Philippines

Environmental Equipment Project for Power Plants

Report Date: September 2002
Field Survey: June 2001

1. Project Profile and Japan's ODA Loan

Location Map of the Project


Meteorological Monitoring Equipment

1.1 Background

As of the time of the project appraisal, the National Power Corporation (NPC) had given priority to the construction of a power station in order to ameliorate a serious shortage in electricity. The construction of power stations had resulted in some improvement of the gap between supply and demand, but pollution had become a serious problem, since action had not been taken to address the environmental impact of new and existing power plants: especially those power plants that use fossil fuel.

Failure to take remedial action could have exacerbated the environmental problems, causing adverse impacts on the environment on surrounding residents, which would have likely created difficulty for the NPC in promoting its Power Development Plan. This in turn would have undermined NPC's progress in increasing power supplies, resulting in further outstripping of supply by growing demand.

To address these concerns, the National Ambient Air Quality Standards, which is one of the frameworks to regulate air pollutants emission from industry sector and was established within the sphere of Clean Air Act, was amended in March 1993 to require power entities to monitor the environment around their stations. The NPC was required to establish a monitoring organization and to ensure compliance with the new regulations. As a further step, the NPC planned to improve the environmental monitoring facilities at its power plants.

1.2 Objective

To install, use and maintain monitoring equipment for emissions, ambient air quality, water quality, hydrology and noise, and to submit periodic reports to the Department of Energy and Natural Resources (DENR)[*1] in order to comply with new Philippine environmental standards.

1.3 Project Scope

Procurement and installation of following equipments mainly on Luzon Island and Visayas Islands: (Whole project cost of 457.1 million yen was to be covered by Japanese ODA loan)

a. 2 sets of stack sampling equipment with calibration systems
b. 10 sets of continuous ambient air quality monitoring devices specific for oil-fired power plants

[1] Responsible for development, implementation and enforcement of environmental regulations in the Philippines

c. 6 sets of continuous air quality monitoring devices for geothermal power plants
d. 12 units of meteorological equipment in major hydro and oil-fired power plants
e. 8 field motor vehicles to carry stacks sampling equipment and ambient monitors
f. 1 set of Environmental Management Department (EMD) Laboratory equipment
g. 5 sets of water quality monitors
h. 7 sets of Hydrological facilities/instruments for Hydrology Services
i. 5 sets of noise level meter
j. Expert services to accompany procurement for equipment installation, calibration, commissioning, as well as operation and maintenance training of NPC for use of above equipment for environmental monitoring

1.4 Borrower/ Executing Agency

The Republic of the Philippines / National Power Corporation (NPC)

1.5 Outline of Loan Agreement

Loan Amount Loan Disbursed Amount	457 million yen 214 million yen
Exchange of Notes Loan Agreement	November. 1994 December. 1994
Terms and Conditions Interest Rate Repayment Period (Grace Period) Procurement	 3.0 % p.a. 30 years (10 years) General Untied
Final Disbursement Date	April. 1999

2. Results and Evaluation

2.1 Relevance

The Philippine Constitution declares that it is the duty of the State to protect and advance the right of the people to a balanced and healthy ecology. This duty had earlier been codified in the Philippine Environmental Policy, which is the national blueprint for environmental protection. Under the policy, the country's first environmental standard for air quality was established in 1978 as Administrative Order No. 14. The air quality standard was also amended with the establishment of the Clean Air Act in 1993. In the act, the Environmental Impact Statement system clearly required all government-owned or controlled corporations, as well as private corporations, firms and entities, to execute environmental monitoring.

At the time of the appraisal, however, the Philippines had been experiencing severe environmental problems resulting from air and water pollution in the major cities. Since existing thermal and geothermal power stations had, in many cases, not taken the steps needed to protect the environment, emissions originating from these power stations were considered one of the main causes of air pollution. Nevertheless, the NPC did not have enough monitoring equipment to measure ambient air quality and other environmental indicators and could not comply with the requirements of the Department of Environment and Natural Resources (DENR) nor accurately measure environmental impacts without them. Thus, the project objective was consistent with the environmental policy of the Philippines at that time.

The Clean Air Act, the country's main legislative framework for air quality enhancement, was again amended in June 1999 to establish much stricter standards and to eventually ease air pollution. The law enables the government to introduce regulations to reduce the sulfur, benzene, and aromatic content of fuel to lessen emission of those substances. In order to comply with the new law, NPC and other generation companies have to strengthen their environmental monitoring activities. Accordingly, the project objective has been and still is relevant to the country's environmental policy.

2.2 Efficiency

2.2.1 Project Scope

A comparison between the originally envisaged scope and the actual scope (see Table-1) shows that the number of continuous ambient air quality monitoring systems, meteorological monitoring instruments and field motor vehicles was pared. Two field motor vehicles were cancelled because of financial constraints on the part of the NPC. Originally, 4 sets of continuous ambient air quality monitoring systems and two sets of meteorological monitoring instruments were planned for installation in the Aplaya and Santos diesel power stations. However, prior to project implementation, NPC decided to decommission these stations; consequently, the equipment for these stations was excluded from the project scope.

Procurement of laboratory equipment was initially deferred owing to contract conflicts between NPC and its supplier, and finally excluded from the project scope. At present, NPC-Environmental Management Department (EMD*[2]) still plans to purchase the equipment. However NPC's financial situation does not allow it to allocate funds for capital expenditures on the equipment. As a result, EMD is still using old-fashioned equipment.

In order to comply with the DENR requirement, NPC originally planned to purchase continuous ambient air quality monitoring equipment for geothermal plants under the project. However, the tender price of the equipment was considerably higher than the original estimate. As a result, NPC decided to purchase discontinuous type equipment, which is much cheaper than the continuous type, but still more expensive than the original estimate.

2.2.2 Implementation Schedule

The project was completed in May 1999, two years and three months after the originally scheduled completion date of February 1997. Unexpectedly, a substantial amount of time was required for contract finalization and preparatory bidding work. A consultant was not hired to supervise the whole project. NPC could not coordinate various activities, such as selection of equipment, preparing tender documents, and negotiating with suppliers, was identified as the major cause of the completion delay.

2.2.3 Project Cost

The actual project cost of 213.9 million yen was 243.2 million yen or 53.2% lower than the appraisal estimate of 457.1 million yen. This considerable cost saving resulted mainly from a narrowing of the project scope and from a lower tender price, which was attributed to intense competition among the equipment suppliers. For example, the tender price of 1 set of ambient air quality system for SO_2, NO_x, CO, SPM was 13.9 million yen, 9.4 million yen lower than the original estimate (23.3 million yen). On the other hand, tender prices for stack sampling equipment, ambient H_2S monitoring system, and hydrological equipment, were relatively higher than the original estimate. However, given the cost savings that resulted from intense bidding, the overall cost overrun was negligible.

Table-1: Comparison of Original with Actual

Item	Original Scope/ Estimate		Actual Scope/ Expense		Difference	
Stack Sampling Equipment	2 sets	12.8 mil yen	2 sets	40.2 mil yen	0	+27.4 mil yen
Continues Ambient Air Quality Monitoring Systems	10 sets	233.1 mil yen	6 sets	83.4 mil yen*	- 4 sets	-149.7 mil yen*
Ambient Air Quality Monitoring Devices for Geothermal Plants	6 sets	11.3 mil yen	6 sets (Discontinuous type)	43.1 mil yen*	Change continuous type into discontinuous type	+31.8 mil yen*
Meteorological Monitoring Instrument	12 sets	52.8 mil yen	10 sets	0.0 mil yen*	-2 sets	-52.8 mil yen*
Field Motoring Vehicles	8 cars	51.7 mil yen	6 cars	14.6 mil yen	- 2 cars	-37.1 mil yen
Laboratory Equipment	1 set	13.9 mil yen	0 set	1.8 mil yen	- 1 set	-12.1 mil yen
Water Quality Monitors	5 sets	10.0 mil yen	5 sets	2.3 mil yen	0	7.7 mil yen
Hydrological Equipment	1 set	10.0 mil yen	1 set	26.2 mil yen	0	+16.2 mil yen
Noise Level Meters	5 sets	7.9 mil yen	5 sets	2.2 mil yen	0	-5.7 mil yen
Total	-	457.1 mil yen**	-	213.9 mil yen	-	-243.2 mil yen

* Actual cost of MET Instrument was included in the actual cost of Continuous ambient air quality monitoring system and Ambient

[2] Environmental Management Department (EMD) of NPC consists of two bodies: 1) Environmental Monitoring & Services Division and 2) Environmental Impact Assessment Division. The former was in charge of this project.

Air Quality Monitoring Devices for Geothermal Plants, ** Including physical contingency and price escalation Source: NPC

2.3 Effectiveness

2.3.1 Utilization of the Project Facilities

As far as air pollution is concerned, the energy sector is potentially one of the most significant sources of pollution. Thus, it is important for NPC to reduce emissions in order to comply with environmental standards. Under environment-related legislation and administrative orders in the Philippines, power stations are required to submit a quarterly pollution monitoring report to DENR Regional Offices[*3] in order to demonstrate compliance with the country's environmental standards. Monitoring results are necessary to obtain a "Permit to Operate (PO)", which DENR Regional Office issues annually to authorize the continuous use of power stations.

In addition, prior to the construction of a power station, NPC has to execute an Initial Environmental Examination (IEE) and a subsequent Environmental Impact Assessment (EIA). If the monitoring results are sufficient, the DENR Regional Center issues an "Authority to Construct (AC)" before construction commences.

The project has enabled NPC to undertake regular and continuous monitoring as required, and to comply with the reporting requirements of the DENR Regional Offices. Environmental monitoring equipment procured under the project has been used for the planning, construction, operation, and decommissioning of power stations.

Table-2: List of the Procured Equipments

	Distribution	Monitoring Target	Frequency of Monitoring
Stack sampling equipment	MRC (Mindanao Regional Center), then relocated to EMD VRC (Visayas Regional Center)	- Sulfur oxides - Carbon monoxide - Nitrogen oxide	Yearly (at each power station), and as needed
Continuous ambient air quality monitoring system for SO_x, NO_x, CO and SPM[*4]	Battan TPP I & II (2 sets) Panay DPP (2 sets) Bohol DPP (2 sets)	- Sulfur oxides - Carbon monoxide - Nitrogen oxide - SPM	Continuous
Ambient air quality monitoring devices for geothermal plants	Bac-man GPP (2 sets) Tongonal GPP (2 sets) Palinpinon GPP (2 sets)	- Hydrogen Sulfide	Weekly
Noise Level Meter and Water Quality Monitors	SLRC (Southern Luzon Regional Center) NLRC (Northern Luzon Regional Center) MMRC (Metro Manila Regional Center) VRC (Visayas Regional Center) MRC (Mindanao Regional Center)	- Noise - Water Quality	As needed
Meteorological monitoring instrument	Bohol DPP, Panay DPP Bataan TPP I & II (2 sets) Bac Man GPP, Tongonan GPP Palinpinon GPP I & II (2 sets) Masinloc TPP, Hydrology Service	- Wind Speed - Wind Direction - Humidity - Temperature - Solar radiation etc.	Continuous
Hydrological equipment	NPC Hydrology Service Division	- Water Temperature - Water Velocity	Not in use
Field monitoring vehicle	EMD SLRC (Southern Luzon Regional Center) NLRC (Northern Luzon Regional Center) VRC (Visayas Regional Center) Battan TPP	-	-

* GPP: Geothermal power plant, DPP: Diesel power plant, TPP: Thermal power plant, EMD: Environmental management division

2.3.2 Operational Status of the Project Facilities

a) Stack Sampling Equipment

Under the project, 2 sets of removable-type stack sampling equipment were procured for the Visayas

[3] The policies formulated by the DENR and its bureaus are implemented by the Regional Offices of the DENR, which are found in the 13 administrative regions of the country

[4] SPM (Suspended Particulate Matter): Small particles of solids or liquids suspended in air.

Regional Center and the Mindanao Regional Center of NPC. The latter was recently relocated to NPC EMD and is utilized at power stations on Luzon Island. The equipment is utilized at various thermal power stations within each respective area.

While the monitoring equipment itself is generally still working properly, the data logger has been malfunctioning since the beginning of 2000 due to some defects in computer software. In response, monitoring staffs have had to record monitoring results manually, and, accordingly, the stack sampling equipment has not functioned as a continuous monitoring system.

b) Continuous Ambient Air Quality Monitoring System for SO_2, NO_x, CO and SPM

Under the project, 6 sets of continuous ambient air quality monitoring systems were procured for three thermal power stations (2 sets for each power station). Judging from the information collected during the site survey, a few of them have had mechanical problems. For example, in the case of equipment procured for the Bataan thermal power station, i) no data showed on the SO_2 analyzer display after calibration executed by a power station staff member, ii) a Y2K problem has prevented two SPM from indicating the exact date, and iii) a NO_x analyzer cannot be reset in spite of an alarm that repeatedly indicates that the unit is malfunctioning.

At the time of the site survey in August 2001, of 30 major monitoring functions[*4], 26 functions (86.7%) were still in use and in good conditions, while 2 functions (6.7%) were also in use but were experiencing problems. The remaining 2 functions (6.7%) were out of order. In addition, computers, printers and UPS*[5] were procured, but some of this equipment was no longer functional. One of the reasons of the malfunctioning can be attributed to the extreme high temperature in a housing unit resulting from an air conditioner outage.

c) Noise Level Meter and Water Quality Monitors

Under the project, a set of noise level meters and water quality monitors were procured for 5 respective regional centers: the Metro Manila Regional Center, the Northern Luzon Regional Center, the Southern Luzon Regional Center, the Visayas Regional Center, and the Mindanao Regional Center. The equipment is usually stationed at each regional center, and, as the need arises, conveyed to each site for monitoring. All of the procured noise level meters and water quality monitors have been kept in good condition since procurement.

d) Ambient Air Quality Monitoring System for Geothermal Plants

The Philippines has great geothermal potential, which could be utilized for energy generation. At present, the country has 6 geothermal power stations with a total generating capacity of 1,557 MW. One problem is Hydrogen Sulfide (H_2S), which may be a contributing factor to various health problems. H_2S is found naturally in the gases emitted by volcanoes, and, in the case of a geothermal power station, is also contained in the steam emitted from production wells.

Figure-1: Ambient H_2S Monitoring System

Under the project, 6 sets of ambient H_2S monitoring systems were procured for the Bac- Man, Tongonan and Palinpinon geothermal power stations (2 sets each). Originally, NPC intended to procure continuous-type equipment to comply with DENR's requirement. As mentioned before, however, non-continuous-type equipment was procured owing to the high actual tender price. As of now, all H_2S analyzers are in good operational condition. On the other hand, of 6 attached data loggers, 3 units are out of order. Thus, monitoring results are recorded manually.

e) Meteorological Monitoring Instrument

Under the project, 10 sets of meteorological monitoring instruments (MET instruments) were procured. Nine of the sets were installed within the sites of NPC-owned power stations. Each instrument is equipped with a

Figure-2: MET Instrument

[4] SO_2 analyzer, NO_x analyzer, CO analyzer, SPM analyzer, and noise level meter (6 units each)

[5] UPS: Uninterruptible Power Supply System

wind speed/ direction sensor, a temperature/ humidity sensor, a solar radiation sensor and a barometric pressure gauge. All meteorological data being monitored are recorded in the computerized data logger and illustrated in a diagrammed display.

One set, procured for NPC's hydrology service department, has not been utilized. Instead, it is stored in NPC's warehouse, because the department has curtailed its activities (details will be provided in a subsequent section). The remaining 9 sets were installed in thermal/ geothermal power stations. From the start, the equipment had many problems. NPC-EMD asked the local office of the original supplier to repair the problematic equipment[*6] whenever there was a problem. As of February 2002, all the equipment was working satisfactorily.

f) Hydrological Equipment

One set of hydrological equipment was procured for utilization at NPC's hydrological monitoring stations. However, NPC's monitoring stations all over the country were closed, effective December 31, 1998, owing to budgetary constraints and the impending NPC privatization. As a result, the services of NPC's gauge keepers were terminated, and all of the hydrological instrument/equipment installed at various locations was removed. This includes equipment that was procured by the project[*7] and is presently stored at NPC's warehouse. Subsequently, most of the personnel at Hydrology Services-Luzon opted to avail themselves of the early retirement program offered in December 1998. Included among the retirees were NPC's instrument technicians, who were trained by the supplier in the operation and maintenance of the project facilities.

Because of the reduction in personnel, all of the equipment and instruments belonging to the department have been left unattended since then [*8]. According to NPC, this equipment will be transferred to the Dam Reservoir Water Management Department, which will be established within Transco[*9].

g) Field Monitoring Vehicle

Under the project, 6 cars were procured for conveying monitoring equipment to the monitoring sites. The cars are usually parked at one of five locations: the Northern Luzon Regional Center, the Southern Luzon Regional Center, the Visayas Regional Center, NPC head office (EMD) and the Bataan thermal power station. As the need arises, the cars convey removable-type monitoring equipment -- including stack sampling equipment, noise level meter and water quality monitors -- to existing power stations or to the proposed site of a power station. At the time of site survey, one car, not being used because of engine trouble, was awaiting repair. That exception aside, the procured cars have successfully contributed to monitoring activities and have suffered no mechanical difficulties.

Figure-3: Field Monitoring Vehicle

2.4 Impact

2.4.1 Improvement of Environmental Consideration in NPC's Decision Making

Environmental monitoring activity -- weighing precise environmental impacts -- is the first step for environmental improvement. NPC has to obtain an Environmental Clearance Certificate (ECC), either a PO or an AC, in order to operate/ construct a power station. Environmental monitoring may influence NPC's decision-making by providing sound information on expected environmental impacts and the means for preventing or reducing those impacts. As such, the project has indirectly contributed to reducing negative environmental impacts from power stations.

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[6] For example, two of METs (meteorological monitoring instruments) installed in geothermal power stations were partially corroded owing to acid gas, which was naturally produced from the field, and two were damaged because of extreme high temperature, occasionally reached 50 degrees Celsius in a housing unit resulting from an air conditioner outage. During the warranty period (within one year after installation), all problems were fixed by original supplier for free During the warranty period (within one year after installation), all problems were fixed by original supplier for free

[7] Procured Equipment for NPC hydrological monitoring group: a set of hydrological equipment and a set of MET Instruments

[8] Presently, the hydrology services-Luzon has only three staff left, consisting of one principal hydrologist, one superintendent hydrologist, and one senior hydrologist.

[9] Transco: NPC's transmission related sections were supposed to be separated by the second quarter of 2002, and National Transmission Corporation (Transco) was established in June 2001 as a public corporation named .

According to NPC's power development program 2000, a total of 1,762 MW of the Philippines' oil-based generation capacity is scheduled for retirement between 2000 and 2010. Since many of these power plants were constructed in the 70's and 80's, they are nearing the end of their service life. In addition, the government's policy favoring a reduction of import oil consumption was attributed to the decommissioning.

Admittedly, precarious import oil prices and aging are the reasons that have been given for decommissioning these oil-based power stations, but it is also true that growing consciousness about environmental impacts probably contributed as well, since monitoring demonstrated that the emissions from these power stations in fact exceeded environmental standards. As a result of monitoring, some power stations – including the Sucat thermal power station and the Panay diesel power station -- could not obtain or renew their PO. Accordingly, it can be said that accurate monitoring results obtained from the procured equipment accelerated the decommissioning of environmentally-*un*friendly power stations.

2.4.2 Encouragement of Efforts to Reduce Negative Impacts Resulting from Existing Power Plants

Environmental monitoring is necessary to ensure that environmental standards are complied with – and, if necessary, to increase the likelihood that remedial measures are taken. The procured monitoring equipment has helped to quantify actual environmental impacts.

a) Installation Plan of a Desulfurizing System at the Panay Diesel Power Station

Under the project, 2 sets of ambient air quality monitoring systems were installed in the Panay diesel power station. In June and July 1999, monitoring showed that ambient SO_2 at the Panay diesel power station ((7.3 MW x 5 units) exceeded (average: 499 ppb[*10], maximum: 710 ppb) the environmental standard of 180 ppb. After that, NPC executed mechanical maintenance on the power station's fuel injection pumps and the cam nose and replaced defective parts. Moreover, NPC cleaned the external tubes of the heat recovery boilers of Units 1 and 2. While the monitored results of ambient SO_2 at times still exceeds the environmental standard (e.g. 290 ppb on March 27, 2000), the situation has certainly improved.

At present, NPC is considering whether to install a desulfurizer and modify smokestacks, which would costs an estimated 75 million pesos, in order to comply with the environmental standard. However, since the power station is already slated to be decommissioned by 2004, further remedial actions may not be taken.

b) Installation Plan for a H_2S Abatement System at the Geothermal Power Station

A geothermal power station may release naturally occurring chemical compounds into the atmosphere as a byproduct of the extraction of geothermal energy. These compounds include varying concentrations of hydrogen sulfide, hydrogen chloride, carbon dioxide, methane, ammonia, arsenic, boron, mercury, and radon. Emission of hydrogen sulfide is a major environmental concern at geothermal power plants because the gas has a characteristic "rotten egg" odor at low concentrations, and at high concentrations is toxic.

In the case of the Bac-man geothermal power station, monitoring showed ambient H_2S density (see Table 3) exceeded the environmental standard of 0.07 ppm. The NPC is considering the installation of an abatement system in order to reduce H_2S emissions from the production wells.

Table-3: Monitoring Results of Ambient H_2S at the Bac-Man I Geothermal Power Station

Environmental Standard	Year	Maximum Value	Average Value
0.07 ppm	1998	0.13 ppm (Oct. 1998)	0.097 ppm (Oct 8-10, 1998)
	1999	0.081 ppm (Jan. 1999)	0.078 ppm (Jan.- Feb. 1999)
	2000	0.160 ppm (Jul. 2000)	0.065 ppm (Jul.- Dec. 2000)

Source: NPC

2.4.3 Fulfillment of Accountability to Local Communities

A major aspect of the ECC approval procedure is social acceptability, which requires project operators to gain consent from local communities affected by a power station.

For example, at the Masinloc coal-fired power station (300 MW x 2 units), besides the usual monitoring activities, special monitoring activities are executed quarterly by a Multi-Partite Monitoring Team composed of NPC, DENR, and representatives of the Department of Energy and the local government. The power station was commissioned in late 1998, and was equipped with the latest anti-pollution equipment. At present, the monitored value are within the environmental standard. Monitoring data from the project

[10] The power station is utilized for peak load facility, and is operated only from 16:00 to 21:00. The average figure indicates measurement during operation.

facilities are open to the public. As a result, the local communities have rethought their initial misgivings and have come to accept the power station.

2.5 Sustainability

2.5.1 Profile and Financial Viability of the O&M Agency

a) Profile of the O&M Agency

Operation and maintenance of the project facilities are executed by the government-owned National Power Corporation (NPC). The NPC's total generating capacity at the end of 2000 was 7,055.46 MWh*[11], which accounted for 62.1% of generating capacity within the country. NPC generates electricity from its own power plants and purchases additional electricity from IPPs. NPC transmits this electricity, which it then sells at wholesale prices to distribution companies: 119 rural electric cooperatives, 17 investor-owned utilities (including Meralco), 9 municipal/ provincial distribution systems and selected industrial bulk consumers. In line with the restructuring of the power sector in the country, NPC's power stations have already been grouped into about 6 categories by location and generation type; these groups are supposed to be spun off and subsequently corporatized. The government intends to sell these generation companies, the so-called Genco, to private investors.

b) Financial Viability of the NPC

Table 4 shows NPC's profits and losses for the most recent five-year period. While operating revenues increased favorably, NPC was not able to fully pass on its added costs to power users; consequently, it has not offset operating expenses, which increased rapidly over that period. NPC's financial position has been in the red since 1998. NPC's financial hardship resulted mainly from the Asian Currency Crisis. As shown in Figure 4, the crisis caused rapid depreciation of the peso vis-à-vis the U.S. dollar.

This caused an increase in interest payments on foreign loans[13], in the procurement cost of materials/ facilities from overseas, and in the cost of procuring electricity from the IPPs[14]. In order to comply with World Bank recommendations, NPC aims to achieve more than 8.0% on a Rate of Return Base[15]. However, based on these conditions, the company's Rate of Return Base has steadily decreased, hovering below the minimum target level of 8.0% since 1997.

Along with a deterioration in profitability, the financial stability of NPC has worsened (see the Table 5), which resulted in a lack of funding for long-term investment requirements. NPC's financial deterioration is thought to have had an adverse impact on budget allocations for operation and maintenance.

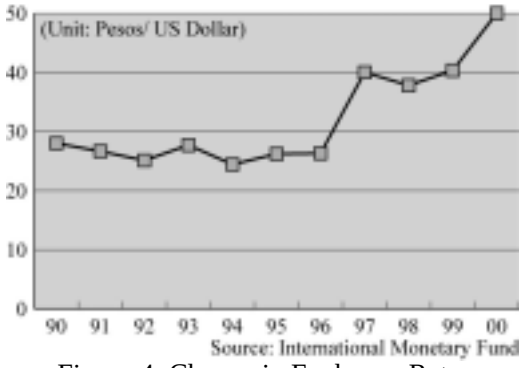

Figure-4: Change in Exchange Rate

Table-4: Summary of NPC's Profit & Loss in Past Five Years (Unit: million peso)

	1996	1997	1998	1999	2000
Operating Revenue	63,635	77,144	86,611	89,686	100,119
Operating Expense	50,318	65,519	79,697	81,197	94,682
Operating Income	13,317	11,625	6,915	8,489	5,438
Other Income	9,268	2,968	11,095	9,427	16,488
Interest and Other Charges	17,044	11,537	21,627	23,869	34,890
Net Income/(Loss)	5,541	3,056	(3,617)	(5,953)	(12,964)

Source: NPC

11 Comprising NPC owned/operated power plants of 5,156.0 MW, and NPC owned and IPPs operated power plants of 1899.5 MW.

13 As of December 31st 2000, foreign loan accounted for 72.7% of NPC's long-term debts.

14 In most cases the Power Purchase Agreements between NPC and the IPPs are based on U.S. dollar.

15 The ratio of allowed operating income to a specified rate base, expressed as a percentage. (Specified rate base represents the utility's appraised asset value - or investment in facilities, equipment and other property used in the provision of electric service - and one-sixth of the utility's annual operation and maintenance cost)

Table-5: Indicators of Measures of Financial Stability and Profitability in Past Five Years

	1996	1997	1998	1999	2000
Return on Rate Base	8.24%	7.25%	3.22%	3.37%	2.22%
Current Ratio[16]	0.58	0.52	0.52	0.38	0.42
Debt Equity Ratio[17]	3.55	4.56	4.00	5.67	8.09
Account Receivables Turnover Period	N.A	1.38 month	1.47 month	1.70 month	2.03 month

Source: NPC

2.5.2 Technical Capacity of staff for Operation and Maintenance

NPC's pollution control officers at the respective power stations and at the Environmental Monitoring Department (EMD) of NPC execute operations, routine maintenance and facile calibration of the project facilities. Most of the project facilities have been owned and utilized at NPC's power stations. As stated above, NPC is scheduled to be divided into about 6 categories, which would be corporatized and eventually privatized. According to NPC, the project facilities will probably be sold to investors as an attached facility. This situation may make NPC begrudge having to allocate a budget for repair of the project facilities.

a) Training Program for Operators

Operation and maintenance of the procured equipment requires a number of capable and experienced staff to promote the sustainability of the project. Under the project, related NPC-EMD personnel received training for operation and maintenance of the project facilities. The training sessions were arranged by the suppliers in accordance with the provision of the contracts between NPC and the suppliers, and were executed both in Japan and in the Philippines. Training sessions focused especially on the practical skills needed to operate the project facilities. After that, as far as operation and maintenance of the project facilities is concerned, no special training has been executed by EMD.

b) Operation of the Project Facilities

Operation of the project facilities is executed in accordance with operation manuals procured from the original suppliers. In line with the restructuring of the power sector in the Philippines, NPC has proceeded to implement an early retirement program. As a result, a number of trained staff members have already retired without transferring their knowledge. In many cases, the positions were filled with personnel that had not received the above-mentioned training. Judging from interviews during the site survey, it seems that it is not so difficult for the staff to operate project equipment, after they have read the relevant operation manuals. However, staff skills are not necessarily sufficient for the operation of computer software, which is necessary for controlling project facilities and analyzing monitoring results.

c) Maintenance of the Project Facilities

Interviews with NPC personnel during the site survey indicate that monitoring staff are able to keep up with routine maintenance and facile calibration of the project facilities by referring to the manual. However, since most of the monitoring staff is made up of scientists, not engineers, it is almost impossible for workers to inspect or repair facilities when mechanical problems occur. Typically in this situation, the monitoring staff ask mechanical engineers, who normally handle other duties at the power station, to inspect the facility. In most cases, they also cannot cope with the problem. In addition, since the spare parts for the facilities are usually not available locally, NPC has to ask the original foreign suppliers to repair or inspect the equipment – which costs a lot of time and money.

Problems regarding maintenance also exist in the calibration of equipment. An ambient H_2S analyzer requires calibration every six months to maintain the accuracy of monitoring results. Since special equipment is needed, NPC has to send the equipment requiring adjustment to a branch of the supplier in

[16] Current assets divided by current liabilities. A financial ratio which shows how easily the company could pay its bills if all its creditors demanded payment at once. In theory this figure should be at least 1.0, and a figure lower than 1 means that the company does not have the liquidity to pay all its creditors straight away.

[17] Net borrowings of a company divided by shareholders' funds. This ratio shows the amount of financing that is provided by sources other than the shareholders. The higher the percentage, the more risky for lenders to the company. Most lenders like the percentage to be below 0.5. If it is above 1.0, the company is said to be highly geared.

Singapore[*18] , which costs about 300 thousand pesos[*19] and takes one month, every time. The monitoring equipment is no doubt important for NPC, but maintenance and repair costs place a financial burden on NPC.

2.5.3 Present Condition of the Project Facilities

As shown in the table below, though 26% of project facilities are not fully utilized, 74% of equipments are still in good condition. Judging from available information, it appears that there have been no serious problems with the procured monitoring equipment itself. However, attached equipment, such as UPS (uninterruptible power supply system) and data logger, have posed problems, inconveniencing workers. Also, aged deterioration seemed to have somewhat affected all of the installed instruments.

NPC is responding to problematic facilities. However, some points are taking much time to be solved, due to budgetary constrains and accessibility of spare parts according to the site personnel. Improvement of operation and maintenance, largely the budgetary measurement, is a key to the sustainability of the project.

Table-6: Conditions of the Procured Monitoring Equipments (As of July 2001)

	In Use with Good Condition	In Use but Function Limited	Not in Use/ Out of Order	Total
Stack Sampling Equipment	0 (0%)	2 (100%)	0 (0%)	2 (100%)
Ambient H_2S Monitoring Systems	3 (50%)	3 (50%)	0 (0%)	6 (100%)
Meteorological Monitoring Instrument	4 (40%)	5* (50%)	1 (10%)	10 (100%)
Field Motor Vehicles	5 (83%)	0 (0%)	1 (17%)	6 (100%)
Water Quality Monitors	5 (100%)	0 (0%)	0 (0%)	5 (100%)
Hydrological Equipment	0 (0%)	0 (0%)	1 (100%)	1 (100%)
Noise Level Meters	5 (100%)	0 (0%)	0 (0%)	5 (100%)
Ambient Air Quality Monitoring Systems**	26 (87%)	2 (7%)	2 (7%)	30 (100%)
Total	48 (74%)	12 (18%)	5 (8%)	65 (100%)

*NPC has repaired problematic facilities with the help of the original suppliers. To illustrate, regarding METs, all of these equipments were successfully repaired by the original supplier by February 2002.

**The unit of Ambient Air Quality Monitoring Systems is by function that the systems have while the others are counted by set of equipment.

Source: NPC

[18] Before establishment of supplier's branch office in Singapore, NPC had to send the facility`s equipment to Arizona in the United States. At that time, each calibration required 2 month.

[19] Including costs such as transportation and insurance

Comparison of Original and Actual Scope

Item	Original Scope (At the time of Appraisal Report)	Actual Scope
(1) Project Scope		
-Stack Sampling Equipment	2 sets	As planned
-Continues Ambient Air Quality Monitoring Systems	10 sets	6 sets
-Continues Ambient H_2S Monitoring Systems	6 sets	6 sets of non-continuous type
-Meteorological Instrument	12 sets	10 sets
-Field Motor Vehicles	8 sets	6 sets
-Laboratory Equipment	1 set	Cancelled
-Water Quality Monitors	5 sets	As planned
-Hydrological Equipment	1 set	As planned
-Noise Level Meters	5 sets	As planned
(2) Implementation Schedule		
1. Preparatory Activities	Oct. 1994 – Aug. 1995	Dec. 1994 – Nov. 1997
2. Procurement Equipments	Dec. 1995 – Sep. 1996	Aug. 1997 – Feb. 1999
3. Training for Manipulation	Nov. 1996 – Feb. 1997	Jan. 1998 – May 1999
4. Completion	Feb. 1997	May 1999
(3) Project Cost		
Foreign currency	457.1 million yen	211.6 million yen
Local currency	0.0 million yen (0.0 million pesos)	2.3 million yen (0.6 million peso)
Total	457.1 million yen	213.9 million yen
ODA loan portion	457.1 million yen	213.9 million yen
Exchange Rate	US1$= 29.2 peso= 110 yen (As of 1994)	US1$= 27.1 peso= 108 yen (Average from 1995- 1997)

Independent Evaluator's Opinion
on Environmental Equipment Project for Power Plants

Epictetus E. Patalinghug
Professor of Economics and Management, University of the Philippines

The project is consistent with the Medium-Term Philippine Development Plan: 2002-2004 which aims to promote environmental sustainability. One of the strategies identified by the Plan is to "strengthen the monitoring and enforcement of compliance to environmental laws, rules and regulations at the national and local levels".

Inefficiency characterized project planning because the original scope of work included the purchase of equipment for Aplaya and Santos diesel stations which were decommissioned prior to project implementation. Contract conflicts between NPC and its supplier led to deferment of procurement of laboratory equipment, and to much higher purchase price than its original estimate. The project was completed 2-1/2 years after the originally scheduled completion date. NPC lacked the ability to coordinate the selection of equipment, preparing documents, and negotiating with suppliers. Overall, the total project cost was 53.2% lower than the appraisal estimate due to intense competition among equipment suppliers.

The project enabled NPC to undertake regular and continuous monitoring and to comply with DENR's reporting requirements. But some project facilities were not well utilized: the stack sampling equipment could not do continuous monitoring because its data logger was malfunctioning; 86.7% of continuous ambient air quality monitoring system was functioning as of August 2001; 3 of the 6 data loggers for the ambient air quality monitoring system for geothermal plants were not functioning; one set of hydrological and meteorological monitoring equipment was not utilized because NPC's Environmental Management Division was curtailing its activities due to the impending privatization of NPC.

The project has indirectly contributed to reducing negative environmental impacts from power plants. The procured equipment allowed accurate monitoring of emissions from power stations: Panay Diesel Power Station, Bac-Man Geothermal Power Station, and Sucat Thermal Power Station could not renew their permits to operate because their emissions exceeded environmental standards. For those plants that were not slated to be decommissioned, NPC had undertaken some remedial actions. It would have been desirable if the post-evaluation report estimated the EIRR and FIRR for this project.

74% of equipment is still in good condition; 26% are not fully utilized; to make the project sustainable, EMD must have the capability to undertake in-house training to replace some people who have already retired; adequate budget for spare parts, maintenance, and repair is necessary.