**Indonesia**

# Equipment Supply for Scattered Diesel Power Plants

Report Date: October 2002
Field Survey: July 2001

## 1. Project Profile and Japan's ODA Loan

Location Map of the Project


Diesel Generators installed at Samarinda

### 1.1 Background

Indonesia's population of 203 million is spread over a countless number of islands, though about 60% of the population is concentrated on Java Island. At the time of appraisal, there was no large-scale power plant and grid power transmission system on any island other than Java – Bali (hereafter "outside Java"[*1]). Approximately 80% of the power consumption in Indonesia was also concentrated on Java, and the development of electric power outside Java had not proceeded well.

Given these conditions, the Indonesian Government spurred electric power development outside Java by installing diesel generators in urban areas, and by constructing isolated networks in areas surrounding cities. In line with this strategy, the government has continuously supported the construction of small-scale diesel power plants in urban areas outside Java. The Japanese Government had assisted in promoting these electrification projects by contributing ODA loans totaling 16.6 billion yen since 1974.

At the time of appraisal of this project, the Indonesian Government and PLN (Perusahaan Umum Listrik Nagara) were planning to construct diesel power plants with a total rated capacity of 1,100 MW, which was about 21% of the total installed capacity, during the Fourth Five-Year Plan (1984/85- 1989/90). With this plan in mind, the Government of Indonesia requested a Japanese ODA loan to execute this project.

### 1.2 Objectives

To reinforce electricity supply in local cities, which are the regional centers outside Java, through the construction of diesel power plants, in order to develop local industries and to raise the living standard in the respective areas.

### 1.3 Project Scope

| | |
|---|---|
| Project Area: | 19 cities on Sumatra, Kalimantan, Sulawesi, Irian Jaya, Nusa Tengara, and Timor[4] |
| Project Facilities: | Procurement and installation of 26 diesel power plants with total capacity of 79.5 MW (2.5 MW x 21 units, 5.0 MW x 3 units, 6.0 MW x 2 units) |
| Consulting Service: | Construction supervision |

[1] In this report, "outside Java" is defined as land areas of Indonesia not including the islands of Java and Bali.

### 1.4 Borrower/ Executing Agency

Government of the Republic of Indonesia / Perusahaan Umum Listrik Negara (PLN)

### 1.5 Outline of Loan Agreement

| | |
|---|---|
| Loan Amount<br>Loan Disbursed Amount | 9,000 million yen<br>8,359 million yen |
| Exchange of Notes<br>Loan Agreement | July, 1984<br>February, 1985 |
| Terms and Conditions<br>Interest Rate<br>Repayment Period (Grace Period)<br>Procurement | <br>3.5 % p.a.<br>30 years (10 years)<br>Partially Untied |
| Final Disbursement Date | December, 1992 |

## 2. Results and Evaluation

### 2.1 Relevance

The Indonesian territory consists of many islands, and there was no major power transmission system installed outside Java and Bali Island in 1984. Approximately 80% of power consumption in Indonesia was concentrated in Java Island, and the development of electric power in the area outside Java had not proceeded well. For this reason, the increase of the electric power supply outside Java was a high priority policy. At the time of appraisal, construction of a large-scale power plant and transmission line network outside Java was not considered feasible, and for this reason power development outside Java consisted of installing diesel generators in urban areas. To fill the gap between Java-Bali and other areas of Indonesia, the Government of Indonesia had continuously carried out small-scale projects of diesel power plant construction in the area outside Java from 1974 to the time of appraisal. Accordingly, this project (hereafter the project) objective was consistent with Indonesia's development policy at that time.

Until the time of evaluation, some large-scale power plants and high voltage grid power transmission systems have already been developed on parts of Sumatra, Kalimantan and Sulawesi islands. However, except for these cases, small-scale diesel power plants still play an important role outside Java. Building new diesel plants, however, conflicts with the government policy to reduce oil consumption at the time of implementation of the project. Where there are potential alternative energy sources, for example water, geothermal energy and natural gas, construction of power stations using such energy sources should take precedence over diesel power plants. However, where there is no alternative energy source, and constructing a large-scale power plant and grid power transmission system is not feasible, small-scale diesel power plants are still required to cope with the increases in demand. Accordingly, the project objective is not necessarily irrelevant to the current power development plan.

### 2.2 Efficiency

#### 2.2.1 Project Scope

At appraisal, 26 units of diesel generators with a total capacity of 79.5 MW, which consisted of 2.5 MW x 21 units, 5.0 MW x 3 units and 6.0 MW x 2 units, were planned for installation in 19 cities outside Java. In reality, 3.0 MW diesel generators were procured instead of 2.5 MW units for the originally estimated price because it was necessary to increase the generating capacity as much as possible, while the costs were almost same. Regarding the installation locations, 7 units were installed at modified locations within the target regions as per actual load requirements.

In addition, in reply to the Indonesian Government's additional request, 3 units of 3.0 MW diesel generators were installed at Sampit (x 1) and Kuala Kapuas (x 2) to cope with increasing regional power demand. As a result, the total number of procured diesel generators and corresponding total capacities

increased to 29 units and 99.0 MW, respectively. In terms of generation capacity, the actual scope was 19.5 MW higher than the original scope. In light of the serious demand-supply balance outside Java, these modifications are considered useful in achieving the project objective.

### 2.2.2 Implementation Schedule

The originally envisaged project scope – installation of 26 diesel generators -- was completed in June 1989, representing a delay of one year and six months beyond the originally scheduled completion date. The delay was caused mainly by: i) late delivery of locally procured steel skeleton and generators, ii) local fund constraints resulting in a delay in civil work.

After the originally envisaged project scope was completed, an additional 3 diesel generators were installed utilizing the balance of the ODA loan. As a result, the overall project scope was completed in August 1992, as against the original completion date of December 1987, a delay of about 4 years and 8 months.

### 2.2.3 Project Cost

At appraisal, the total project cost was estimated at 13,656 million yen-equivalent, comprised of a 9,000 million yen foreign currency portion and a 4,656 million local currency self-finance portion. The ODA loan portion was supposed to be appropriated for the foreign currency expenditures, while the local currency portion was to be fully covered by the Indonesian Government's domestic development budget.

The actual disbursed amount of ODA loan was 8,359 million yen, which accounted for 93.9% of the approved amount. Regarding the local currency portion, there are no records that still remain at PLN.

## 2.3 Effectiveness

### 2.3.1 Operational Performance of the Project Facilities

The area outside Java is divided by PLN into 11 administrative regions. Figure-1 shows the location of these 11 regions. Under the project, 29 diesel generators with a total capacity of 99.0 MW were installed in Regions I, IV, VI, VIII, X, and XI.


Figure-1: Location Map of the Project Facilities

According to PLN, these diesel generators were initially utilized as base/ middle load facilities[*2]. Since then, with the grid transmission systems and large-scale power plant development in areas outside Java, some units have been used as peaking facilities[*3], and other units have been shifted to isolated power stations.

Of 28 diesel generators[*4], 20 units are still in operational condition. However, more than a decade has

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[2] Base load facility: A plant that is normally operated continuously to take all or part of the minimum load of a system.

[3] Peak load facility: A plant, which is normally operated only during the peak-load periods.

[4] Under the project, one diesel generator (3.0 MW) was installed in Dili, then the capital city of East Timor Province. However, East Timor has already declared independence from Indonesia, and so PLN could not tell the current condition of the generator is unknown.

passed since the project completion, and eight units are currently inoperable; among these, one generator has already been dismantled for diversion and the engine blocks from two other generators have been taken for use at other power stations. At present, the total effective capacity of the 20 diesel generators in operation is 51.6 MW, which accounts for 53.7% of the original total capacity of 96.0 MW (see Table-1).

Table-1: Current Operational Status of the Procured Diesel Generators (Unit: No. of Generators)

| | Region I | Region IV | Region VI | Region VIII | Region X | Region XI | Total |
|---|---|---|---|---|---|---|---|
| In Operation | 1 | 4 | 8 | 3 | 1 | 3 | 20 (71.4%) |
| Shutdown | 0 | 1 | 2 | 2 | 0 | 0 | 5 (17.9%) |
| Dismantled/ Scrapped | 0 | 0 | 0 | 3 | 0 | 0 | 3 (10.7%) |
| Total | 1 | 5 | 10 | 8 | 1 | 3 | 28 (100%) |
| Rated Capacity (MW) | 3.0 | 15.0 | 40.0 | 24.0 | 3.0 | 11.0 | 96.0 |
| Effective Capacity (MW) | 2.5 | 7.5 | 26.3 | 8.0 | 2.3 | 5.0 | 51.6 |

Source: PLN

The detailed operational status of the procured diesel generators in each region is as follows:

a) Region IV (Southern part of Sumatra)

Sumatra Island has the most developed grid power transmission system outside of Java. At present, there are two different major grid transmission systems: the West Sumatra-Riau system in Central Sumatra and the South Sumatra-Lampung system in Southern Sumatra. These systems are scheduled to be connected by the end of 2002.

Under the project, five 3.0 MW diesel generators were installed in the late 1980s within region IV (two units were installed on Sumatra Island and the remaining three units were installed on Belitung Island, which is located east of Sumatra Island). Initially all of them were operated as base load facilities, while two units in the Metro power station on Sumatra Island were switched to peak load use after the power station was connected to the Sumsel-Lampung system.

The three diesel generators located on Belitung Islands have supplied electricity to an isolated small-scale power transmission system. The one in Tanjung Pandan was shut down in 1998 because of heavy damage to its crankshaft. A spare crankshaft for the generator, which was taken from the same type engine in another region, has already been transported to the site. After replacement of the crankshaft, the generator will resume operation; it is expected to come back on line in April 2002. The other two units have experienced no major damage as of yet, and have been utilized as base load facilities since commissioning.

b) Region VI (Eastern part of Kalimantan Island)

Under the project, 10 diesel generators with a total capacity of 40.0 MW were installed in Region VI from the late 1980's to the beginning of 1990's. During that time, the units were connected to the regional isolated power transmission system. Each unit had the largest generating capacity and best thermal efficiency within its respective system. Accordingly, most of them served as base load facilities.

In the middle of the 1990's, to stabilize the electricity supply, two different 150 kV grid power transmission systems[*5] were constructed in the region. One, located in the southern area, was called the Barito system; the other one, located in the northeastern area, is known as the Mahakam system. Subsequently, all 10 of the procured diesel generators were connected to these systems. After that, two large-scale power stations[6] were constructed within the systems. Since then, it is these new power stations, not the existing diesel generators that have served as the base load facilities.

Figure-2: The Balikpapan Power Station

Judging from the available data, the procured diesel generators generally have not achieved the levels of operation envisaged at appraisal[*7]. As of May 2001, the total

[5] These systems were planned to be unified in the late 1990's, with the commissioning of a new coal-fired power station. As a result of the cancellation of the power station and the lack of an adequate budget, the unified plan was postponed indefinitely.

[6] The Asam-asam coal-fired power station (65 MW x 2 units) was commissioned in 2001, and connected to the Barito system. The Tanjung-Batu combined cycle power station (20 MW x 3 units) was commissioned in 1997, and supplies electricity to the Mahakam system.

[7] The target level (plant load factor): 1st year: 15%, 2nd year: 30%, 3rd year: 45%, 4th- 8th year: 60%, 9th- 15th year: 50% (project life= 15 years)

effective capacity of the units was 26.3 MW, 65.8%, of the total rated capacity of 40.0 MW. Furthermore, mechanical problems have caused one unit in Balikpapan to remain in shutdown mode since November 1998, and one unit in Sampit has been shut down since 1995. Because PLN operates on a tight budget, at the present time there is no plan to rehabilitate these generators.

c) Region VIII (Southern part of Sulawesi Island)

Region VIII consists of South Sulawesi and Southeast Sulawesi provinces. Until 1990, electricity supply for the province depended completely on small-scale isolated power transmission systems and diesel generators. Under the project, eight 3.0 MW diesel generators were installed in Pajalesang (3 units), Palopo (2 units) and Pangsid power station (3 units) in the late 1980's. Originally, each of these generators supplied electricity to separate isolated systems and were utilized fully to satisfy increasing demand.

Ever since the first large scale-power station in the region, the Bakalu hydro power station (63 MW x 2 units), was commissioned in 1990, a 150 kV grid power transmission system has been developed progressively. Currently, the system covers the central and southern parts of South Sulawesi Province. As a result, the total six units, which were at the Pajalesang and Pangsid power stations, ended operations in 1994 and 1997, respectively. The two units out of the six units were subsequently relocated to the Palopo power station. The two units out of the six units, which were already in shutdown mode owing to mechanical trouble, were dismantled, and only the engine blocks were relocated to the Palopo and the Jayapura power station for diversion. The remaining two units out of the six units have been out of order since the middle of 1990's, and are still housed in the same power station.

The Palopo power station and its small power distribution system have not yet been connected to the 150 kV transmission systems. The one unit out of the two unit which was installed in Palopo was dismantled in 1998. It was used as spare parts. At present, the system is facing a serious energy shortage. To solve the problem, PLN has already relocated two diesel generators and one engine block from Pangsid and Pajalesang. Moreover, PLN plans to rehabilitate the two unused diesel generators at Pajalesang and Pangsid by the end of 2002, for relocation to the Palopo power station.

d) Other Regions (Regions I, X, and XI)

Regions I, X, and XI have neither a major power transmission system nor a large-scale power station, and receive electricity primarily from isolated diesel generators. Under the project, six diesel generators with a total capacity of 20.0 MW were installed. East Timor used to belong to Region XI, and had already been spun off from the Indonesia as independent state. Thus, no data from the one generator installed in Dili, East Timor, are available at PLN.

One generator installed in Region X (Jayapura) suffered forced outages frequently owing to mechanical trouble. But the other 4 generators installed in Regions I and XI have been operating favorably. However, mechanical problems have caused considerable deterioration of the generation capacities of three generators in region XI recently; they require immediate rehabilitation.

### 2.3.2 Re-Evaluation of Financial Internal Rate of Return (FIRR)

At appraisal, the FIRR of the project was estimated at 10.3%. In that calculation, the plant load factor and the project life of the diesel power units were assumed to be 15- 60% and 15 years, respectively.

Since sufficient data for re-evaluating the FIRR are not available, a re-evaluation based on actual, current data was not carried out. Based on available operational data, however, the actual performance of the project facilities is shown to be lower than the appraisal estimate. Moreover, the project life of the generators is assumed to be shorter than the appraisal estimate. Given these conditions, it can be concluded that the actual FIRR is lower than the appraisal estimate.

## 2.4 Impact

### 2.4.1 Positive Impacts on the Population Outside Java

A lack of generating capacity constitutes a significant impediment to electrification in city areas outside Java. New applicants in these areas cannot be accepted so as not to exceed the effective capacity of the generating facilities.

For example, during the construction period of the project, in March 1991, the number of waiting applicants in areas outside Java was 146,830 (in terms of connected capacity: 556,849 kVA). The project enabled PLN to accept some of those applicants by installing 99.0MW of additional generating capacity.

The electricity supply outside Java is generally unstable. Thus, many large-scale industrial consumers are

utilizing captive power plants for their electricity supply[*8]. Moreover, PLN sometimes asks large-scale industrial consumers to install captive power plants in order to reduce the heavy burden on the PLN's grid system. Accordingly, it is thought that the main beneficiaries of the project are domestic, commercial, and small-scale industrial consumers. In the case of the Palopo Kuala Kapuas power station on Kalimantan Island, the project facilities (3.0 MW x 2) supplied electricity not only to domestic consumers but also to small-scale industries such as the agricultural processing plants, ice making plants, lumber mills and plywood factories. Undoubtedly the project has strengthened the local power supply and contributed to the development of the local economy.

### 2.4.2 Negative Impacts on the Socioeconomic Climate

Out of 17 project sites, only four[*9] required fresh land; in these cases, no one lived on or near the land used. All the remaining units were installed on existing power station sites which were acquired more than 15 years ago. Therefore, it is reported neither relocation/ resettlement nor conflicts over land compensation were reported to have resulted from project implementation.

### 2.4.3 Environmental Impacts

According to the regulations of the Central Commission for Environmental Assessment of Department of Mines and Energy, a diesel generator with a capacity of less than 20 MW shall require no environmental impact assessment. The diesel generators that were procured under the project were relatively small-scale (3.0 MW- 5.0 MW). Accordingly, no environmental impact assessment for the project was executed.

In order to minimize negative impact on the surrounding environment, a silencer and a closed cycle-cooling system[*10] were installed on the project site. No negative environmental impact has been recorded so far.

## 2.5 Sustainability

### 2.5.1 Capability of Operation and Maintenance of the Project Facilities

The diesel generators procured by the project belong to PLN's regional offices. Each Region has a number of Sector offices and a Cabang office. The Sector office is responsible for operating relatively large-scale generating facilities. The Cabang office is in charge of distribution, generation and revenue collection within its own area. Operation and maintenance of the project facilities are executed by PLN's regional offices.

Operation of a 3.0- 6.0 MW class diesel generator is managed by four groups in three shifts, in accordance with operation manuals prepared by suppliers. An operation group for a diesel generator used to consist of a skilled engineer and contract workers. Since most contract workers are well experienced and receive on-the-job training, there have been no reports of problems concerning their capabilities.

Table-2: Maintenance Activities for a Diesel Generator

| Category | Item | Frequency | Content of Work |
|---|---|---|---|
| Routine Maintenance | Daily Check | Every day | Checking fuel supply/ lubrication system, and leakage |
| | Weekly Check | Every week | Checking clearance tappet valve |
| | Monthly Check | Every month | Checking fuel oil injector, battery for control and protection, etc. |
| Corrective Maintenance | | On demand | Based on facility's condition and result of preventive maintenance |
| Breakdown Maintenance | | On demand | Maintain main journal cylinder, cylinder head |
| Overhaul/ General Maintenance | Top Overhauling | 6,000 hours | Checking cylinder head, grinding valve, injector (10 days) |
| | Semi Overhauling | 12,000 hours | Checking two sets of cylinder heads, cylinders, piston bearings (20 days) |
| | Major Overhauling | 18,000 hours | Checking cylinder head, cylinder, piston, bearings, turbo charge, auxiliary equipment (30 days) |

Source: PLN

On visiting a power station, the survey noted that routine maintenance for the project facilities is implemented on schedule but that overhauling/ general maintenance sometimes falls behind schedule, or is

[8] As of the end of December 2000, the total installed capacity of captive power plants was 5,893.7 MW, which was larger than the installed capacity of PLN, or 5,270MW.

[9] Development of building lot: Balikpapan, Dilli, and Sigli. Expansion of existing site: Bimaraba

[10] The closed cycle-cooling system does not discharge contaminated water.

skipped all together, because of an insufficient budget and a lack of spare parts. This tendency has become more acute since the Asian Currency Crisis and PLN's subsequent financial deterioration.

As a result, some of the units were forced to shut down due to mechanical trouble, such as damage to the crankshaft, leakage of lubricant oil and the breakdown of the cooling unit motor. To make matters worse, once problems arose, the lack of funds and spare parts caused considerable repair and rehabilitation delays. It is not unusual for it to take several years for repair and/or rehabilitation. In order to realize uninterrupted electricity supply to surrounding consumers, intensification of maintenance systems and sufficient budget allocation will be required.

Figure-3: A Unit under Top Overhauling
(At the Ampenan power station)

### 2.5.2 Financial Viability of PLN's Business Outside Java

While Java and Bali Island has a well-developed grid transmission systems and a number of large-scale power stations, outside Java, generation, transmission and distribution of power are provided through a large number of small isolated power grids. Furthermore, diesel power plants, which entail higher generating costs than the PLN average (see Figure-4), still dominate the electricity supply outside of Java (see Figure-5). Thus, the size of operation outside Java generally is so small that generation costs are higher. However, the government has adopted a uniform electricity tariff. Under such circumstances, the financial condition of regional offices is generally poor.

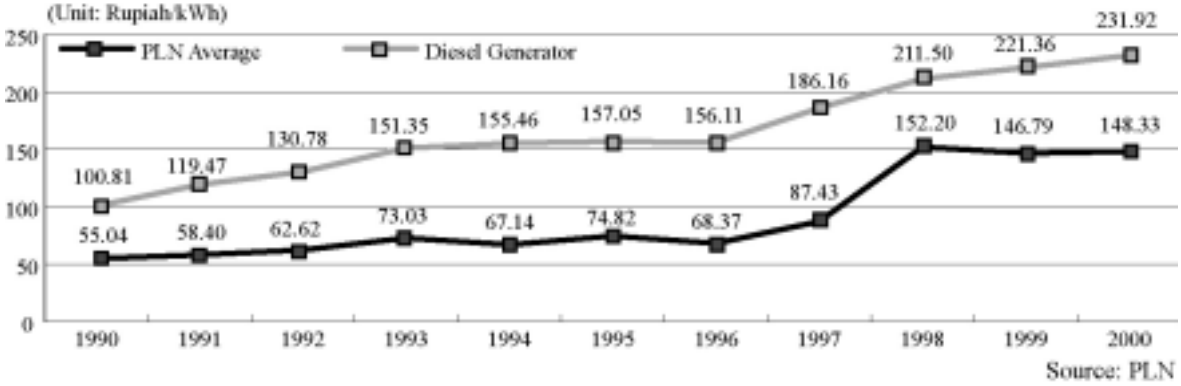
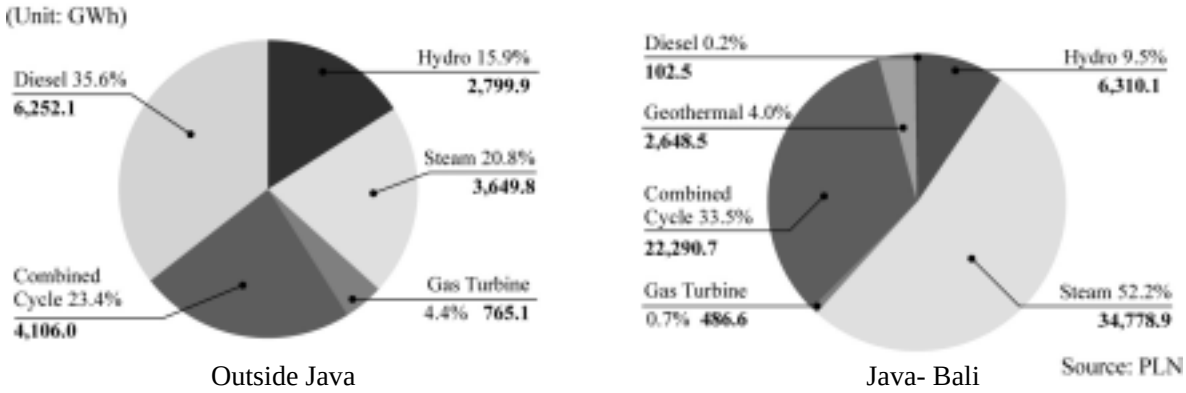



Figure-4: Generation Cost: PLN Average versus Diesel Generators




Outside Java Java- Bali

Figure-5: Energy Production by Type of Power Station (Year 2000)

Overall, PLN's losses outside Java were made up by profit earned from Java and Bali Island. However, after the Asian Economic Crisis in 1997, PLN's overall financial condition deteriorated considerably.

In order to remedy PLN's financial condition, the power sector is being restructured. In the Java-Bali Grid, which supplies 75% of the electricity in the country, PLN's generation and distribution businesses will be vertically unbundled to create several buyers and sellers in the market, some of which will be privatized. However, transmission remains a government-controlled business.

The power sector outside Java-Bali will also remain government-controlled, since they are not likely to be

returns on investment large enough to attract the private sector. Financial and political assistance are indispensable for sustaining the power supply business outside Java. However, the Indonesian Government has recently raised fuel oil prices (including diesel oil) in order to help offset soaring oil prices in international markets and to reduce large subsidies for fuel oil. The rapid increase will exert a harmful influence, particularly on the power supply business outside Java. The table below shows recent oil prices.

Table-3 Fuel Oil Product Pricing (Unit: rupiah/ liter)

| | May 1998 | October 2000 | June 2001 | January 2002 |
|---|---|---|---|---|
| Gasoline | 1,000 Rp. | 1,150 Rp. | 1,450 Rp. | 1,550 Rp. |
| Kerosene | 280 Rp. | 350 Rp. | 400 Rp. | 600 Rp. |
| Automotive Diesel Oil | 550 Rp. | 600 Rp. | 900 Rp. | 1,150 Rp. |
| Industrial Diesel Oil | 500 Rp. | 550 Rp. | 1,000 Rp. | 1,100 Rp. |
| Bunker Fuel Oil | 350 Rp. | 400 Rp. | 900 Rp. | 925 Rp. |

Source: Directorate General of Oil and Natural Gas

The Government of Indonesia, with the cooperation of PLN, has already increased the electricity tariff, and plans to execute further tariff increases. Appropriate tariff increases are critical for the sustainable operation of this project.

### 2.5.3 Future Prospects for the Demand-Supply Balance Outside Java

Indonesia has, in the short term, a sufficient total generation capacity to meet aggregate demand. However, because of delays in completing generation and transmission projects, several funding programs for generation projects have been cancelled and there is a drought in new investment. In order to ameliorate serious demand- supply balance outside Java, PLN employs private sector owned and operated diesel generators[*11] for base load facilities. However, the energy shortage persists.

At present, many regional areas are experiencing frequent and regular power shortages. Recently, the economy has begun to grow again, and electricity demand is expected to grow significantly. Based on a forecast GDP growth rate of 4-6%, PLN expects electricity demand on the Java-Bali grid to increase 9.1% on average each year from 2000 to 2003. According to the forecast, Regions IV and XI will suffer supply shortages and Regions I, VI, VIII and X will reach the limits of their systems.

Region IV is currently suffering an electricity shortage and forced load shedding. Particularly in Palembang, the capital city of the South Sumatra Province, load shedding is implemented during the evening peak hour. A number of isolated systems in Regions VII and XI also suffer electricity shortages.

In spite of such circumstances, funding for new generation projects is not adequate because the PLN's financial condition has deteriorated. Given these severe demand-supply conditions, it can be said that the project facilities have an important role to play, both now and in the future. If there is no alternative renewable energy source, immediate budgeting for the rehabilitation of existing diesel generators must be undertaken to prevent further deterioration of the current situation.

## 3. Recommendations

In order to ease the serious energy shortage outside Java, the immediate reinforcement of generation capacity is considered to be indispensable. Although the generation capacity of the procured diesel generators has deteriorated, it can be recovered through appropriate rehabilitation works. However, since deregulation of diesel oil prices will raise generation costs for diesel generators, rehabilitation of existing diesel generators may not be the best alternative.

In order to proceed with power development projects outside Java at minimum cost, PLN should make a comparative study of alternatives -- such as rehabilitation of existing diesel generators, power purchase from private owned diesel generators, development of new power stations which runs on new and renewable energy sources, interconnection of existing transmission system -- at every area of outside Java.

[11] PLN provides the site for generators and supplies fuel oil to private operators, which are responsible for the operation and maintenance of their own generators. PLN then purchases generated electricity from them at a contracted price.

## Comparison of Original and Actual Scope

| Items/Activities | Original | Actual |
|---|---|---|
| I. Project Scope | | |
| (1) Procurement and Installation of diesel generators | | |
| 1) Region I | | |
| 1. Sigli | 1 Unit x 2.5 MW | 1 Unit x 3.0 MW |
| 2) Region IV | | |
| 1. Muntok | 1 Unit x 2.5 MW | 1 Unit x 3.0 MW (Metro) |
| 2. Manggar | 1 Unit x 2.5 MW | 1 Unit x 3.0 MW |
| 3. Tanjung Pandan | 2 Units x 2.5 MW | 2 Units x 3.0 MW |
| 4. Pagar Alam | 1 Unit x 2.5 MW | 1 Unit x 3.0 MW (Metro) |
| 3) Region VI | | |
| 1. Barabai | 2 Units x 2.5 MW | 2 Units x 3.0 MW |
| 2. Sampit | 1 Unit x 2.5 MW | 2 Units x 3.0 MW |
| 3. Balikpapan | 2 Units x 6.0 MW | As Planned |
| 4. Samarinda | 2 Units x 5.0 MW | As Planned |
| 5. Kuala Kapuas | - | 2 Units x 3.0 MW (Additionally included) |
| 4) Region VIII | | |
| 1. Makali | 1 Unit x 2.5 MW | 1 Unit x 3.0 MW (Palopo) |
| 2. Pangsid | 2 Units x 2.5 MW | 2 Units x 3.0 MW |
| 3. Sengkang | 2 Units x 2.5 MW | 2 Units x 3.0 MW (Pajalesang) |
| 4. Watan Sopeng | 1 Unit x 2.5 MW | 1 Unit x 3.0 MW (Pajalesang) |
| 5. Palopo | 2 Units x 2.5 MW | 2 Units x 3.0 MW |
| 5) Region X | | |
| 1. Manokwari | 1 Unit x 2.5 MW | 1 Unit x 3.0 MW (Jayapura) |
| 6) Region XI | | |
| 1. Bimaraba | 1 Unit x 2.5 MW | 1 Unit x 3.0 MW |
| 2. Sumbawa | 1 Unit x 2.5 MW | 1 Unit x 3.0 MW |
| 3. Dili | 1 Unit x 2.5 MW | 1 Unit x 3.0 MW |
| 4. Ampenan | 1 Unit x 5.0 MW | As planned |
| Total Capacity | 26 Units, 79.5 MW | 29 Units, 99.0 MW |
| (2) Consulting Service<br>- Consulting Supervision | Total: 86 M/M<br>(Foreign: 56 M/M, Local: 30 M/M) | N.A |
| II. Implementation Schedule | | |
| 1. Loan Agreement | November 1984 | February 1985 |
| 2. Selection of Consultant | Nov 1984 – Oct 1985 | Nov 1984 – Oct 1985 |
| 3. Tender, Evaluation and Contract | Nov 1984 – Mar 1985 | Jun 1985 – Nov 1990 |
| 4. Civil Works | Nov 1985 – Jun 1987 | Sep 1987 – Jan 1992 |
| 5. Manufacturing and Installation | Jul 1986 – Dec 1987 | Jan 1987 – Aug 1992 |
| 6. Consulting Service | Nov 1985 – Dec 1987 | Nov 1985 – Aug 1992 |
| III. Project Cost | | |
| Foreign currency | 9,000 million yen | N.A |
| Local currency | 4,656 million yen | N.A |
| | (19,647 million rupiahs) | N.A |
| Total | 13,656 million yen | N.A |
| ODA loan portion | 9,000 million yen | 8,359 million yen |
| Exchange Rate | 1 US$ = 235 yen = 0.922 rupiah (As of 1984) | |

**Independent Evaluator's Opinion on**
**Equipment Supply for Scattered Diesel Power Plants**

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This project is relevant - despite the fact that in general diesel power plant will produce more expansive electricity production compared to other power plants like gas or coal turbines – for several reasons.

(1) As mentioned in the evaluation report, many places in Indonesia are located in remotes area with a relative low density. This implies a relative low demand for electricity.
(2) Most of areas in Indonesia – except in Java-Bali and partly Sumatra – were not connected with network transmission system such that the electricity must be supplied by a separate plant.
(3) In addition, electricity ratio in off Java-Bali is relative low. A household without electricity connection has to pay about 6-7 times for energy cost then that whose has connection with electricity. Furthermore, most of unconnected households are poor.
(4) With those considerations, this project will allow the poor to enjoy a reduction energy cost and providing new economic opportunities. Since as explained above due to lack of transmission network, diesel power plant is the least expansive and economically power plant even though it may have a conflict with the objective of reducing domestic oil consumption.

Taken those altogether, I agree with the evaluator, this project is relevant with the Indonesian development objectives.

As mentioned earlier, this project will directly reduce the use of primary energy by Indonesian households hereby their energy costs. In addition, electricity expansion will also produce many positive economic externalities such as encouraging rural industrialization and transformation both from economic and demographic perspective.

It is also empirically proven that this project has been reduced the number of waiting list of connection applicants. It obviously shows that high potential demand for electricity in locations where this project developed.

Power plant development is also important in order to reduce the disparity between Java and off Java particularly in manufacturing sector. It reduces the start up cost for manufactured companies which in turn encourages off Java industrialization. Some important notes should be raised i.e.:

(1) The delay of project would increase the cost of the project. Therefore it needs to find the ways for reducing the delay of the project.
(2) Better planning in demand projection and transmission development will also reduce cost of supplying electricity in Indonesia and hereby it will increase financial viability of PLN.
(3) Building diesel generator has to be considered as a short run solution.