The Philippines

Ex-Post Evaluation of Japanese ODA Loan Project
"Northern Negros Geothermal Project"

Nobuyuki Kobayashi, OPMAC Corporation

1. Project Description

Project Site


Northern Negros Geothermal Power Plant

1.1 Background

The Philippines has a very limited source of fossil fuel and has depended on imported energy for its energy. In the early 1990s when this project was formed, imported oil accounted for approximately 70% of total energy consumption. Less dependency on imported energy has been a priority in energy sector strategy since the 1970s. Geothermal, as a promising source of domestic energy, has been developed in the Philippines, where volcanoes are abundant. In 1995, geothermal power plants accounted for approximately 10% of the installed generation capacity of the Philippines. The executing agency of this project, the Philippine National Oil Company – Energy Development Corporation (PNOC-EDC)[1] had been engaged in the development of geothermal energy for a long period.

Negros Island, where the project is located, is a part of the Visayas grid where electricity demand showed a massive growth from the mid-80s. In 1996, the time when appraisal for this project was conducted, demand in the Visayas grid was expected to expand in the future and, therefore, the development of electrical power was urgently required to meet this growing demand. The project site is in the northern region of Negros Island in which the Visayas grid supplies energy and is adjacent to the national park in Mt. Kanlaon. The development of geothermal energy began in the 1970s. The drilling of exploration wells in 1994 revealed a certain level of energy source.

1.2 Project Outline

The objective of this project is to utilize domestic energy source and ensure the stable electricity supply to the Visayas grid by the construction of geothermal power plant in the province of Negros Occidental, thereby contributing to the promotion of regional economy nearby the Visayas Grid.

[1] The name of the executing agency at the time of the appraisal

Approved Amount/ Disbursed Amount	14,460 million yen / 10,510million yen
Exchange of Notes Date / Loan Agreement Signing Date	March 1997 / March 1997
Terms and Conditions	Interest Rate: 2.7% (Consulting services: 2.3%) Repayment Period: 30 years (Grace Period: 10 years) Conditions for Procurement: General untied
Borrower / Executing Agency(ies)[2]	Energy Development Corporation /Same as above Guarantor: Government of the Republic of the Philippines
Final Disbursement Date	July 2006
Main Contractor (Over 1 billion yen)	Miescor Builders, Inc. (Philippines), Kanematsu Corporation (Japan)・Fuji Electric Systems Co., Ltd.(Japan) (JV)
Main Consultant (Over 100 million yen)	Institute of Geological & Nuclear Sciences Limited (NZ)・PB Power (NZ) Ltd・Sigma Energy Technology, Inc.(Philippines)・Kyushu Electric Power Co. Inc. (Japan)・West Japan Engineering Consultants Inc. (Japan) (JV)
Feasibility Studies, etc.	The Government of the Philippines, Feasibility Study (1993) JICA "Special Assistance for Project Formation for Northern Negros Geothermal Project" (1995)
Related Projects	None

2. Outline of the Evaluation Study

2.1 External Evaluator

Nobuyuki Kobayashi, OPMAC Corporation

2.2 Duration of Evaluation Study

Duration of the Study: February 2010 – November 2010

Duration of the Field Study: May 25, 2010 – June 7, 2010, August 22, 2010 – August 28, 2010

2.3 Constraints during the Evaluation Study

The executing agency of this project was privatized and listed on the Philippine Stock Exchange. For this reason, the duty of confidentiality was taken into account when this evaluation report referred to evaluation information. Assessing the estimate of geothermal resources and the adequacy of the feasibility study required technical knowledge. Although the evaluation is based mainly on the information obtained from the executing agency, there are some points which do not allow clear judgment.

[2] The name of the executing agency at the time of the ex-post evaluation

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

3.1 Relevance (Rating: a)

3.1.1 Relevance with the Development Plan of the Philippines

The national development strategy at the time of the appraisal was the Medium-Term Philippine Development Plan 1993-1998. The strategy aimed at not only the promotion of domestic energy but also the diversification of electric sources for a stable supply of electricity at a reasonable cost. The development of geothermal power was on the focus for the diversification of electric sources.

Less dependence on imported energy and the further utilization of domestic energy sources has been a policy in the energy strategy since the 1970s. The Philippine Energy Plan 1992-2000, the energy sector strategy at the time of the appraisal, regarded geothermal power generation as a promising source of domestic energy. In order to ensure a stable and sufficient supply of electricity at a reasonable cost, the expansion of the generation capacity for the effective use of domestic energy sources was stressed.

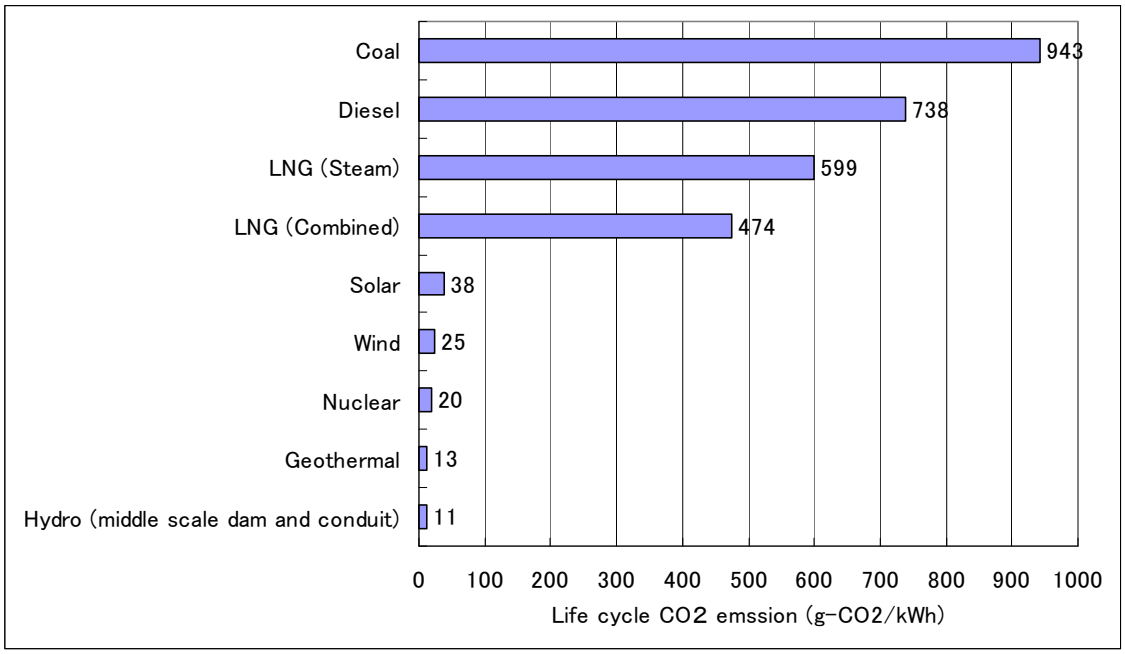
The national development strategy at the time of the ex-post evaluation was the Medium-Term Philippine Development Plan 2004-2010. Energy independence is the pillar of the energy strategy and emphasizes the development of domestic energy. In addition, the plan advocates a wider development of renewable energy such as geothermal, wind, solar, hydro and biomass as well as exploration for oil and natural gas in the Philippines with the objective of fully utilizing domestic energy. In order to fully take advantage of renewable energy, the Renewable Energy Act of 2008 sets out incentives such as reductions in income tax and the import duty on equipment.

As for the Philippine Energy Plan 2007-2014 sector policy, the share of domestic energy over total energy consumption remains at a similar level. While the total energy supply in 2006 was 38.7 million tones of oil equivalent (MTOE), this is expected to rise to 54.5 MTOE (a 41% growth from 2006). The plan forecasts that domestic energy (the total of domestic oil, domestic natural gas, biogas, hydro, geothermal, etc.) will account for 57% of the total supply of energy while geothermal will account for 20% in 2014.

The implementation of this project corresponded to national and sector policies at both the time of the appraisal and that of the ex-post evaluation. The use of domestic energy had been pursued from the time of the appraisal to the ex-post evaluation. The ongoing national development strategy focuses more on the development of renewable energy. As the wider use of renewable energy is advocated, geothermal energy continues to be developed. A law to promote the utilization of domestic energy has been enacted. The sector strategy at the time of the ex-post evaluation spelled out the policy of maintaining the share of domestic energy under a massive growth of energy consumption. Geothermal energy has the biggest share among domestic energy sources and its development is expected to continue.

3.1.2 Relevance with the Development Needs of the Philippines

The Visayas grid, which this project is connected to, recorded the highest demand growth in the country for the decade until 1995. The development of electrical power was an urgent task as demand for electricity was expected to grow at 12% p.a in the decade from 1995 to 2005 at the time of the appraisal. At the time of the ex-post evaluation, the Transmission Development Plan 2009, the strategy set by NGCP, forecasted a maximum demand growth of approximately 40 % (5% p.a.) from 2009 to 2018. This is expected to reach dependable capacity in 2010. Tight supply and demand is likely to continue for next several years. Given the tightness of supply and demand, it can be seen that the development of electrical power in the Visayas grid is appropriate and is consistent with the development needs of the Philippines.



Source: Central Research Institute of electric power industry "Evaluation of Life Cycle CO2 Emissions of Power Generation Technologies" (July 2010)

Figure 1: Life cycle CO_2 emission by power source

After adopting the Kyoto protocol in 1997, the international community has accelerated efforts to reduce greenhouse gases including carbon dioxide (CO_2). The Philippines ratified the Kyoto protocol in 2003. In terms of CO_2 emission, geothermal power is a desirable source of electricity. According to the past data in Japan, the CO_2 emission from geothermal power is smaller than that from fire power, and moreover, is smaller than that from other renewable energy sources. The life cycle CO_2 emission[3] per kWh from geothermal power is second only to hydro power (see Figure 1). The development of geothermal power is highly necessary to achieve both the satisfaction of the growing electricity demand in the Philippines and the control of greenhouse gas emissions simultaneously.

3.1.3 Relevance with Japan's ODA Policy

Japan's Official Development Assistance (ODA) Charter, the preceding charter approved in 1992, referred to the close relationship between Japan and East Asia, including ASEAN, and placed a special emphasis on assistance to the Asian region. The charter prioritized assistance in infrastructure development. Moreover, in the ODA Annual Report for FY 1997, the country assistance strategy for the Philippines regarded the establishment of economic infrastructure as a priority and set out a policy to support the development of the economic infrastructure mainly in the energy sector.

At the time of the appraisal, Japan's ODA Charter placed importance on both assistance to Asian countries and on infrastructure development. Furthermore, the country assistance strategy emphasized assistance specifically in the energy sector. The project has been consistent with Japan's ODA Policy as this project assists infrastructure development in the power sector in the Asian region.

[3] The life cycle CO_2 emission includes not only the CO_2 emission from the operation of a power plant but also the CO_2 emission from other relevant activities such as the construction and disposal of a power plant and the exploration and transport of fuel.

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 Efficiency (Rating: b)

3.2.1 Project Outputs

This project financed (1) the drilling of geothermal wells, (2) fluid collection and disposal systems (FCDS), (3) the construction of a geothermal power plant, and (4) consulting services. In the implementation of the project, construction works and procurements were adjusted (see Table 1). At the time of the appraisal, the National Power Corporation (NPC) was expected to construct transmission lines. However, an electricity purchase agreement was not made and, thus, construction period and specific sections of transmission lines were not determined. As a result of the government decision in 2001 on the partition and privatization of NPC, the executing agency changed the buyer from NPC to the wholesale electricity market and electric cooperatives and also constructed transmission lines.

Table 1: Major changes in outputs and the reasons

Changes	Reasons
A decrease in the drilling of geothermal wells (planned: 21 wells, actual: 13 wells)	After re-evaluating the geological characteristics of the area, the executing agency limited the number of production wells in the Pataan area, which were drilled after 1995. (planned: 14 wells, actual: 10 wells). The number of reinjection wells was also reduced as the drilling of production wells enabled a more accurate estimation of brine reinjection (planned: 7 wells, actual: 3 wells). While the total number of geothermal wells was planned at 21 wells, the actual number was 13 wells.
An increase in the installed capacity of the power plant (planned: 40MW, actual: 49.37MW)	The installed capacity was assumed to be 40MW at the time of the appraisal. Although a bidder proposed a larger capacity (54MW), the capacity was adjusted to the appropriate level (49.37MW) in consideration of the forecasted amount of brine and steam. The change in the installed capacity required negotiations on project cost. However, as neither party could agree, a retender was carried out.
Construction works for the geothermal power plant (planned: with a gas abatement system, actual: without a gas abatement system)	The ambient air model showed that hydrogen sulfide was within the environmental standard set by the Philippine government both outside the power station and the buffer zone[4], assuming a installed capacity of 49.37MW.[5] As it was concluded the power plant was harmless to residents nearby, a gas abatement system was not installed.
Scope change in consulting services	The evaluation of environmental management and environmental monitoring was added to the consulting services. This scope change was made in order to assess the appropriateness of environmental safeguards from an expert viewpoint.

[4] The buffer zone was established in the area surrounding the geothermal power plant in light of effects on the natural environment from the power plant.

[5] In Japan, the Offensive Odor Control Law set concentration limit at 0.02-02ppm, the similar level of the Philippine environmental standard (0.07ppm).

Source: Project Completion Report on Northern Negros Geothermal Project

3.2.2 Project Inputs

3.2.2.1 Project Period

The project period was significantly longer than planned (353% of the original plan) (see Table 2). At the time of the appraisal, both the development of geothermal wells and the construction of a power plant with sizable capacity were planned to be carried out almost simultaneously in order to shorten the project period and close a supply demand gap of electricity of this region in a short period. The delay was caused mainly by (1) unclear prospects in the electricity purchase agreement due to the Asian financial crisis, (2) retendering of the construction of a power plant (see "3.2.1 Outputs"). Since the Asian financial crisis caused the Philippines government to reduce the fiscal deficit, NPC became cautious about a new electricity purchase agreement. For this reason, EDC temporarily suspended the implementation of new projects, including this one, and this resulted in the delay in consultant selection.

Table 2: Details of the project implementation

	Plan	**Actual**
Signing of the loan agreement	March 1997	March 1997
Selection of consultants	December 1996 – June 1997	February 2000 – December 2000
Bidding and award of main contracts	June 1997 – January 1998	November 2001 – April 2006
Steam field development	April 1997 – July 1999	November 2000 – September 2006
Construction and commissioning of power plant	January 1998 – December 1999	March 2005 – February 2007
Construction of transmission lines	July 1997 – September 1998	March 2003 – June 2006
Consulting services	June 1997 – December 1999	January 2001 – April 2007
Project completion[6]	December 1999 (34 months)	February 2007 (120 months)

Source: EDC

3.2.2.2 Project Cost

The project cost was lower than planned. The planned project cost (after adjustment) was JPY17,261 million, reflecting the reduction in the number of geothermal wells and the cancellation of the gas abatement system. The actual project cost was JPY 16,578 million (96% of the original). The depreciation of the Philippine Peso against the Japanese Yen, caused by the Asian financial crisis, resulted in the project cost being in Japanese Yen.

Although the project period was significantly longer than planned, the project cost was lower than planned, therefore efficiency of the project is fair.

[6] For both "Plan" and "Actual", project completion is defined as the end of construction including commissioning.

3.3 Effectiveness (Rating: c)

3.3.1 Quantitative Effects

3.3.1.1 Results from Operation and Effect Indicators

(1) Steam amount, Maximum output, and Net electricity energy production

Immediately after the commencement of plant operation, the amount of steam was approximately two thirds of the amount forecasted by the executing agency. Due to the adhesion of calcite and the waning of steam from production wells, the amount of steam started declining in the last half of 2007. Operation was halted temporarily from May 2008 to May 2009 because of rehabilitation works. The amount of steam recovered after the rehabilitation works but in April 2010 it had not reached the forecasted amount.

In tandem with the decrease in the amount of steam, the maximum output of the power plant and net electric energy production also declined. The maximum output was half of the installed capacity immediately after the commencement of plant operation. After the rehabilitation works, the maximum output slightly recovered and had stayed at a fifth of the projected figure (85% of the installed capacity) in April 2010. Net electric energy production followed a similar pattern and, at the time of the ex-post evaluation, had stayed at a fifth of the amount forecasted at the appraisal.

Photo 1:Production well under development

Out of ten production wells, there were three active wells, two reserve wells, three inactive wells, and two monitoring wells at the time of the ex-post evaluation. The development risk of the heat source is a fundamental issue in a geothermal power plant. It can be assumed that this project made efforts to reduce the risk with the feasibility study and the Special Assistance for Project Formation study. In geothermal development for a geothermal power plant, assessment before plant operation is not very precise in general[7]. Even with a sufficient source of heat, the inappropriate location of a production well occasionally results in insufficient steam. Thus, geothermal development involves the risk that the amount of steam is smaller than its estimate. As for the geothermal development for this project, the development area was adjacent to a protected area in the national park. This constricted the location of drilling points. In addition, silica adhesion in the pipes did not allow a simultaneous discharging test at multiple wells. This prevented the accurate assessment of the geothermal resource.

In order to conduct drilling in a location closer to the heat source, the executing agency is developing additional production wells in the buffer zone adjacent to the power plant by using its own budget. One production well was completed in March 2010 and the discharging test of the well was held until the end of June 2010. External experts hired by EDC having reviewed the estimate of the geothermal resource using the results of the discharging test, the executing agency will decide on the further development in the buffer zone by the end of 2010.

(2) Operational hours and unplanned outages

The operation of the power plant was halted from May 2008 to May 2009 because of the rehabilitation works for the geothermal wells. The availability factor[8] decreased in 2008 and

[7] The status of underground resources cannot be assessed directly. As information on geothermal resource starts to increase after plant operation, the accuracy of resource assessment improves.

[8] Total operational hours / Total hours

2009 (see Table 3). Since June 2009, monthly operational hours of the FCDS and the power plant were above 90% of the planned total hours. Unplanned outages were frequently caused by machine troubles (see Table 4). These were mainly due to trouble in the main stop valve of the steam pipe (see "3.5.4 Current Status of Operation and Maintenance").

Table 3: Operational hours and Availability factor

	2007	2008	2009
Total hours	8,760	8,784	8,520
Total operational hours	7,422	3,709	5,343
Availability factor (%)	84.7%	42.2%	62.7%

Source: EDC

Table 4: Unplanned outages (frequency and hours)

	2007	2008	2009
Unplanned outages (frequency)	3	0	3
Machine troubles (frequency)	3	0	2
Human errors (frequency)	0	0	1
Unplanned outages (hours)	70.59	0.00	89.48
Machine troubles (hours)	70.59	0.00	77.00
Human errors (hours)	0.00	0.00	12.48

Source: EDC

3.3.1.2 Results of Calculations of Internal Rates of Return (IRR)

The Financial Internal Rate of Return (FIRR) for this project is below the forecast at the time of the appraisal (7.0%). The assumptions of the FIRR are as follows:

Table 5: Assumptions for the FIRR

Item	At Appraisal	At Ex-post Evaluation
Costs	Investment costs, operation and maintenance costs, income tax (based on the assumption at the appraisal: 26% until 15 years after project completion and 35% after 16 years and from thereon), steam costs	Investment costs (including the additional costs for new development), operation and maintenance costs (based on the amount provided by EDC), income tax (10%), contribution to the community fund (0.01 peso/kWh)
Benefits	Electricity sales, Steam sales (it was itemized to estimate government share. This revenue was offset by steam costs)	Electricity sales (actual sales for 2007 – 2009, the estimated amount based on 2010 actual data for 2010 – 2012, and the estimated amount by EDC for 2013 and after; data provided by EDC for the electricity tariff)
Project life	25 years after the project completion (1999 – 2023)	25 years after the project completion (2007 – 2031)

Source: appraisal documents, EDC

The FIRR is lower than the estimate at the appraisal. This is mainly due to (1) electricity sales being smaller than forecast at the appraisal and (2) additional investment costs for new

production wells.

3.3.2 Qualitative Effects

(1) Interview with beneficiaries

In this ex-post evaluation, managers and employees of private companies in Bacolod City and those of the National Grid Corporation of the Philippines (NGCP) were interviewed on the frequency of blackouts and the stability of voltage.

The interviews with the staff of the private companies revealed that rotating blackouts had continued for almost one year and especially during the summer months when demand increased. Before the development of the buffer zone, the executing agency agreed to give priority to the province of Negros Occidental in the sale of electricity from the project. At the time of the ex-post evaluation, the power plant did not generate sufficient energy and had little room for additional supply. The electric cooperative whose supply area covers Bacolod City was expected to purchase energy from other firms after 2011 and, thus, could not enter into an electricity purchase agreement with the executing agency.

Large users in Bacolod City had backup generators. However, they strongly demanded a stable supply of electricity as the electricity costs of the backup generators were twice those of the usual electricity tariff. According to the user, in addition, switching to backup generators required the rearrangement of production lines, a process that is time-consuming. Meanwhile, NGCP staff suggested that the power plant contributed to the stability of voltage at the time of peak demand.

The lack of sufficient power generation from the Northern Negros Geothermal Power Station was not a sole reason for the unstable power supply in Bacolod City. It should be noted that the demand increased and, further to that, the electric cooperative was reluctant to enter into a new electricity purchase agreement because of an existing agreement with another firm. While the power plant played a limited role as a base load power station, it contributed to the stability of voltage to a certain degree.

This project has achieved its objectives at a limited level, therefore its effectiveness is low.

3.4 Impact

3.4.1 Intended Impacts

(1) Proportion in the Visayas grid

In 2008, the Northern Negros Geothermal Power Station accounted for negligible portions of both gross power generation and electricity consumption in the Visayas grid. Therefore, it is presumed that the power station has played a limited role in the stable supply of electricity and that it has had a very marginal impact on the macro economy.

3.4.2 Other Impacts

(1) Impacts on the natural environment

The monitoring data provided by the executing agency showed that the hydrogen sulfide in ambient air is within the environmental standard (0.07ppm). Although a gas abatement system was not installed at the Northern Negros Geothermal Power Station, hydrogen sulfide levels satisfied the environmental standard set by the Department of Environment and Natural Resources (DENR). According to the executing agency, monitoring of surface water was conducted at Pattan River and Bago River. DENR set the environmental standards for heavy metal and chemical substances (hexavalent chromium, lead, cadmium, arsenic, etc.) in light of the use of river water. Pattan River corresponds to Class B (level which allows swimming) and

Bago River to Class D (level which allows irrigation)[9]. Noise was below 50dB under normal operation and there was no difficulty in daily living[10].

In addition, the executing agency regularly reported monitoring results to the third party Multi Sectoral Monitoring Team (MSMT)[11].

(2) The development of the buffer zone

At the time of the ex-post evaluation, the executing agency developed a new steam field in the buffer zone adjacent to the power plant as an additional source of heat. At the time of the appraisal, it had not been discussed whether the buffer zone would be developed. The Mt. Kanla-on Natural Park Act of 2001 (RA9154) was approved in 2001 and this act showed that the development of the buffer zone was permitted.

Before the development of the buffer zone, the executing agency made an agreement with the provincial government of Negros Occidental. The major items on which the both parties agreed were (1) the priority of the electricity supply to the province of Negros Occidental, (2) reforestation, and (3) the monitoring of the development area. Reforestation was begun and aimed at 535 ha, an area larger than that agreed with the provincial government (400 ha). A local farmer's association participated in reforestation. On the monitoring of the development area, the committee of the provincial congress has conducted inspections without prior notice several times since 2008. Furthermore, the committee reviewed the design drawings of the development site and access roads and recommended design changes in order to reduce the environmental burden.

(3) Land acquisition and resettlement

In 2000, the executing agency reached an agreement with residents on the conditions of land acquisition. Land acquisition for this project required the resettlement of 42 households. While 25 households moved to a relocation site, 13 households selected cash compensation. For 4 households, only farmland was acquired. Replacement land was allocated to these households. Following the agreement on resettlement, the executing agency allocated 200 m^2 of land and 25m^2 of a house to each relocated household. According to the executing agency, land ownership and cultivation rights were unclear as land registration was incomplete at the project site. For this reason, households whose farmland was acquired were allocated 1 ha if they had a Certificate of Land Ownership Award (CLOA) and 0.5ha if they did not have a CLOA. The executing agency issued certificates of land ownership to relocated households. The procedures for land transfer require the satisfaction of residency for 5 years and, following this, the completion of land registration. At the time of the ex-post evaluation, the transfer of allocated land was incomplete due to a delay in legal procedures at the land registration office, though the executing agency took the necessary actions.[12] The executing agency took on all costs related to land registration.

Photo 2: Relocation site

[9] According to power station staff, DENR officially classified Pattan River and Bago River. The Regional Office of DENR monitored Pattan River as Class B and Bago River as Class D.

[10] 50dB corresponds to "quiet office." (Architectural Institute of Japan "Sound Insulation Standards of Building and Design Guidance")

[11] MSMT members include the staff of environmental departments of municipalities, DENR staff, and NGO staff.

[12] The executing agency expected that land registration would be completed by the end of 2010.

Interviews with resettled residents (three households) revealed that there were several households whose cultivation areas were reduced after relocation and that the improvement of transportation had led them to switch to more profitable commercial crops as well as leading to an increase in employment opportunities. The executing agency provides income enhancement programs to the farmers' associations in the area neighboring the power plant (32 associations) including to the relocated households. Via the income enhancement programs, there is a small contracting program (contracting of cleaning, etc,) and support for vegetable farming and native chicken feeding. The executing agency monitored the livelihood of the relocated households from the pre-resettlement period to the time of the ex-post evaluation. The results show that the average income of the relocated households improved after resettlement (see Table 6). The reasons for an increase in income included switching to more profitable crops, an increase in employment opportunities, additional income from the small contracting programs, and business activities started with crop damage compensation at the time of resettlement. At the time of resettlement, the executing agency set a target for the average value of household assets at 429, 112 pesos. In 2009, the average value of household assets for the relocated households reached 495,920 pesos and surpassed the target.

Table 6: Household Income

Unit: peso

	2000	2006	% change
Resettled households (Average)	43,501.53	145,915.52	+235.4%
Western Visayas (Average)	109,600	129,905	＋18.5%

Source: EDC, NSCB "2009 Philippine Statistical Year Book"

The executing agency developed and maintained the road to the power station and the road was used as a community road by residents. In addition, the executing agency repaired and refurbished a health center in the neighboring community and provided medicine for the center.

Philippine law allows land acquisition by a project to contribute to public welfare with the deposit of compensation in accordance with legal procedures if a land owner does not agree with the sale of land. This project acquired land in several places for the construction of transmission lines by following the above procedure. At the time of the ex-post evaluation, there were approximately 20 cases where compensation to land owners had not been settled. As the land owners did not agree with the sales price, the executing agency was waiting for court decisions but was ready to pay compensation in accordance with Philippine law.

(4) Brine spill accident

In February 2009, a malfunction in the pump of the production well in the PT-B field[13] caused a brine spill accident for 4 hours. The incident was reported to the DENR and an independent investigation was requested by EDC. MSMT conducted an environmental assessment and reported the assessment results to DENR and other offices in April 2009. The assessment revealed that the executing agency did not violate the relevant environmental regulations and confirmed that there was no residual negative effect on farm soils. The case was cleared by the DENR on April 17, 2009. Despite the closure of the case, EDC assisted the farmers to regain the original harvest of the farmers. According to MSMT, some residents claimed skin allergies but there was the lack of clear proof of causality between the symptoms and the accident based on the hospital records in the affected area. According to the executing agency, the accident was connected with the rehabilitation works of the production wells where the fluid collection and recycling system and wells were on shutdown, thus, it would not happen again under normal operation. A warning device and perimeter canals to trap brine were

[13] This project developed geothermal resource at three locations, PT-A, PT-B, and PT-C.

installed for the reduction of any future damage.

The contribution to the stable supply of electricity and the regional economy is considered to have been limited. On the other hand, no severe negative impacts have been found as the executing agency has made efforts to reduce the burden on the natural and social environments. The monitoring activities for ambient air, water, the development of the buffer zone, and for the livelihood of the relocated households are carried out appropriately and routinely.

3.5 Sustainability (Rating: b)

3.5.1 Structural Aspects of Operation and Maintenance

At the time of the appraisal, the state-owned company, the Philippine National Oil Company (PNOC) owned the executing agency. At the time of the ex-post evaluation, PNOC sold all equities and the executing agency became a subsidiary of the private corporation Red Vulcan Holdings. The executing agency is listed on the Philippine Stock Exchange.

The operation and maintenance (O&M) of the facilities constructed by this project is separated into two sections. One is for the O&M units of the geothermal wells and the administration department and the other for the O&M of the power plant. The executing agency separately manages the two sections for clarity of responsibility as the operation of the geothermal wells and that of the power plant have different natures. The responsibility for O&M of the facilities constructed by this project is clearly defined.

3.5.2 Technical Aspects of Operation and Maintenance

The contractor and the consultant (Fuji Electric Systems and West Japan Engineering Consultants) provided training for the power plant to the executing agency. The executing agency had sufficient experience in the operation and maintenance (O&M) of geothermal wells as it had operated geothermal wells since the 1970s. At the time of the ex-post evaluation, the staff engaged in the O&M of the geothermal wells and the power plant were required to have 40 hours training per year. The training is intended to brush up basic knowledge of O&M. According to the executing agency, employees had skills adequate for daily operation but there was no expert to supervise the overhaul of the power plant. The executing agency requested the contractors to send an engineer when necessary.

The number of employees who work at the project site is approximately 170 persons. Out of these, the number of staff directly engaged in the O&M of the geothermal wells and the power plant is shown below. In light of its past experience, continuing training and the adequate number of staff, it is concluded that the executing agency has the appropriate technological capabilities for daily O&M.

Table 7: The number of staff engaged in O&M

Responsibilities	Number of staff	Engineers
FCRS operations	26	12
FCRS maintenance	14	4
Steam field technical services	17	3
Power plant	40	30

Source: EDC

3.5.3 Financial Aspects of Operation and Maintenance

Since the executing agency is a listed company, it discloses financial statements based on accounting standards in the Philippines. ROA[14] was 4% in 2009, which can be considered an appropriate profitability for an electric utility (see Table 8). Profitability, both ROA and ROE[15], declined in 2008 due to foreign exchange loss. Both the current ratio[16] and the total debt equity ratio[17] worsened from 2007 to 2009 but the levels of these ratios do not suggest that the financial stability of EDC is in peril.

Table 8: Financial Indicators for EDC*

	2007	2008	2009
ROA	12.2%	1.9%	4.0%
ROE	25.4%	4.7%	11.1%
Current Ratio	1.33	0.87	0.88
Total Debt Equity Ratio	1.08	1.41	1.79

Note: * based on the annual reports of EDC for 2008 and 2009

At the time of the ex-post evaluation, electricity sales from the Northern Negros Geothermal Power Plant did not adequately cover the O&M costs of the plant because of insufficient power generation. Therefore, the visibility of financial sustainability is not clear. The executing agency anticipates that the ongoing development of geothermal wells will result in an increase in the electric sales sufficient for the O&M.

3.5.4 Current Status of Operation and Maintenance

The power plant is expected to have minor maintenance (inspection, lubrication, etc.) biennially and major maintenance (inspection and, if necessary, the replacement of critical parts such as a turbine) every four years. The latest biennial maintenance was held during the rehabilitation works. There were malfunctions in the main stop valve of the steam pipe after project completion. As this problem occurred within the warranty period, the contractor sent a specialist to the power plant and replaced the parts which had caused the malfunctions.

No serious injury which had affected the operation of the geothermal wells and the power plant was found during the site survey. The corrosion caused by hydrogen sulfide was marginal. There was no serious damage disrupting the project effects.

Some problems have been observed in terms of finance; therefore sustainability of the project is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project was consistent with the development policy of the Philippines, with its development needs and with Japan's ODA Policy as it supported the Philippine government in the development of domestic energy source. Thus, the project is considered to have relevancy. Meanwhile, the project period was prolonged due to the Asian financial crisis and retender for the power plant. The overall evaluation result of this project is attributable to effectiveness,

[14] Net profit / Total Assets
[15] Net Profit / Total Equity
[16] Current Assets / Current Liability
[17] Total Liabilities / Total Equity

evaluated to be low. At the time of the ex-post evaluation, power generation was below plan because of the insufficient amount of steam. However, the executing agency has taken the necessary steps to augment steam including additional investment and, at the time of ex-post evaluation, has also engaged third party to assess the project. This result needs to be reviewed with the recovery of steam amount in the future. Safeguards on the natural and social environments were carried out appropriately in accordance with the law. The executing agency managed its social and environmental safeguards effectively and properly, through which it was able to minimize conflicts with the stakeholders. The power plant alone does not generate enough revenue but the executing agency is financially stable. There was no issue disrupting the sustainability of project effects in either the structural or the technical aspects or in the current status of the facility. The project is considered helpful by the transmission company as it helps stabilize the voltage of the grid.

In light of the above, this project is evaluated to be (D)unsatisfactory.

4.2 Recommendations

4.2.1 Recommendations for the Executing Agency

It is desirable that EDC continuously pursues efforts to recover power generation in consideration of the results of the discharging test.

4.2.2 Recommendations for JICA

It is desirable that JICA continuously monitors EDC's efforts to recover power generation.

4.3 Lessons Learned

In the Philippines, where geothermal resources abundantly exist, geothermal power is a promising renewable energy source. In addition, geothermal power is more desirable than other power sources in terms of CO_2 emission. The effectiveness of the project was low. However, this result needs to be reviewed with the recovery of steam amount in future and does not mean that the relevancy of geothermal power generation in the Philippines is undermined. The development risk, as a unique risk of geothermal power generation, severely affects project effectiveness. This risk became an issue for this project also. For this Project, the executing agency conducted a feasibility study. The development risk was tried to be reduced by conducting the Special Assistance for Project Formation study but it could not be completely avoided. The tightness in the electricity demand and supply and additional cost needs to be taken into consideration. Nevertheless, it is desirable that measures to reduce development risk are examined at appraisal.

End

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
1. Project Outputs	(1) Drilling of wells (14 production wells and 7 reinjection wells) (2) Procurement and construction of FCDS (3) Construction of geothermal power plant (20 MW × 2 units) including transmission lines (4) Consulting servivces (geothermal fesibility study, D/D, procument support, construction supervision)	(1) Drilling of wells (10 production wells and 3 reinjection wells) (2) As planned (3) Construction of geothermal power plant (49.37 MW × 1 unit) including transmission lines (4) Consulting servivces (geothermal fesibility study, D/D, procument support, construction supervision, evaluation of environmental monitoring)
2 Project Period	March 1997 – December 1999 (34 months)	March 1997 – February 2007 (120 months)
3.Project Cost Amount paid in Foreign currency	12,196 million yen	10,427 million yen
Amount paid in Local currency	7,084 million yen (1,771 million Ph. Peso)	6,151 million yen (2,412 million Ph. Peso)
Total	19,280 million yen	16,578 million yen
Japanese ODA loan portion	14,460 million yen	10, 510 million yen
Exchange rate	1 Ph. Peso = 4.00 yen (As of May 1996)	1 Ph. Peso = 2.55 yen (As of 2005)

Third Party Opinion on Northern Negros Geothermal Project

Prof. Fernando Y. Roxas, Asian Institute of Management

Relevance

The Northern Negros Geothermal Project (NNGP) ranks very high on the relevance benchmark because it directly addresses many issues relevant during the time of project inception and are still relevant today. The Cebu-Negros-Panay sub-grid has always had the highest electricity demand growth rate in the country. Because of scale, majority of the additional capacities are envisioned to be coal-fired plants. Geothermal plants are a valuable, environmentally benign resource which helps the economy grow its generation portfolio but mitigate the increase in green house gasses from fossil fuels. But unlike other Renewable Energy technology like wind or solar, geothermal plants contribute non-intermittent power which does not require more ancillary services for grid stability. Moreover, the NNGP provides valuable voltage support that improves the quality of service even in Panay Island.

Efficiency

The development of the NNGP did not result into cost over-runs for PNOC EDC. However, there was a long delay in completion time as the off-taker, NPC deferred taking on additional liabilities in the wake of the suppressed demand after the Asian Financial Crisis. However, these delays were caused by externalities that no one could have foreseen.

Effectiveness/Impact

On these measures, the NNGP does not achieve commendable results primarily because the project did not even come close to the capacity or the energy that was designed for. The main reason for the shortfall is the discrepancy between the amount of steam forecasted and actually delivered at well head. Thus, the output today in terms of both MWs and energy is only a fifth of installed capacity and expected generation. Moreover, the plant was closed from May 2008 to May 2009 due to problems at the production wells.

Sustainability

Because of low production levels, NNGP could not even cover its own running costs.

Since the continued operation of the plant will required the drilling of new production wells, which cannot be funded by NNGP's earnings, the project cannot be deemed sustainable as a stand-alone enterprise.

Lessons learned

From an economic and technological standpoint, it would seem more prudent in the future to quickly install small capacities early and learn more about the nature of the brine and the dynamics of the reservoir before committing to larger plants. Early revenues minimize the capex for succeeding units. Likewise, the larger units will be designed with better data and information.

(End)