Solomon Islands

Ex-Post Evaluation of Japanese Grant Aid Project
The Project for Improvement of Honiara Power Supply in Solomon Islands

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0. Summary

This project aimed to establish a stable power supply system in Honiara city by developing generating facilities. The relevance of this project is high, as it is consistent with the priority area of Solomon Island's development plans and Japan's ODA policy, and has development needs. By implementing the project, benefits such as increasing the power supply, stabilizing voltage drops and decreasing outage time due to damage to distribution and transmission lines, were confirmed. However, overall power outages in Honiara city have increased due to the breakdown of other generating facilities. Furthermore, the urgent reserve capacity is now at the same level as the planning stage due to the increased power demand. Conversely, it would not be possible to retain the balance of power demand and supply if the project were not implemented, and a certain level of contribution was confirmed by the project such as increasing the power supply, revitalizing economic activities and stabilizing the public facility operation. Therefore, the effectiveness of the project is fair. Its efficiency is also fair, as the project cost remained within budget while the actual project period went slightly beyond the schedule. Finally, the sustainability of the project is also fair as no major problems were observed in terms of the institutional aspect and technical capacity, despite some concerns about the financial status and supply of spare parts, etc.

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

1. Project Description

Project Location

Installed Diesel Engine Generator

1.1 Background

The capital of the Solomon Islands is Honiara which is located on Guadalcanal Island and which is the center for the country's political and economic activities. The city experienced a severe power crisis originating from an insufficient available capacity from 1996-1998. This power shortage was solved in 1998 as a result of foreign assistance which included the installation of the generating unit at the Lungga Power Station under the Power Development Project in the Lungga District, a Japan's grant aid project, making a positive contribution to the securing of power supply capacity. Despite such improvement, sudden breakdowns had been frequently taking place at the time of project planning due to the aging of the existing generating facilities and insufficient maintenance during the period of ethnic conflict from the end of 1998 to 2003, illustrating the insufficiency power supply capacity in Honiara. Meanwhile, power supply to users was provided by 33 kilo Volt (kV) transmission lines and 11kV distribution lines. Almost all of the existing transmission and distribution equipment was 20 years old or more and showed signs of aging as well as wearing out. The resulting lack of capacity in distribution lines resulted in a voltage drop of some 20%, while the step-down transformers are subject to constant overloading due to insufficient capacity. This means replacing the existing distribution equipment with new distribution equipment to handle the present load is crucial.

Under these circumstances, the project aimed to ensure the power supply as well as improve the socioeconomic activities and lives of citizens by installing additional generating facilities and transmission/distribution systems.

1.2 Project Outline

The objective of this project is to establish a stable power supply system in Honiara city by installing an additional generating facilities for base load operation and improvement of the Honiara city's transmission and distribution systems.

Grant Limit / Actual Grant Amount	1,476 million yen / 1,429 million yen
Exchange of Notes Date	(Phase I) June, 2005 (Phase II) June, 2006
Implementing Agency	Solomon Islands Electricity Authority
Project Completion Date	(Phase I) February,2007 (Phase II) February, 2008
Main Contractor(s)	(Phase I) Itochu /Toshiba Plant Systems & Services, (Phase II) Itochu
Main Consultant(s)	Yachiyo Engineering
Basic Design	Basic Design Study Report on the Project for Improvement of Honiara Power Supply in Solomon Islands, Yachiyo Engineering February, 2005.
Detailed Design	June-July, 2006 for phase II
Related Projects (if any)	・Power Development Project in the Lungga District, (1998): Installation of No.9 Diesel Engine Generator (DEG) ・Grant Aid for Grassroots (2002): Procurement of spare part ・Follow up cooperation (2004): Overhaul of No.9 DEG

2. Outline of the Evaluation Study

2.1 External Evaluator

Hisae Takahashi, Ernst & Young Sustainability Co., Ltd.

2.2 Duration of Evaluation Study

Duration of the Study: November, 2011 – September, 2012

Duration of the Field Study: March 4 – 26, 2012

3. Results of the Evaluation (Overall Rating: C[1])

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance with the Development Plan of Solomon Islands

The "National Economic Recovery, Reform and Development Plan (2003-2006)", which was the national development plan at the time of the basic design study (B/D), aimed to rehabilitate and stabilize the country[3], with the revitalization of industry and reconstruction of infrastructures as priority areas. Among them, electricity in particular was positioned as vital infrastructure to attract investment and achieve the economic recovery. The "National Development Strategy (2011-2020)", a current development plan, also highlighted infrastructure development, which would improve the access to "basic services including electricity, gas and water supply" out of nine priority areas, as well as clearly citing the vital need to ensure a reliable and affordable power supply and increase the coverage of electricity.

The "Electricity Sector Development Plan", which was formulated by the Solomon Islands Electricity Authority (SIEA) in 2004, showed a specific development plan for power sources, including the generating unit in the Honiara area based on a simulation showing a 4% increase in electricity demand. This plan, which was revised in 2011, continues to target an increase in supply in line with growing demand[4], hence confirming its consistency with the project.

3.1.2 Relevance with the Development Needs of Solomon Islands

There are two power stations in Honiara city, namely Lungga and Honiara power stations. At the time of B/D, the facilities in both power stations had deteriorated and regular operation for periodic maintenance had to be suspended due to the insufficient power supply. Accordingly, their collective output was less than 59% of the peak due to excessive operation. Furthermore, only 3–4 of 12 diesel engine generators (DEG) were operating regularly, since some had broken down and others were aging. The distribution line capacity also became insufficient in the industrial area, resulting in power outages, which affected citizens' daily lives and functions. At the time of ex-post evaluation, only 5 facilities in two power stations, including that (No. 11) procured under this project were operating out of a total of 7 facilities[5]. Their available capacity is 14.6 megawatts (MW), while peak demand hit 13.9 MW, which means a massive power outage could still occur if one large size generating unit were to break

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

2 ③ High, ② Fair, ① Low

3 The Solomon Islands suffered considerable damage economically and socially, due to an ethnic conflict which occurred from 1998-2003.

4 Plans to install the generation facilities were revised in 2011 to reflect the delay in the original plan and the increase in demand.

5 5 out of 12 generating units were removed as of B/D due to aging.

down. Furthermore, the power demand in Honiara city has increased year by year with the increased population and industrialization[6]. Thanks to the installation of DEG by the project however, day to day electric outages are avoidable, although sufficient capacity to respond to increasing demand is not ensured under the current situation, based on the scheduled maintenance plan. Since DEG must be taken offline on a regular basis for maintenance, the need to ensure the power supply remains high.

3.1.3 Relevance with Japan's ODA Policy

In ODA policy dialog held on June 2005, 1) Conflict prevention and peace building, 2) Good governance and 3) Sustainable national development were raised as priority issues. Among them, 3) especially prioritized the development of infrastructure (electricity, airport and water and sewerage systems) which are necessary for economic reconstruction. Furthermore, 5 initiatives which Japan needs to work on with the Pacific Islands Forum were agreed in the Pacific Islands Leader's Meeting held in 2003. Among them, the achievement of "more vigorous sustainable trade and economic growth" is mentioned, thus this project is consistent with Japan's policy since it targets a stable power supply, which is essential for economic reconstruction.

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

3.2 Effectiveness[7] (Rating: ②)

3.2.1 Quantitative Effects (Operation and Effect Indicators)[8]

(1) Load Shedding Accompanied by Periodic Maintenance

Daily load shedding, which is accompanied by periodic maintenance, has increased year by year. The average was 2.4 times per day in 2011, meaning it was not achieved as planned (Table 1). The major reason behind the increase in load shedding hours is due to damage to DGE and the increased number of DGE maintenance hours, which was not covered by the project. However, the situation is expected to improve as one of the DGEs (No. 6), currently down for maintenance, will resume operation in 2012.

Table 1 Number of Load Shedding Accompanied by Periodic Maintenance

(Unit: times/day)

Pre-project	Planned	Post-project		
2004		2009	2010	2011
Over 1	0	0.6	1.5	2.4

Source: Data provided by SIEA

Documents provided by JICA forecast 0 incidents per day. However, it is unlikely that the number

6 The population of Honiara city was 49,000 in 1999 (document provided by JICA) at the time of planning. However, it increased to 64,600 in 2009 (National Statistics Office), and is currently estimated at 70,000 (SIEA).
7 Sub-rating for Effectiveness is to be put with consideration of Impact
8 Indicators are for Honiara city.

of load shedding incidents, which are accompanied by periodic maintenance, will remain at zero in Honiara city for an extended period, given the aging conditions of existing power supply facilities. A certain number of load shedding incidents within a certain period could have been expected, meaning stipulating such a forecast (zero times per day in Honiara city) did not completely reflect the reality. There was a need to be more realistic if the number of load shedding accompanied by any issues concerning facilities procured by the project was set as an Operation and Effect Indicator.

(2) Voltage Drops at End Users

Voltage Drops at End Users in Honiara city were kept below 10% at the time of ex-post evaluation, meaning the planned figure was achieved. Normally the electricity created at a power station is transmitted at high voltage to avoid any loss of heat in the course of transmission and then connected to substations, where the voltage is lowered and transmitted to households and companies. However, given the limited number of substations in Honiara city before the project, the electricity was transmitted without appropriate changes of voltages. After four substations were constructed under the project, electricity was transmitted to users at a more stable electric voltage, hence confirming the effectiveness of the project.

Table 2 Voltage Drops at End Users (Unit: %)

Pre-project	Planned	Post-project		
2004		2009	2010	2011
More than 20	Fewer than 10	Fewer than 10	Fewer than 10	Fewer than 10

Source: Documents provided by SIEA

(3) Power Failure caused by Insufficient Capacity of Transmission and Distribution System

The project developed aged transmission and distribution facilities. Thanks to newly extended transmission lines and the laying of underground cables, accidents and leakages of electricity were reduced. Under the project, a 33kV switching facility, which has an important function to connect and disconnect transmission lines or other components from the system in case of maintenance or failure, was established to prevent troubles and facilitate maintenance of transmission and distribution systems. Consequently, power failure caused by insufficient capacity of transmission and distribution systems can now be kept at 0 as planned.

Table 3 Power Failure caused by Insufficient Capacity of Transmission and Distribution System

(Unit: time/month)

Pre-project	Planned	Post-project		
2004		2009	2010	2011
2－4	0	0	0	0

Source: Documents provided by SIEA

3.2.2 Operation of DEG (No.11) Installed by the Project

DEG, which was installed by the project in Lungga power station, is operating well as shown in Table 4 as well as the explanation written below.

Table 4 Operation of DEG (No.11)

	2008	2009	2010	2011
Annual operation hours (hours)	7,163	6,204	7,235	6,285
Annual capacity factor Note 1 (%)	74	65	75	65
Annual availability factor Note 2 (%)	82	72	83	72
Maximum output (MW)	3.9	3.9	3.8	3.8
Annual outage hours (hours)	N.A.	N.A.	N.A.	949

Note 1: The ratio of electrical energy produced in a given period of time to the electrical energy that could have been produced based on continuous maximum power operation during the same period. (= Annual output / (electrical energy×annual hours[9])×100

Note 2: Amount of time for which electricity can be produced over a certain period, determined by the length of the period.＝(Annual operation hours[10]/ annual hours)×100

Source: Data provided by SIEA

(1) Annual Operation Hours

Given the downtime of the procured generating unit for required periodic maintenance (approximately 768 to 984 hours) and low demand at midnight, the annual operation hours of recent years are reasonable. The figure has decreased by 6200 to 6300 hours every two years, due to the overhaul conducted once every two years[11].

(2) Annual Capacity Factor and Annual Availability Factor

The annual capacity factor of the No. 11 generating unit has stabilized at around 70% for these years. Since no planned figure was set at the time of planning, the degree of attainment cannot be analyzed. However, the targeted annual capacity factor is generally between 70 and 90% and the No. 11 generating unit has generally been utilized within or slightly below this range. The annual availability factor is also stabilized between the low 70s and 80%, thus No. 11 can be said to have been operating well.

(3) Maximum Output

The maximum output of the No. 11 generating unit has ranged between 3.8 and 3.9 MW in recent years while the rated power output is 4.2 MW. According to the SIEA technical staff, the reason is mainly due to climate conditions and age-related deterioration. Normally the function of the generating unit is weakened due to high temperature and the maximum output of the No. 11 generator was confirmed as exceeding 4.0 MW on a rainy or relatively cool day. This means the maximum output of the No. 11 generating unit also functions well in terms of maximum output.

(4) Annual Downtime

About 90% of annual downtime is due to planned inspections or maintenance. Other than that, approximately 56 hours were load time due to machine trouble. In addition to this downtime, there

9 Annual hours of the generating facility are basically 8,760 hours (=365 days ×24 hours).

10 The figure for annual operation hours indicates the operation hours of the generating unit in 8,760 hours.

11 Please refer to "3.5.4 Current Status of Operation and Maintenance" regarding the downtime for maintenance.

were 1,526 hours of downtime in 2011 to avoid unnecessary overnight operation, a period of low demand. This downtime is considered reasonable to ensure the safety and efficiency of the facility.

3.2.3 Qualitative Effects

At the time of B/D, a qualitative effect was anticipated, whereby the installation of 33kV switchgear within the Honiara power network would protect the transforming facilities from damage. This is because the transforming facilities would be quickly cut off from the system, preventing severe damage in the event of power failure. In interviews with the SIEA staff, the following effects were confirmed:

- The 33kV Substations (S/S) help minimize downtime elsewhere in the network since it provides more flexible switching arrangements in the distribution networks during planned maintenance or repairs.
- After the installation of the 33kV S/S, there was a notable improvement in the reliability of transmission and distribution networks and reduced equipment failure, because periodic maintenance was made easier.

Before the project, Honiara city lacked an appropriate number of S/S and switching gear facilities, meaning periodic maintenance was not adequately implemented, due to inevitable outages in the event of any trouble or maintenance. However, the construction of the S/S and switching gear facility have enabled periodic maintenance without disturbing the operations of other networks. This allowed protection against serious damage before it happened and minimized outages to other networks.

During the field survey of this evaluation, a simplified beneficiary survey was conducted to determine the qualitative effect of the project[12], the results of which are summarized below.

When comparing the condition of power supply before and after the project, 55% of the respondents answered either “Highly satisfied” or “Satisfied”. Furthermore, 40% of respondents stated “There was an improvement but there remains room for further improvement” as shown in Figure 1.

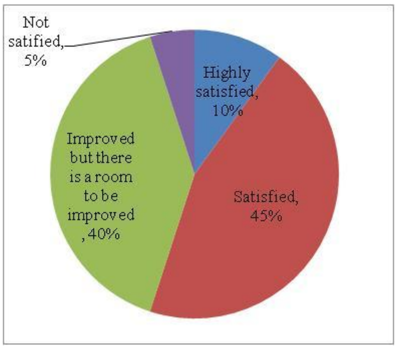


Figure 1: Situation of power supply (Comparing pre- and post-project)

Both large and individual users have recognized that the voltage stability, frequency of outages[13] and situation of the power supply in Honiara city have improved to a certain extent. In addition, all the large users interviewed owned generators in case of power outages. When comparing the pre- and post-project usage of their own generators, it was confirmed that the utilized hours and amount of fuel

[12] A simplified beneficiary survey was conducted as follows: Period: March, 2003. Number of samples: 42 (11 large users, including hotels, hospitals, ministries, city council, colleges, gas stations, and factories, etc.. The other 31 were individual users around the market or industrial area) .

[13] According to the respondents, the frequency of power outages five years ago exceeded 3.2 times daily for individual users and 1.5 times daily for large users on average. However it has currently decreased to 0.7 times for individual users and 0.5 times daily for large users on average. Here, the power is preferentially provided to areas housing many large users, such as hotels and hospitals, increasing the frequency of outages in residential areas.

had been reduced, though the figure differs from year to year, as explained in BOX below. Since the fuel price has continued to rise, the fuel cost burden on large users has also increased. Conversely, the usage hours and amount of fuel for their generators decreased, while the usable power increased, which indicates that the situation of the power supply in Honiara city has improved to a certain extent.

However, since the power demand in Honiara has increased every year, the power supply cannot keep pace, meaning temporary power outages are enforced during periodic maintenance or repairs under current circumstances. As explained above, since all large users must own and utilize their own generators in case of power outages, there remains room for improvement. This result seems to meet the qualitative effect, which shows an improvement in the power supply, albeit to a limited extent, by conducting the project.

BOX Power usage situation of large users (Based on interview surveys)
[Case of company A] Company A, one of the largest SIEA customers, has its own generator in case of outages and to avoid having to shut down the production line. According to them, their burden in terms of generator fuel has been increasing since the fuel price soared. Conversely, the annual usage hours of their own generator between the project completion and last year was approximately 50% of the pre-project figure, on average while total power usage increased more than 20% . [Case of company B] Sales of company B doubled over the past four years and power consumption also increased by 40%. However, the amount of fuel used for their standby generator was approximately 70% of the pre-project figure, as with company A. However, the burden faced by company B in terms of payment for fuel has continued to increase due to the rise in the fuel price.

3.3 Impact

3.3.1 Intended Impacts

3.3.1.1 Boosting Economic Activities and Stabilizing the Operation of Public and Welfare Facilities in Honiara

At the time of B/D, boosting economic activities and stabilizing the operation of public and welfare facilities were expected as an impact of the project. Though the evaluation team attempted to obtain data showing economic growth or the operation ratio of facilities, reliable data were not available and no quantitative analysis could be conducted. Therefore, a qualitative analysis was performed based on the result of a beneficiary survey detailed below.

① Boosting Economic Activity

The result of the beneficiary surveys cited more than 90% of respondents as stating that economic activities in Honiara had been revitalized after the project, as shown in Table 2. According to the respondents, the reason was as follows: the situation of the power supply had stabilized, with less downtime, meaning economic activities were not interrupted as frequently as before the project. In addition, they added that since power was crucial for economic activities on any scale, a stable

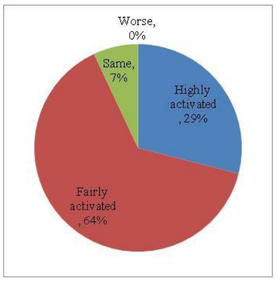


Figure 2 Revitalization of Economic Activity

power supply would always contribute to and boost economic activities.

② Stabilizing the Operation of Public and Welfare Facilities

In the beneficiary survey, most individual users answered that the operation of public and welfare facilities had stabilized as shown in Table 3. Before the project, the reduced operating hours of public services such as hospitals and schools as well as public offices were problematic. However, it emerged from beneficiaries that the operating hours of public services had become more stable and there was less damage or loss of data and equipment after the project.

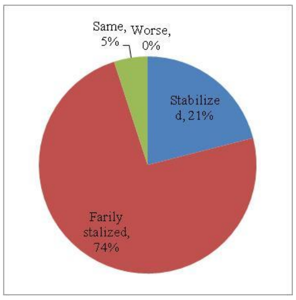


Figure 3 Stabilizing the public and welfare services

3.1.2 Electric Power Supply and Demand in Honiara City

The electric power balance of supply and demand in Honiara city showed a tight situation, as mentioned in "3.1.2 Relevance with the Development needs". The major indicators are shown in Table 5.

Table 5 Electric Power Balance of Supply and Demand in Honiara City

(Unit : MW)

Item	Pre-project	Post-project				
	2004	2008	2009	2010	2011	2012 [Note 1]
Peak Demand	9.9	12.6	12.8	13.8	13.9	14.0
Available Capacity (AC)	10.8	16.6	15.0	15.3	14.6	17.5
Honiara power station	0	1.9	0.6	0.6	0.6	0.6
Lungga power station	10.8	14.7	14.4	14.7	14.0	16.9
Power Balance	0.9	4.0	2.2	1.5	0.7	3.5
AC of the largest unit	3.9	4.1	3.8	3.8	3.8	3.8
Stable Capacity [Note 2]	6.9	12.5	11.2	11.5	10.8	13.7
Urgent Reserve Capacity [Note3]	-3.0	-0.1	-1.6	-2.3	-3.1	-0.3

Note 1: Data for 2012 is predicted data.
Note 2: Stable Capacity=AC－AC of largest unit
Note 3: Urgent Reserve Capacity= AC－Peak demand －AC of largest unit
Source: Documents provided by JICA or SIEA

Thanks to the project, the available capacity has increased and the urgent reserve capacity was marked as positive in 2006 when the generating unit was installed, so the situation can be said to have improved. However, some generating units stopped operating due to maintenance or damage. In addition, new generating facilities were not yet installed due to the budget shortfall after the project. Those situations, as well as the increased power demand due to the population growth and revitalization of economic activities, again resulted in the present deficit in the urgent reserve capacity. This means that despite the available capacity exceeding peak demand, the planned urgent reserve capacity, namely 0.8 MW, could not be achieved. Under these circumstances, there is the potential for a massive blackout in Honiara city if any large generating facilities were to break down.

Conversely, it is obvious that peak demand would have exceeded the available capacity if the project had not been implemented[14]. Therefore, the project can be considered as having helped improve the lack of reserve power capacity to a certain extent.

3.3.2 Other Impacts

3.3.2.1 Impacts on the natural environment

According to the interview survey with the executing agency and the result of a beneficiary survey, no impacts on the natural environment were confirmed during and after the project implementation.

3.3.2.2 Land Acquisition and Resettlement

Land was acquired amicably to construct the White River S/S, without any complaint or dispute and in line with the appropriate process, based on the rule defined by the executing agency. Since other land used to construct the S/S belonged to the SIEA, no other land acquisition was implemented. Resettlement was also not implemented, hence no issues were raised.

As mentioned above, the available capacity was increased by installing a generating unit, and voltage to end users was also stabilized by developing the transmission and distribution facilities in Honiara. However, the effectiveness remained limited as some planned operated and effect indicators did not achieve the planned value due to damage or maintenance of other generating facilities as well as the delay in installing new generating units due to the budget shortfall. Furthermore, the current urgent reserve capacity was almost the same at when planning the project which is very tight. However, if the project did not install the No. 11 generating unit, it would not be possible to maintain the power balance of supply and demand and power cuts over a large area of Honiara on a daily basis would be inevitable. In addition, the beneficiary admitted impacts in the form of revitalized economic activities and stabilized public service operation, meaning the project could be considered as having helped the power supply in Honiara to a certain extent. Accordingly, this project has somewhat achieved its objectives, therefore its effectiveness is fair.

3.4 Efficiency (Rating: ②)

3.4.1 Project Outputs

The project consisted of phase I, the procurement and installation of equipment related to the extension of Lungga power station, and phase II, improvement of the Honiara transmission and distribution system and extension of the power house and switching gear buildings. The output of both phases I and II was conducted as planned, with planned and actual output shown in a Table.

Table 6 Project Outputs (Planned/Actual)

Phase I (Extension of Lungga Power Station)

Extension of the existing facilities and construction of the foundation	Planned	Actual

[14] If the No. 11 generating unit had not been installed by the project, the available output would be 10.8 MW against peak demand of 13.9 MW.

1) Extension of the power house 2) Extension of the switchgear house 3) Construction of the foundations for the new DEG and fuel tank, etc.	258m^2 62m^2 1set	As planned
Procurement and installation of the following equipment	Planned	Actual
1) 4.2MW DEG 2) Procurement and installation of auxiliary mechanical systems/equipment for the DEG. Fuel oil storage tank (300m^3), fuel oil supply system, fuel oil service system, lubricating oil purifier unit, air intake and exhaust gas system, cooling water system, compressed air system 3)Procurement & installation of the auxiliary electrical systems/equipment for the DEG Auxiliary equipment for the generator (Generator control panel, protection relay panel, low voltage panels, power supply system), High voltage facilities (11kV switchgears, station transformer(11kV/415-240V), cabling facilities) 4) Procurement of spare parts & maintenance tools for the DEG and auxiliary equipment 5) Preparation of O&M manuals for the DEG and auxiliary equipment and implementation of OJT.	1 unit 1set 1set 1 set 1 set	As planned

Phase II (Upgrading of Transmission and Distribution System of Honiara Power Network

Procurement and installation of the following equipment	Planned	Actual
1) Construction of the 33kV Ranadi Substation (S/S) －33kV and 11kV outdoor type switchgears and low voltage outdoor type panels －Step-down transformer, station transformer and other related facilities and foundations for the above equipment 2) Extension of 33kV line from Lungga Power Station to the new Honiara East S/S －Laying of 33kV underground cable －Installation of the 33kV indoor type switchgear at the Lungga Power Station 3) Construction of the 33kV Honiara East S/S －33kV and 11kV outdoor type switchgears and low voltage outdoor type panels －Step-down transformer and station transformer, －Other related facilities and foundations for the above equipment 4) Upgrading of the 33kV switching facilities at the Honiara Power Station －33kV outdoor type switchgears －Other related facilities and foundations for the above equipment 5) Extension of the 33kV line from the Honiara Power Station to the new White River S/S －Laying of the 33kV underground cable 6) Construction of the 33kV White River S/S －33kV and 11kV outdoor type switchgears and low voltage outdoor type panels －Step-down transformer and station transformer －Other related facilities and foundations for the above equipment 7)Procurement of spare parts and maintenance tools for the 33kV transmission and 11kV distribution facilities 8) Preparation of O&M manuals for the transmission and distribution facilities and implementation of OJT	 1 set 1 set 4.2Km 1set 1 set 1set 1set 1set 1set 4.2Km 1 set 1set 99.6m^2 1set 1set	As planned except 5) 5) 33kV cable route was amended. (No additional cost was incurred and no technical specification was made.)

In phase II, the underground cable route was partially amended since the road nearby the White River S/S was widened and a local produce market (200 meters), initially located on the coast side, was shifted to a more landward location. This change was made based on local circumstances and to avoid any potential hazard to both vendors and customers using the market. It is therefore considered reasonable.

Transformer in Ranadi S/S

Switchgear in Honiara East S/S

3.4.2 Project Inputs

3.4.2.1 Project Cost

The grant limit of the Japanese side was a total of 1,471 million yen for phases I and II, and the actual total project cost of the Japanese side was 1,429 million yen, which was 3% lower than planned.[15]

3.4.2.2 Project Period

While the planned project period at the time of B/D was 31 months in total, the actual project period was 32 months, which was slightly longer than planned. Although it did not exceed the contract period, it was delayed approximately one month based on the criterion indicated as of planning in B/D[16].

As stated above, the project cost was within the plan, the project period was slightly exceeded, therefore efficiency of the project is fair.

3.5 Sustainability (Rating: ②)

3.5.1 Structural Aspects of Operation and Maintenance

SIEA is in charge of operating and maintaining the facilities installed by the project. SIEA was reorganized as part of the reform of State Owned Enterprises (SOEs) last year and the current organization chart is as shown in Figure 4. The generation and distribution units of the Engineering Department assume the roles of operating and maintaining the facilities, with 29 and 23 technical staff members in the generation and distribution units respectively. According to the chief engineer of the Engineering Department of SIEA, an adequate number of staff was allocated and no issues were noted concerning

[15] The actual cost of the Solomon Islands side was not available for either the Solomon Island or Japan sides. However, both SIEA and the consultant firm admitted that SIEA had completed all the foundation works for which the Solomon Islands side was responsible before the project. Therefore, the planned cost is considered as having been covered by the Solomon Islands side as planned.

[16] According to the consultant, the original plan as of B/D was usually tentative and the actual plan was revised during the executing phase, meaning the project was completed within the project period recorded in the official contract documents. Conversely, under the current evaluation scheme, the planned project period is defined by that described in B/D.

operation and maintenance in terms of the structural aspect.

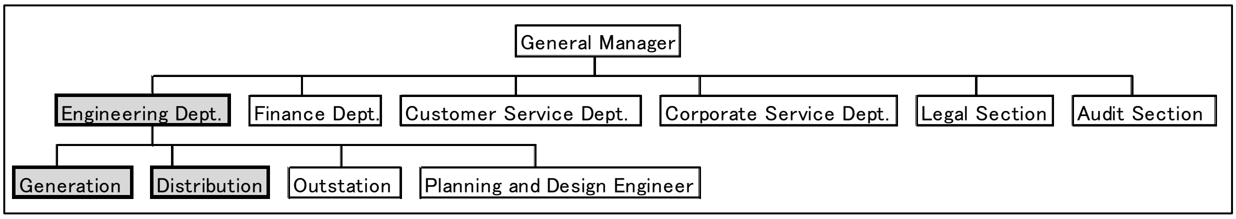


Figure 4　Organization Chart of SIEA

3.5.2 Technical Aspects of Operation and Maintenance

The technical SIEA staff members had sufficient technical capacity for the daily operation and maintenance of facilities. However, training in the operation and maintenance of newly installed facilities was provided via technicians dispatched from the manufacturing company. Currently, appropriate inspection and maintenance activities have been conducted based on the operation and maintenance manual, and SIEA is planning to establish a training program for its staff when new facilities are installed in future for necessary technical acquisition. When the SIEA technical staff were interviewed during the site survey, no issues concerning the technical capacity for daily inspection and maintenance were confirmed.

3.5.3 Financial Aspects of Operation and Maintenance

Table 7 shows the financial status of SIEA. SIEA was in deficit till 2010, but achieved a surplus for the first time in 2011. The reason is explained as follows; the burden of SIEA was reduced since its debt had been written off, while the achievement from introducing a pre-paid tariff system was shown as part of the support from the World Bank (WB) to improve management since 2008[17]. However, SIEA staff explained the need to install a new generating unit with capacity equivalent to No. 11 to maintain a stable power supply in Honiara city and improving the financial situation of SIEA was one of the challenges involved in realizing this plan. Under the current situation, it is still not easy to install new generating facilities and further effort is needed.

Table 7　Financial Status of SIEA

(Unit: Million SB$)

	2008	2009	2010	2011	2012 [Note 1]
1. Sales	227.8	243.5	258.9	320.2	391.0
2. Cost of sales	214.7	193.2	217.4	257.4	315.3
3. Gross profit	**13.0**	**50.3**	**41.5**	**65.8**	**75.7**
4. Operating cost	40.3	61.5	115.5	57.0	69.7
5. Operating profit/loss	**(27.3)**	**(11.2)**	**(74.0)**	**8.8**	**6.0**
6. Other revenue / expense	10.4	2.5	8.0	4.4	10.6
7. Profit / loss	**(16.9)**	**(8.7)**	**(66.0)**	**13.3**	**16.6**

Note 1: Forecast figures.
Source: Documents provided by SIEA

17 Support from WB, Sustainable Energy Project, continues and assistance is implemented to improve the management, system liability and financial situation of SIEA. Under this support, capacity building of financial staff, promoting the pre paid system and introducing a finance and accounting manual, etc. are implemented.

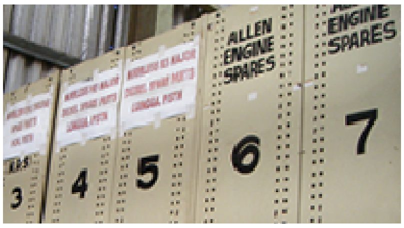
Major concerns concerning the financial status include the increased level of bad debt, which has become one of the issues delaying the installation of the new generating facilities. Total bad debt was 67 million SB$ (approximately 98 million yen) at the time of planning, rising to 93 million SB$ (approximately 1,000 million yen) as of ex-post evaluation (March, 2012). 70% of the figure is debt from the SOEs, and 70% is attributable to the Solomon Islands Water Authority (SIWA), which is equivalent to 38 million SB$ (approximately 405 million yen). Under such circumstances, the Government of Solomon Islands (GOSI), SIWA and SIEA have continued dialog and discussion whereby GOSI supports the portion repayable by SIWA to SIEA[18]. Meanwhile, measures to tackle issues such as water leakage and theft have commenced, and an increase in water tariff was also confirmed in SIWA, which is expected to improve the repayment from SIWA to SIEA,

Furthermore, the increase in fuel price has also affected the financial situation of SIEA, since part of the increase in the electricity tariff associated with the fuel price is covered by SIEA[19]. The electricity tariff, which was 1.1SB$/ kilowatt (kWh) at the time of planning, has now increased fivefold to 5.3SB$/kWh for individual users and 5.7 SB$/kWh for commercial use in 2011.

As stated above, the financial status is not fully stabilized, though the SIEA balance was positive last year. With this in mind, measures to improve the financial status are needed to install the new generating facilities. For example, many challenges remain to be measured; tariff collection is not made thoroughly, 70% of its income is paid by only 150 users, power theft must be addressed, meter reading must be done properly and there is a lack of effort among users, such as failing to turn off lights, etc. In addition to the support from WB, further efforts to solve these issues will be needed.

3.5.4 Current Status of Operation and Maintenance

The facilities installed by the project have been fully utilized and it was confirmed through the site survey and maintenance sheet that the necessary maintenance had been conducted as planned (refer to the maintenance plan in Table 8). Spare parts and equipment for maintenance are appropriately stored and the current operation and maintenance status is also appropriate.



Spare parts are stored in shelf by generating units.

Table 8 Inspection and Maintenance Plan for Generating Unit

	Type	Item
Diesel Engine	Daily maintenance	Visual check of appearance, checking of jacket cooling water level, checking of starting-up air receive pressure
	1,000 hours maintenance	Checking of proper tightening of nuts and bolts, Cleaning of fuel and filters (8 days required)
	2,500 - 3,000 hours	Checking of proper working of and oil leakage from valves, fuel pump, piston and

18 After the site survey, an agreement of debt arbitration was concluded in May 29, 2012 among the Ministry of Finance and Treasury, SIWA and SIEA. The debt issue of SIWA to SIEA is subsequently expected to improve.

19 The electricity tariff consists of two components, namely a base tariff and a fuel tariff. The base tariff is adjusted annually, which is 90% of the Consumer Price Index increase. The fuel price is adjusted, partially to reflect users and partially to reflect SIEA in case the fuel price exceeds the base price. This adjustment is made on a quarterly basis.

	maintenance	liner, etc. (15-18 days required)
	8,000 hours maintenance (Overhaul)	Replacement of rings, Checking and replacement of rings and valves, Overhauling of cylinder head and replacement of gasket, Inspection of fuel injection valve and replacement of nozzle, Inspection of crank pin bearings and replacement if necessary, Analysis of lubricating oil of sump tank and change of oil if necessary (20 – 25 days required)
	16,000 hours maintenance	All items under 8,000 hours maintenance, Overhauling and inspection of lubricating oil pump attached to engine and replacement if necessary, Inspection of main bearings and exhausted valves and replacement if necessary
Generator	Daily maintenance	Visual inspection of all sections and checking of abnormal sound and temperature
	Monthly maintenance	Checking of abnormal vibration, Checking of oil flow and leakage, Necessary cleaning of components
	Annual maintenance	Measurement of insulation resistance and inspection of lead sires and terminal, Visual inspection of accessories, including heater, bearing and cleaning if necessary

Source: Documents provided by SIEA

Although maintenance was conducted based on the plan, the high maintenance cost of spare parts and service engineering needed every 8,000 operation hours are currently a burden to the executing agency[20]. An exclusive contract was therefore established for these 8,000 hours of operational maintenance, based on the maintenance manual, with a Japanese agency. This was costly compared to other facilities, which affected the installation of new generation facilities. As explained in “3.5.3. Financial Aspects of Operation and Maintenance”, this is a serious issue in terms of the sustainability of project effectiveness.

SIEA attempted public tendering to reduce the burden. However, this has not been sorted out for various reasons, for example the maintenance contract was established on an exclusive basis, and substituting spare parts was not easy due to the need to ensure quality. SIEA claimed that they were not informed about the exclusive contract and expensive maintenance cost at the time of planning, and later learned that an expensive fee would be needed for each overhaul, which led to SIEA distrusting agents as well as the Japanese side.

As described above, some problems have been observed in terms of the financial situation and the cost of maintenance, meaning the sustainability of the project effect is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aimed to establish a stable power supply system in Honiara city by developing generating facilities. The relevance of this project is high, as it is consistent with the priority area of Solomon Island’s development plans and Japan’s ODA policy, and has development needs. By implementing the project, benefits such as increasing the power supply, stabilizing voltage drops and decreasing outage time due to damage to distribution and transmission lines, were confirmed.

[20] The cost of spare parts and dispatched service engineering fee for the No. 11 generating unit overhauling is 65 million yen and 1.56 million yen respectively. According to the technical staff of SIEA, the figures for the other generating unit in Lungga power station were about half.

However, overall power outages in Honiara city have increased due to the breakdown of other generating facilities. Furthermore, the urgent reserve capacity is now at the same level as the planning stage due to the increased power demand. Conversely, it would not be possible to retain the balance of power demand and supply if the project were not implemented, and a certain level of contribution was confirmed by the project such as increasing the power supply, revitalizing economic activities and stabilizing the public facility operation. Therefore, the effectiveness of the project is fair. Its efficiency is also fair, as the project cost remained within budget while the actual project period went slightly beyond the schedule. Finally, the sustainability of the project is also fair as no major problems were observed in terms of the institutional aspect and technical capacity, despite some concerns about the financial status and supply of spare parts, etc.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

(1) SIEA must continue striving to improve its financial status. For example, accumulated bad debt has affected the financial status of SIEA, and likewise the installation of the new generating unit. To install new generating facilities to cope with the increased electricity demand, solving this debt issue is crucial. For example, the following issues must be tackled: 1) measures to solve the debt issue should be drawn up and implemented as soon as possible among GSI, SIWA and SIEA; 2) examining measures similar to SIWA is required of other SOEs; at the same time, 3) the meter reading system, the number of faulty meters and the rate of tariff correction must all be improved, 4) the system to check by-passed system must be strengthened.

(2) Thanks to the project, the power balance in Honiara city has been retained. However, the situation is so severe that any damage to or stoppage of a major generating unit could result in a large scale outage in Honiara city. Therefore, the steady implementation of the plan to increase the available capacity (installation of a new generating unit, project for hydropower development) must be ensured, taking account of important assumptions which affect electricity demand, including increases in population and fuel prices.

(3) Issues to be resolved from the user side were also confirmed, to improve electricity wastage. For example, electricity not being switched off, even if unused or when users leave their workplaces. Therefore, the customer service department of SIEA, with the cooperation of the government and city council, should attempt to plan and execute awareness activities for power users to improve their awareness.

4.3 Lessons Learned

The high cost of spare parts and service engineering to date has been a burden to the executing agency and a serious issue hindering the installation of new generating facilities. Therefore, when conducting similar projects in future, there is a need to go through the procedure after a thorough review of the appropriateness for drawing up an exclusive contract. Even if there is a need to make an exclusive contract with quality assurance in mind, it is important to consider the appropriateness of cost to ensure sustainability. Furthermore, the information must be fully shared and prior agreement reached with the executing agency concerning the content of the contract.