.0 | 44,296.5 |
| Transfer to the Sarakata Special Reserve Fund | 48,523.3 | 43,099.9 | 13,873.6 | 20,979.3 | 89,794.9 |

Source: Documents submitted by UNELCO to the Energy Unit

The amount transferred to the Sarakata Special Reserve Fund was considerable in 2010 when the power station came into full-scale operation. The project substantially increased the amount of hydroelectricity in that year, producing a saving of 151.05 million Vatu in fuel costs.

According to the URA audit of the Sarakata Fund (available only for the years 2003 through 2008), the balance of the Sarakata Special Reserve Fund as of the year-end

2008 was 61.53 million Vatu. Since 2007, no electrification projects have been implemented funded by the Sarakata Fund and the yearly transfers since then have brought the cumulative balance as of the time of this ex-post evaluation to 176.53 million Vatu, which is in the custody of the Ministry of Finance and Economic Management, as was confirmed in a statement by the Ministry.

During the six years from 2003 through 2008, 63% of the total disbursements from the Sarakata Fund were directed to electrification projects and the remaining 37% was paid to the government. A portion of the disbursements to the government were paid as compensation to the landowners who had been identified by then.¹⁴

As was mentioned earlier, a lawsuit is pending between the government and UNELCO. The government plans to decide whether to revive the Sarakata Fund soon after the final court decision is made. The original MOU with VUI remains in force and effect until a formal contract is signed, even though the initial term has expired. No problems have emerged in this respect for the operation and maintenance of the power station.

Power generation services are contracted entirely to the private sector in Vanuatu. The financial soundness of the government (Energy Unit) is not affected by the results of the private-sector services. This is not a case unique to the Luganville region; all other three regions (Port Vila, Malekula, and Tanna) have their electricity services operated on a stand-alone basis.

3.5.4 Current Status of Operation and Maintenance

The power generators of the Sarakata River Hydroelectric Power Station were being operated efficiently without any problems at the time of the visit for the ex-post evaluation. The Defect Inspection that was made one year after the project completion found that the governor for the No.1 and No.2 Generators provided under the previous project was made inoperable automatically. The visit in this ex-post evaluation confirmed that the defect had been corrected. It was learned that water was leaking from the No.1 Generator when the new concessionaire took over in 2011 and a substantial repair was made. This ex-post evaluation found no problems in the intake water canal or the access road and other civil engineering work. The power station building was in generally good condition as well.

Though not covered by the project, in contrast, most of the five diesel power generators in the Luganville Diesel Power Station had some troubles. After 2011, VUI was kept busy addressing these problems, including the replacement of large parts and components. By the time of the field study of the ex-post evaluation, repairs to the

¹⁴ An analysis by the external evaluation, based on URA audit reports and other references

diesel power generators had been completed to the extent that they could be operated for the peak demand hours. No problems were observed in the procurement of parts; there were no inoperable generators simply left idle.

Overall, the generators never all failed simultaneously leading to a power shortage, even though minor repairs had to be made occasionally. Even since the time when UNELCO was the concessionaire, the Sarakata River Hydroelectric Power Station and the Luganville Diesel Power Station have generally been operated well. At one point, more frequent repairs were necessary than before because some of the generators tended to have trouble that was associated with aging. Currently, however, VUI applies its experience of electricity supply services in Fiji and the Northern Mariana Islands to maintain an effective level of maintenance and repair for the facilities here.

A matter of slight concern is the slow progress of efforts to narrow down the area affected by outages. The current power grid has been installed in such a way that an interruption at one location leads to a failure of the entire supply network. VUI intends to install breakers at key locations in order to isolate the outage area, but is hesitant to make a sizeable capital investment in the absence of a long-term concession contract with the government. If protracted, this contractual uncertainty can negatively affect not only the grid structure, but also the maintenance and repair of other existing facilities as well as the contemplated new investments for the expansion of the electrified area. It is hoped that accelerated efforts will be initiated for the conclusion of a long-term concession contract so that the concessionaire can reduce the business risks involved.

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

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was implemented to supply stable electricity to Luganville through hydropower generation by strengthening the supply capacity at the Sarakata River Hydroelectric Power Station. This project was highly relevant to the development policy and needs of Vanuatu, which had the goal of ensuring a stable power supply and reducing its dependence on diesel fuel, and also with the ODA policy of Japan having the focus of assistance for economic development. The effectiveness of the project was high as the actual amount of diesel fuel for power generation was reduced more than the planned amount, and the power generation capacity also continually surpassed the electricity demand. With regard to the implementation of the project, the project outputs, costs and

periods were all implemented as planned, resulting in a high level of efficiency. In addition, the sustainability of the project can be seen as high since there are no issues regarding the supervising and outsourcing structure, the technical level of the concessionaire and the financial aspects.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

4.2.1.1 Restructuring of power generation

The diesel power generators of the Luganville Diesel Power Station are obsolete and are suffering from trouble rather frequently. The newest generator is already more than 10 years old and the oldest has been in service for over 20 years. The successful completion of this project has made it unnecessary to run all the five diesel generators simultaneously even during peak hours. At night and on weekends and holidays it is often possible to meet the demand with the supply from the hydroelectric power station alone. This has alleviated the noise problem of the diesel power station which is located within the city.

It is believed worthwhile to consider replacing the existing diesel power station by constructing a new hydroelectric power station --- for instance, the project under consideration by another donor on a different river on Santo Island --- or by introducing more efficient diesel generator(s). Such modernization of the power generation structure would further reduce the dependence on imported diesel fuel and eliminate the increasing costs of maintenance and repair of the existing equipment.

4.2.1.2 Future of the Sarakata Fund

A nationwide flat-rate tariff for electricity has been the tradition in Vanuatu. Residents of the Luganville region, especially the local business community, often voiced the complaint that they do not benefit much from the revenues that the Sarakata River Hydroelectric Power Station generates and that most of the benefits are transferred to the capital city and other islands. In reality, the residents on Santo Island are believed to have benefitted from significant progress in the electrification of their communities. It is nonetheless felt important to pay attention to a proper balance between regional equity and the return to the local communities when deciding the future course of the Sarakata Fund.

4.2.2 Recommendations to JICA

No recommendations.

4.3 Lessons Learned

As mentioned above, the Sarakata Fund is presently frozen. Some expressed the view that the freeze does not need be lifted because the electrification of the rural areas that is financed by the Fund generates further profits from the sale of electricity. In short, profitable projects do not need such a special funding system, they say. It is however correct to state that the Sarakata Fund was indeed an effective mechanism in facilitating, at the least, the initial investment required for the low-profitability electrification projects in rural areas. It will be worth considering the advantages and disadvantages of setting up a similar funding scheme in the context of the applicable tariff system when planning a power supply project in or outside the country.