No. 1

# EX-POST EVALUATION REPORT

# OF

# JAPANESE ODA LOAN PROJECTS 2008

# (INDONESIA V)

**NOVEMBER 2009**


**JAPAN INTERNATIONAL COOPERATION AGENCY**

**SHINKO OVERSEAS MANAGEMENT CONSULTING, INC.**


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# Preface

Ex-post evaluation of ODA projects has been in place since 1975 and since then the coverage of evaluation has expanded. Japan's ODA charter revised in 2003 shows Japan's commitment to ODA evaluation, clearly stating under the section "Enhancement of Evaluation" that in order to measure, analyze and objectively evaluate the outcome of ODA, external evaluations conducted by experts shall be enhanced.

This volume shows the results of the ex-post evaluation of Japanese ODA loan projects that were mainly completed in fiscal year 2007. The ex-post evaluation was entrusted to external evaluators to ensure objective analysis of the projects' effects and to draw lessons and recommendations to be utilized in similar projects.

The lessons and recommendations drawn from these evaluations will be shared with JICA's stakeholders in order to improve the quality of ODA projects.

Lastly, deep appreciation is given to those who have cooperated and supported the creation of this volume of evaluations.

November 2009
Atsuo KURODA
Vice President
Japan International Cooperation Agency (JICA)

Disclaimer

This volume of evaluations shows the result of objective ex-post evaluations made by external evaluators. The views and recommendations herein do not necessarily reflect the official views and opinions of JICA.

Indonesia

**Ex-Post Evaluation of ODA Loan Project "Renun Hydroelectric Power and Associated Transmission Line Project"**

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Field Survey : Feb. 2009 - Jun. 2009

## 1. Project Profile and Japanese ODA Loan


Map of Project Area

Renun Hydroelectric Power Plant
Located at Lakeside Toba

### 1.1 Background

Sumatra Island is located at the west end of the West Great Sunda Islands of Indonesia. The shape of the island is vertically long extending from northwest to southeast, reaching about 1,750km in length and 450km in width at the broadest. The island which is the second biggest in Indonesia and the sixth biggest in the world occupies total area of about 433,800km$^2$, 1.15 times as big as the territory of whole Japan having total population of approximately 45,000 people. Being located at a strategic position in east-west maritime transportation, the island is rich in numbers of ancient dynasties among which the Sriwijaya Dynasty is most well-known for its domination widely extended up to the territories of Southeast Asia over the Strait of Malacca. The capital city of North Sumatra Province where the Project site is located is Medan, the forth biggest city in Indonesia after Jakarta, Surabaya and Bandung having its population of about 2.25 million people. Although agriculture consistently dominates the regional industry, food, rubber processing and chemical industries were also developing actively, which was

strongly promoting rapid growth of power demand. The 6th Five-year National Development Plan (REPELITA VI) under which the Project was formulated aimed at stable power development. At the same time, utilization of potential hydropower resources coupled with construction of coal-fired thermal power plants mainly to supply base-load electricity demand was an urgent issue in that framework.

### 1.2 Objective

The objective of this project is to construct 82MW hydroelectric power plant and associated transmission lines at the region of Lake Toba in the North Sumatra Province of Sumatra Island aiming to meet the growing power demand to be supplied by the PLN's Regional Distribution Office II (Wilayah North Sumatra), and thereby contributing to the region's economic development and improvement of the people's standard of living.

**1.3 Borrower/Executing Agency** : The Government of Indonesia / PT. PLN (Persero)

### 1.4 Outline of the Loan Agreement

| | |
|---|---|
| Approved Amount/Disbursed Amount | (I)5,460 million yen (II)15,668 million yen (III) 5,479 million yen (Total) 26,607 million yen / (I) 5,439 million yen (II)15,642 million yen (III) 3,219 million yen (Total) 24,300 million yen |
| End Notes Exchange Date/Loan Agreement Signing Date | (I) June 1991 (II) June 1993 (III) July 1994 / (I) September 1991 (II) November 1993 (III) November 1994 |
| Terms and Conditions | Interest Rate: (I) (II) (III) 2.6%<br>Repayment Period: 30 years (Grace Period: 10 years)<br>Procurement: (I) Compound (II, III) General Untied |
| Final Disbursement Date | (I) (II) (III) December 2005 |
| Main Contractor (over 1 billion yen) | HYUNDAI CORPORATION (South Korea), JINRO (Indonesia), MBRC (Indonesia), PT. MARTA KARYA (Indonesia), PT. AUSTRODWIPA (Indonesia), VA TECH ELIN GMBH |

| | |
|---|---|
| | (Austria), SAKAI IRON WORKS Co. Ltd (Japan) |
| Main Consultant<br>(over 100 million yen) | NIPPON KOEI Co., Ltd. (Japan) |
| Feasibility Studies, etc. | Feasibility Study: Renun Hydroelectric Power Development(JICA, 1985)<br>Engineering Service: Renun Hydroelectric Power Project (JBIC, 1985)<br>Special Assistance for Project Implementation (JBIC, 2003) |
| Related Projects | N/A |

## 2. Evaluation Results (Rating: A)

### 2.1 Relevance (Rating: a)

#### 2.1.1 Relevance at Appraisal

Under the objectives of the energy sector to reduce its oil dependency by means of raising the share of alternative energy resources and new energy source development, the 6th Five Year National Development Plan (REPELITA VI, 1994~1998) was taking major policies enforcing (1) increase in supply of energy resources and their effective use, (2) infrastructure and facility development and (3) institutional strengthening of the energy sector. Expecting improvement of electrification (from 37% in 1993 to 60% in 1998) and economic growth of 6% mark, the power demand was anticipated to grow at 13% during the period. It also targeted average annual rate of conversion at 20% from diesel-based self generation to the PLN-grid connection and reduction of the ratio of oil thermal generation from 17.5% to 9.9% during the plan period in the framework of getting rid of oil dependency and improving efficiency. The trends of power demand, peak load and installed generation capacity of PLN throughout Indonesia forecasted at the time of Appraisal are shown in the next table.

Table 1 : Supply-Demand Forecast

| | 1993 | 1998 | 2003 |
|---|---|---|---|
| PLN Power Demand | 38,962GWh | 88,285GWh | 137,484GWh |

| | | | |
|---|---|---|---|
| Peak Load | 7,448MW | 17,291MW | 27,018MW |
| Installed Generation Capacity | 12,605MW (Hydropower, 2,315MW) | 20,128MW (Hydropower, 3,193MW) | 24,951MW (Hydropower, 6,952MW) |

Source: Appraisal Documents
Note: (1993) Actual performance (provisional) at the time of Appraisal, (1998, 2003) Forecast and planned total capacity to be installed

The average rate of power sales growth in the north Sumatra region (PLN Region II then) was 17.4% per annum from 1992 to 2003. Total power demand was 11,005GWh (11,888GWh) and peak load was 2,343MW (2,581MW)[1]. In the PLN Region II, the construction of Salurlla and Sibayak geothermal power stations that was planned to be implemented in 1999~2001 under private participation was delaying, and Asahan Hydroelectric Power Plant (III) had no prospect of start. Under such conditions, it was an urgent need to start this Project to cope with the critical condition with only 4% power supply reserve against the peak load, otherwise the growing power demand would be hardly met with the existing capacity of supply. Or, even if the power development was implemented as planned, the tight supply-demand condition would necessitate expansion of the power supply reserve. The power supply structure in North Sumatra was biased with too much dependence on oil thermal and diesel generation (1,543MW (98.5%) out of 1,567MW in 1998), therefore additional construction of hydroelectric power stations was eagerly expected to be established in order to attain balanced as well as stable power supply.

### 2.1.2 Relevance at Ex-Post Evaluation

The "Medium-Term National Development Plan (Rencana Pembangunan Jangka Waktu Menengah Nasional: RPJM-N) <2004-2009>," which announces the necessity of the development of the power sector for overall national development, puts continued emphasis on the development of alternative power resources including hydropower aiming for alleviating the dependency on oil as a main energy source. The growth of power demand has been also remarkable. The high rate of growth at 10% per annum in 1997 was once suspended by the economic crisis experienced in the same year, however, constant consumption with annual rate of 7.6% has been continuing afterwards.

[1] The region II was planned to be connected to the Region I (Aceh Province) then. The figures in parenthesis are the consolidated total of the two.

Table 2: Growth of PLN Power Salas

(Unit: TWh)

| Region | 2003 | 2004 | 2005 | 2006 | 2007 | Annual Growth Rate |
|---|---|---|---|---|---|---|
| Sumatra | 11.22 | 12.34 | 13.28 | 14.59 | 15.80 | 8.9% |
| Total Indonesia | 90.54 | 100.10 | 107.03 | 112.61 | 121.25 | 7.6% |

Source: RUPTL<Long-term Power Development Plan> 2009-2018

From the aspect of power development under the policy to alleviate oil dependency, hydroelectric power generation utilizing potential hydraulic resources is strengthened coupled with extended conversion to coal-fired thermal power generation for meeting base-load power demand. They occupy 39% and 11% respectively in total installed capacity, which turned to exceed the oil and gas fired generation that occupy 46%[2]. The potential capacity of hydroelectric power generation throughout Indonesia was estimated to be about 75,000MW ("Hydroelectric Power Potentiality Study," 1982), however, the total power volume developed up to the year 2008 amounts to 4,125MW, only 5.5% of the total potential.

PLN nominates areas whose peak-load demand can not be met with existing installed capacity of power generation as "Daerah Krisis (Critical Area)," and prioritize their power development in the Long-Term Power Development Plan (RUPTL, 2009~2018). North Sumatra (NAD, North Sumatra, Riau Provinces) where the Project is located is one of the 10 Critical Areas. Especially emphasis is placed on the power investment in NAD Province which was attacked by the great earthquake off the coast of Sumatra in 2004 and following Tsunami and the resultant damage on power facilities has not been fully recovered.

The power supply-demand conditions in the supply areas of the Renun Power Plant are critical. RUPTL forecasts the growth rate of peak load will reach at 73% for NAD and the highest 163% for Riau in coming 11 years. To cope with this expanding power demand, the estimated construction of needed power plants amounts to 57,442 MW (PLN, IPP inclusive) throughout Indonesia and 9,145MW (ditto) in Sumatra during the same period, among which hydroelectric power plant should occupy 4,740 MW, 3.8% (3,835MW, 10.9% for PLN only) in overall Indonesia and 893MW (262MW, 7.1% for PLN only) of the capacity totally required.

[2] Geothermal 4%. All the figures are taken from RUPTL

Table 3: Forecasted Power Demand of Respective Areas

| Wilayah (Region) | Power Demand (GWh) | | | Peak Load (MW) | | |
|---|---|---|---|---|---|---|
| | 2008 | 2018 | Growth Rate | 2008 | 2018 | Growth Rate |
| NAD (Note) | 1,225 | 2,206 | 80% | 239 | 413 | 73% |
| North Sumatra | 6,382 | 15,213 | 138% | 1,146 | 2,648 | 131% |
| Riau | 2,316 | 6,347 | 174% | 423 | 1,114 | 163% |

Source: RUPTL2009-2018

Note: Nanggröe Aceh DarussalamProvince. NAD used to be called Aceh Special Province until 2002.

Thus, this project has been highly relevant with Indonesia's national policies and development needs at the times of both appraisal and ex-post evaluation.

### 2.2 Efficiency (Rating: b)

#### 2.2.1 Output

This Project is to construct a run-of-river type hydroelectric power plant at the lakeside of Toba[3] utilizing the water resource available by transferring the water flow of Renun River which is currently flowing into the Indian Ocean to the lake. The construction works were divided into three phases each of which is separately financed by the yen loan.

Table 4: Phasing and Each Content of Project

| Phase | Loan No. | Major Contents |
|---|---|---|
| I | IP-376 | 1. Consulting Services<br>2. Construction of Access Roads, and Base Camp |
| II | IP-407 | Construction of Upstream and downstream head-race tunnels |
| III | IP-424 | 1. Construction of hydroelectric power plant<br>2. Construction of associated transmission lines |

[3] A crater lake with the length of 84km from north to south, 24km from east to west. It is the greatest lake in Indonesia with the total area of 1,460km$^2$, which is twice as big as Lake Biwa of Japan. The depth of water is 903m at the deepest (No.8 in the world), and the altitude of the water surface is 906m above the sea level. The lake is well known as an international tourist resort having attractive spots of Prapat, a lakeside health resort, and Brastagi situated at the north plateau.

Actual project output of the power station and associated facilities is almost the same as planned with some additions in the following two areas.

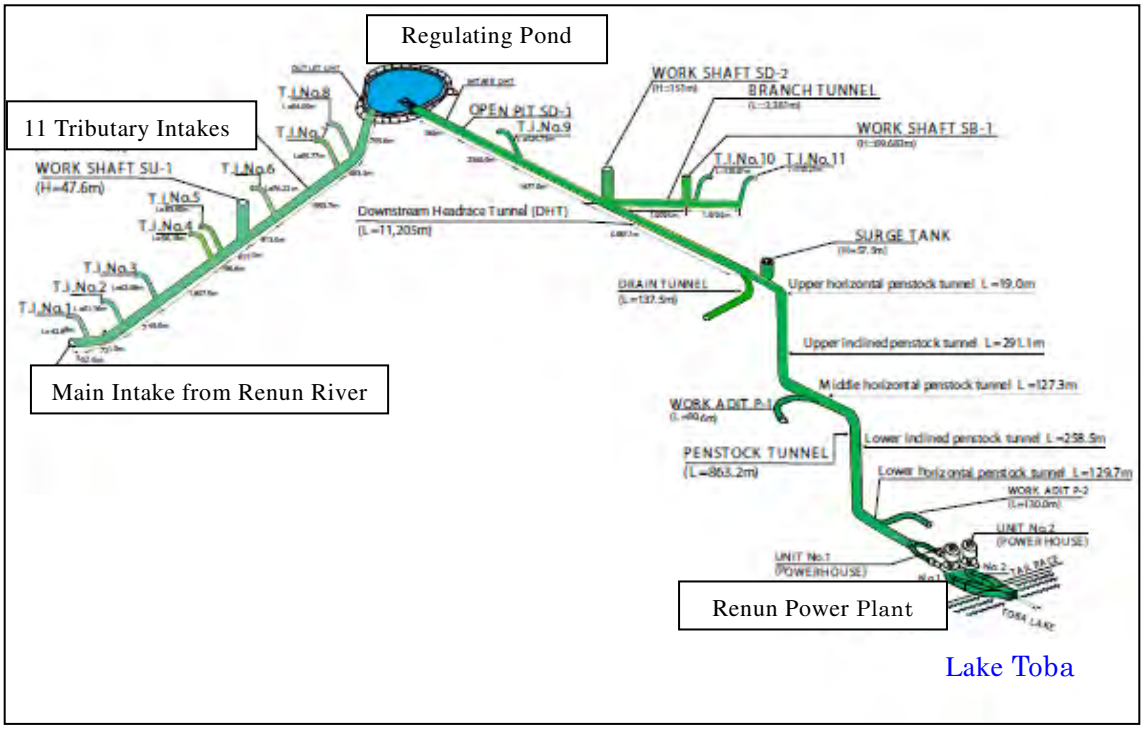
1. Addition of Irrigation Facilities

There are totally 2,000ha irrigation areas downstream the eleven tributaries of Renun River. In order to keep favorable coexistence between the hydropower generation and irrigation, facility development of irrigation was added to the original Project scope with totally 31.3 million yen investment.

2. Man-Month Addition of Consulting Service

As described below, the implementation period was obliged to be significantly extended from various causes being compared to the original schedule planned in Appraisal. The actual input volume of the supervision works of the consulting services was drastically increased.

Figure 1: Layout of Project



Substation

Regulating Pond

### 2.2.2 Project Period

Under the initial plan, the project period was from September 1991 to October 1999 (98 months), but the actual project period was from September 1991 to November 2006 (183 months) including a set of extension of the loan disbursement period, which turned out 86.7% longer than planned.

Table 5: Summary of Loan Disbursement Extension

| IP No. | Original Expiry Date | Extended Expiry Date | |
|---|---|---|---|
| | | First Extension | Second Extension |
| IP-376 | October 29, 2000 | December 29, 2001 | December 30, 2005 |
| IP-407 | December 8, 2001 | December 30, 2005 | - |
| IP-424 | December 15, 2001 | December 30, 2005 | - |

Major causes and corresponding approximate months of delay are as follows.

1. The Phase I (IP-376) construction works for the access roads undertaken by a local contractor were delayed (6 months).
2. The Phase II (IP-407) construction works for the downstream headrace tunnel were significantly delayed due to (1) performance failure of an international contractor and (2) significantly prolonged excavation works for the headrace tunnel hindered by unexpected fault zone with sandy tuff layer (18 months).
3. After passing the fault zone above, large-scale groundwater discharge confronted the excavation works and badly affected the implementation (42 months).

4. The commissioning test of the turbine and generator was delayed from a technical trouble (12 months).

### 2.2.3 Project Cost

Planned project cost was 31,422 million yen (of which Japanese ODA loan was 26,607 million yen), and the total disbursed amount from the ODA loan was 24,300 million yen, 8.7% smaller than planned disbursement. Reliable actual project cost in total was unavailable because the amounts invested from the government and PLN budgets were not properly recorded in project accounting under imperfect project accounting system of PLN. In spite of the significant implementation delay as well as the added scope and input, the amount of ODA loan disbursement was saved within the plan. It is mainly due to the successful reduction of total payment through efficient procurement with reasonable prices through fair price competition under international and local competitive bidding, secondly due to the significant depreciation of Rupiah currency (about 80% depreciation against the rate at Appraisal) brought by the Asian currency crisis in 1997.

Although the project cost was held within the initial plan, the project period considerably exceeded the plan; therefore the evaluation for efficiency of this project is moderate.

## 2.3 Effectiveness (Rating: a)

### 2.3.1 Effectiveness Measurement with Operation and Effect Indicators

The following table 6 comparatively shows the targeted figures set at Appraisal and their actual performance.

Table 6: Operation & Effect Indicators: Target and Performance

| Indicators (Unit) | Generator | Target at Appraisal | Performance 2007 | Performance 2008 |
|---|---|---|---|---|
| Operation Indicators | | | | |
| Rate of Unplanned Outage | No. 1 | | 0% | 8% |
| (Note 2) | No. 2 | | 0% | 0% |
| Rate of Planned Outage | No. 1 | | 5% | 1% |
| (Inspection & Repair) (Note 2) | No. 2 | | 2% | 1% |
| Capacity Factor | No. 1 | 44% | 27% | 50% |
| (Note 3) | No. 2 | | 63% | 52% |
| Rate of Internal Plant Use | | 2.1% | 1% | 0% |

| | | | | |
|---|---|---|---|---|
| Annual Operating Hours | No. 1 | | 4,911 hours | 4,860 hours |
| | No. 2 | | 4,559 hours | 5,882 hours |
| Maximum Water Use | | 22.1 ㎥/s | | |
| Average Annual Water Intake | | 10.1 ㎥/s | | |
| Effect Indicators | | | | |
| Net Power Generation | | | | |
| (GWh/year) | No. 1 | 313.5 | 97.6 | 179.6 |
| | No. 2 | | 228.0 | 186.2 |
| | | | | |
| Maximum Output（MW） | No. 1 | 82 | 41 | 41 |
| | No. 2 | | 38 | 41 |
| Electrification Ratio (Sumatra Island) | | 54.8% | 56.8% | |

Source: Appraisal Document, PLN data, RUPTL

Note1 : No available data for blank columns.

Note 2: Rate of outage hours from inspection, repair and other unplanned causes against annual operating hours.

Note 3: Annual Energy Production / Maximum Power x Annual Hours

The power plant is operated in peak hours (from 5 until 10 p.m.) by the water released through the downstream headrace tunnel from the regulating pond (Capacity: approximately 567,000$m^3$) at a time after getting full storage collecting water through the upstream headrace tunnel. The water volume used for generation is not recorded, but can be estimated at 335,669 million $M^3$ in 2008 applying the rate of water usage 917,561$M^3$ / MWh.

Since the commencement of operation, the operational condition is satisfactory generating electricity more than the targeted volume.

### 2.3.2 Results of Economic and Financial Internal Rates of Return

Based on the consultant's project completion report which recalculates the Internal Rate of Return (IRR) under the same method with the one applied at Appraisal, update of Economic Internal Rate of Return (EIRR) and Financial Internal Rate of Return (FIRR) was attempted replacing the figures of following factors with updated operational performance until 2008. Since accurate amounts of the total project cost and its annual disbursement are not available as stated in section 2.2.3 above, figures used in the project completion report were utilized as they are.

Table 7: Assumption and Results of IRR Recalculation

| | | EIRR | FIRR |
|---|---|---|---|
| Project Life | | 50 years after project completion | |
| Benefit | | Following benefits derived from incremental power generation of Renun and Asahan[4] Hydroelectric Power Plants<br>1. Least cost construction & annual operation & maintenance (O&M) cost of alternative power plant <Capacity Benefit><br>2.Fuel cost of the above <Energy Benefit> | Incremental power sales revenue |
| Cost | | 1. Total economic project cost<br>2.Economic O&M cost | 1.Total financial project cost<br>2. Financial O&M cost |
| Result | Appraisal | 13.0% | 4.4% |
| | Ex-post Evaluation | 19.4% | 5.8% |

Both EIRR and FIRR are calculated higher than the rates at Appraisal. The reason would be as follows.

1. Fuel oil price (HSD) has gone up from US$ 23.0/barrel in 1990 which was applied at Appraisal to the level of US$ 105/barrel (cited in RUPTL), which pushed up the capacity benefit. (Upward factor for EIRR)
2. Actual volume of annual power generation of Renun Power Plant (365.8GWh in 2008) exceeds the planned volume at Appraisal (313.5GWh). (Upward factor for FIRR)

### 2.3.3 Qualitative Effect

(1) Electrification Ratio and Gross Regional Domestic Products (GRDP) of Sumatra Island

Although it is difficult to measure direct benefit derived from the Renun Power

[4] Assuming that the water level of Lake Toba will be lifted by the transferred water flow from Renun River as a result of the Project, generation of Ashan Power Plant which depends on the water from Lake Toba will be accordingly boosted. This incremental power generated is counted as benefit of EIRR calculation. However, the water level of Lake Toba is maintained high enough by abundant rainfall recently, therefore it is not the prevailing case under which the transferred water from Renun River can contribute 100% to the Ashan's generation increase. Therefore, it is rational to consider conservatively that the actual EIRR at ex-post evaluation is somewhat lower than the estimated result above. However, the extent is not reasonably estimated because the future volume of rainfall is unpredictable.

Plant because of its minor share shown in the following Table 8, the annual trend of "Electrification Ratio" and "GRDP" are presented in the following in Table 9 just for reference.

Table 8: Share of Renun Hydroelectric Power Plant

| | Installed Capacity (MW) | Share of Renun Power Plant |
|---|---|---|
| North Sumatra Total | 1,607.80 | 5.1% |
| Sumatra Total | 9,145.00 | 0.9% |
| Hydroelectric Power Station Total in Sumatra | 893.00 | 9.8% |

Table 9: Annual Trend of Electrification Ratio and GRDP

| | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|
| Trend of Electrification Rate (%) | | | | |
| Sumatra Island | 54.9 | 55.8 | 57.2 | 56.8 |
| Total Indonesia | 57.5 | 58.3 | 59.0 | 60.9 |
| Trend of GRDP (trillion Rupiah) | | | | |
| Sumatra Island | 357 | 370 | 389 | 403 |
| Total Indonesia | 1,604 | 1,690 | 1,778 | 1,878 |

Source: RUPTL 2009-20018 (Electrification Ratio), BPS Statistics (GRDP)

Both of the indicators have been steadily improving, however the contribution of Renun Power Plant is minimal because of its little share.

(2) Effect on Oil Consumption Saving

The value of oil consumption saving is estimated US$ 85 million based on the actual generation performance of the power plant applying unit diesel price for generation cited in RUPTL 2009-2018.

Therefore, this project has largely produced the planned effects, and its effectiveness is high.

## 2. 4 Impact

### 2.4.1 Beneficiary Survey

Since the share of Renun Power Plant is minimal at 0.9% in its supply area (throughout Sumatra, and 5.1% in North Sumatra), no meaningful questionnaire survey is possible to the direct beneficiaries. On the other hand, benefit, as the side effect of the power station constructed, of the access roads created by the Project can be asked to the residents along the roads. The access roads were constructed during the period between October 1992 and March 1996 with the total length of about 20 km connecting the provincial road from Medan to Aceh to the district road Sidikarang-Dolok Sanggul. The beneficiary survey was conducted interviewing 180 residents living in six villages along the roads using questionnaires. The samples are voluntarily taken avoiding biased selection. The survey result is summarized in the Table 10 below.

There used to be only 25 households and 2 shops before the advent of the access roads, and the numbers have increased up to 630 households and 47 commercial shops up to the moment. Additionally, there appeared churches, mosques, clinics, gas stations, filling stations, markets, water supply facilities and so forth, each of which scarcely located in the area before.

Table 10: Result of Beneficiary Survey on Access Roads

| Items of Inquiry and Comments | Ratio of Positive Answer |
|---|---|
| Relocated being attracted by the access roads | 43.9% |
| Being benefited by the access roads | 98.3% |
| Daily transportation has been improved | 60.0% |
| Socialization and community communication has improved | 74.2% |
| Enjoying benefit on children education | 71.1% |
| Enjoying benefit on family health | 96.7% |

The newly constructed access roads under the Project attracted many people from other regions and have been contributing side effect of the power station activating the local economy. Although negative impact is being partly felt by the residents (for instance, traffic accidents <answered 22%>, air pollution <2%>, entry of unwelcome outsiders <4%>, deforestation <12%>), most of the people do not care on that.

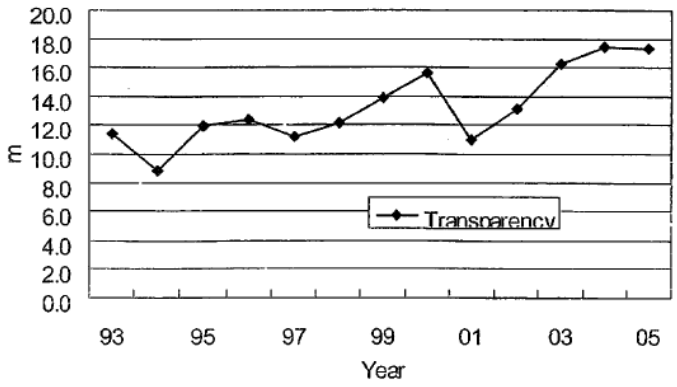
### 2.4.2 Impact on Natural Environment

(1) Water Quality of Lake Toba

It was a matter of concern at Appraisal whether the water quality of Lake Toba would be affected by the water inflow from Renun River which was partly transferred to the lake Toba from the Indian Ocean by the Project. Periodic transparency monitoring survey was conducted on the lake water near the power plant site until 2005[5], and no negative impact was shown as indicated in the following line graph. This survey was mainly for the water quality monitoring to detect contamination by the inflow of the earth and sand from the construction and was ceased after its completion. The field observation of the ex-post evaluation found no contamination or color change in lake water and witnessed its constant blue color. To alleviate influence on the lake water quality, a box culvert type headrace was installed to put generation water, which is 6 to 7℃ cooler than the lake water, down the lake bottom among other devices. Periodic monitoring of the lake water should be continued after the commencement of the plant operation also to confirm the effect of those remedial devices.

Surface of Lake Toba near Renun Power Plant

Figure 2: Trend of Transparency of Lake




(2) Other Items and Efforts for Environmental Conservation

Periodic environmental monitoring has been continuing after the Project completion for 12 checkpoints following the "Environmental Monitoring Plan," and no specific adverse environmental impacts have been reported. Several efforts are being attempted to minimize the Project's negative impacts on environment; such as PLN's afforestation in the Renun basin, regulation by the Ministry of Forest to control illegal deforestation by intruders entering through the access roads.

2.4.3 Impact on Social Environment

[5] The consultant's project completion report (PCR).

(1) Land Acquisition and Resident Relocation

The area of 773,000 $m^2$ for the preparatory works and 623,000 $m^2$ for the construction were acquired, and 832,000 $m^2$ was leased for construction works. Neither problem or dispute have been experienced. No resident relocation was executed.

(2) Issue of Water Sharing with Irrigation and Domestic Uses

The issue arisen during the project implementation raised by the local farmers through an environmental NGO in North Sumatra have been settled based on the result of the "Special Assistance for Project Implementation (SAPI) of JBIC (JICA at present)," conducted from May until September 2003, reaching agreement among the district government, PLN, residents and NGO that (a) people's water demand shall be prioritized after the commencement of the power plant operation, (2) the volume of water flow shall be jointly monitored and (3) the following committees and taskforce shall be organized to establish systems for joint control.

- "Water Management Committee" for settlement of water problems
- "Socialization Committee" for proper water sharing with irrigation
- "Special Taskforce" for regulating deforestation

Discussion with local farmers on the influence of Renun Power Plant on irrigation water

Actually, such arrangement was not practically executed, but no concern on the issue of water sharing has been revived again. The water intake facilities were designed such a way that Renun Power Plant is supplied for generation with residual water after securing a certain amount of water to meet the people's need. These facilities are effectively working and actually securing required water flow for the peoples use. Supported by such institutional and technical devices, the people's fear for anticipated water shortage has already been removed, and no protest or

complaint has been claimed by the residents or NGO afterwards[6].

To confirm the above state of affairs, the ex-post evaluation conducted a field interview survey to directly hear the prevailing voice of the people involved in parallel with the beneficiary survey for the access roads discussed in section 2.4.1 above. Total numbers of 180 households from 6 villages which draw irrigation water from the 11 tributaries of Renun River were taken as samples. The samples were taken voluntarily avoiding biased selection, and the interviews were carried out using questionnaires prepared in advance.

The survey result is summarized as follows.

Table 11: Result of Impact Survey

| Comments | | % Commented |
|---|---|---|
| Feel some impact from Renun Power Plant | | 82.8% |
| No impact, + do not know | | 17.2% |
| | Total | 100.0% |
| Kinds of impact felt | Irrigation water has reduced | 37.2% |
| | Power failure has been improved (Note 1) | 20.0% |
| | Conflict on water has increased | 17.8% |
| | Others | 25.0% |
| | Total | 100.0% |
| Possible remedies | Irrigation facility should be improved | 46.1% |
| | Residents' water use should be prioritized (Note 2) | 36.7% |
| | Others | 17.2% |
| | Total | 100.0% |
| Change in rice production | Reduced after completion of power plant | 70.6% |
| | Others | 29.4% |
| | Total | 100.0% |
| Reason of rice production decrease | Lack of quality rice seeds | 28.9% |
| | Insufficient fertilizer/pesticides | 33.3% |
| | Insufficient agricultural technology | 20.0% |
| | Shortage of water | 17.8% |
| | Total | 100.0% |
| Irrigation facility improvement under the Project is beneficial | | 75.6% |
| | Others | 24.4% |
| | Total | 100.0% |

[6] The initial protest by local people and an NGO was raised before the commencement of water intake for generation, and it was against the fear for the future, which was partly attributed to insufficient explanation from the PLN side in a proper manner. However the people's concern was eventually wiped out later on by the practice of objective water flow monitoring, mutual close discussion on that issue, institutional preparatory arrangement and, most of all, by the realized fact that the plant operation has never exercised adverse influence on the local agriculture and people's living.

(Note 1) Since the electricity from Renun Power Plant is distributed throughout Sumatra Island, so almost nothing to do with power failure reduction.

(Note 2) Actually already done so by using residual water after the peoples' use.

Some of the emotional comments insist reduction of agricultural (rice) production and water intake to the generation of Renun Power Plant as its major cause. However, objective facts revealed from the answers to other questions fail to support that argument. As a matter of fact, 82% of the respondents confess that the reduction of rice production is caused by other reasons than the water problem. The water problem itself is mostly affected by poor irrigation facilities, which is proved by the fact that the irrigation improvement implemented under the Project is much benefiting the agricultural production. It is an undeniable fact that the volume of irrigation water flow has been reduced after the water intake for the power generation, however, the influential bottleneck for sufficient water supply for the irrigation would not be the water intake in question but the defective irrigation facilities. It should be therefore concluded that it is not the case that the water intake from the 11 tributaries is exercising unfavorable influence on local agriculture through reduced water supply for irrigation. On the contrary, being coupled with effective practice of proper water sharing with people's living, the irrigation facility development added to the original scope of the Project and implemented in a part of the region has improved the water supply to the irrigation (partly used in daily domestic use), and is appreciated by the local people.

Irrigation Canal Improved under this Project
A young girl is doing washing-up after lunchtime

## 2.5 Sustainability (Rating: a)

### 2.5.1 Structural Aspects of Operation and Maintenance

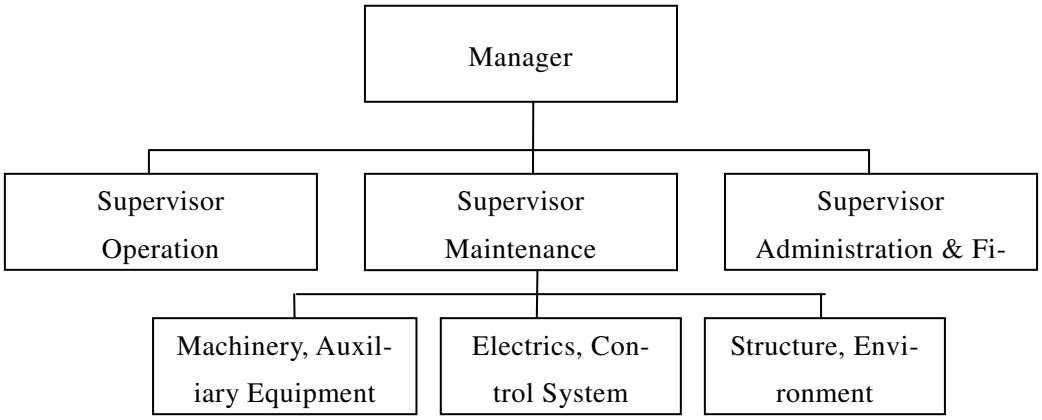
Each power station is operated and maintained under the layered responsibility of the relevant institutions under PLN as shown below.

Table 12 : Institutional Structure of Operation & Maintenance (O&M)

| Institutional Structure of O&M |
|---|
| - Pembangkitan Sumatra Bagian Utara) |
| - Sektor Pembangkitan Pandan) |
| - Renun Power Station |

The organization of the power plants of PLN are simply structured basically as illustrated in the figure below.

Figure 3: Simplified Organizational Structure of Renun Power Plant




Numbers of engineers (staff) assigned to each division are 3 people for “Operation,” 2 people for “Maintenance (Machinery, Auxiliary Equipment), 3 people for “Maintenance (Electrics, Control System)” and 3 people for “Maintenance (Structure, Environment).”

### 2.5.2 Technical Aspects of Operation and Maintenance

Most of the staff assigned to the sections of operation and maintenance above has academic background of electrical or mechanical engineering at STM or other institutions of higher education. All follow technical training courses below specially prepared for the area of hydroelectric generation several times a year so as to continually upgrade their technical skills.

PLN makes much of staff education and training based on its internal regulation. The training is conducted systematically providing staff with such courses as below.

a. Freshman educational training
b. Professional training (Power generation, Transmission O&M, Distribution O&M, etc.)
c. Grade training (Managers, Strategic specialist, etc.)
d. Other supplementary training (Technical workshop, seminar, diffusion of knowledge, etc.)

Those training programs are carried out basically at PUSDIKLAT (Center of Education & Training) of PLN. Additionally courses especially focused on hydroelectric power generation are prepared in the training center in Padang, West Sumatra, and approximately 1,100 staff members were participated in more than 50 courses mainly on O&M and other technical training in 2008.

The engineers of Renun Power Plant are sufficiently trained following the special courses above. At the same time PLN applies a basic policy to assign staffs with enough experience in other power stations especially to new power plants. No technical problems or shortcomings were found considering well-prepared institutional arrangement and practices as well as the current good conditions of the facilities under operation.

### 2.5.3 Financial Aspects of Operation and Maintenance

Operation and maintenance budgets of power stations under direct management of PLN are formulated at each location based on their requirement for O&M activities and requested to the headquarters through relevant Sektors and Wilayah (regional office). The approved amount is provided from the recurrent budget of PLN headquarters. PLN's financial difficulty as shown below does not allow those budgetary requests to be fully met, however, no significant cash flow shortage for operation and maintenance is prevailing in the field. Also being supported by their significantly cheap cost of operation, Renun Power Plant is well operated and maintained without any significant financial obstacle.

Table 13: Trend of Financial Performance of PLN on Consolidated Basis

(Unit: billion Rupiah)

| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|
| Power Sales | 39,018 | 49,809 | 58,232 | 63,246 | 70,735 | 76,286 | 84,250 |
| Government Subsidy | 4,739 | 4,097 | 3,470 | 12,511 | 32,909 | 36,605 | 78,577 |
| Total Operation Revenue | 44,183 | 54,430 | 62,273 | 76,543 | 104,726 | 114,042 | 164,209 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fuel & Lubrication Cost | 17,957 | 21,478 | 24,491 | 37,355 | 63,401 | 65,560 | 107,783 |
| Total Operation Cost | 52,345 | 55,876 | 59,710 | 76,024 | 105,228 | 111,505 | 160,598 |
| Operation Profit | -8,162 | -1,446 | 2,563 | 519 | -502 | 2,537 | 3,611 |
| Foreign Exchange Profit / Loss | 2,725 | 1,009 | -1,523 | -699 | 1,763 | -858 | -9,296 |
| Total Profit | -6,060 | -3,558 | -2,021 | -4,921 | -1,928 | -5,645 | -12,304 |

Source: Annual Report, PLN

PLN is chronically supported by a big amount of government subsidy and is hardly operating as a financially independent corporation, or rather it could be regarded as a direct government's business. That state of affairs is also implicitly represented by the attitude to categorize government subsidy as the company's operational revenue. The fundamental factor is a serious financial burden of fuel cost for generation. Especially in 2008, having been attacked by the soaring oil price, PLN received almost the same amount of gigantic government subsidy as the total power sales. PLN recorded a massive financial loss amounting to 12 trillion Rupiah in the same year incurring big foreign exchange loss caused by the significant depreciation of Rupiah currency, which could not be recovered even by the large scale government subsidy. That amount of PLN's loss occupied 83% of the entire amount of loss of all the state-owned companies incurred (23 companies, total 14.5 trillion Rupiah[7]).

Thus PLN as a company faces a significant financial problem and much effort should be made in operation and management to improve the situation, however, it is the condition that the Indonesian power sector is under full financial support by the government with massive subsidy. The financial issue of operation and maintenance in the field belongs to a different dimension, and PLN's financial problem does not exercise direct influence on the power plants' cash flow for effective operation and maintenance.

### 2.5.4 Current Status of Operation and Maintenance

[7] The company that suffered from the second biggest financial loss was Merpati Nusantara, state-owned airline company, whose amount of loss was 500 billion Rupiah which is only 5% of the PLN's. (KOMPAS <internet version>, May 14, 2009)

1. Generation Facility

The generator No.1 was out of order (but it was making no problem for the overall operation of the power plant being fully shouldered by the No.2 generator) at the time of the first field visit in March 2009, however it returned normal having been properly repaired by the maker.

2. Sedimentation at Main Intake

The issue of mud sedimentation at the main intake is a burdensome problem for PLN and is being tackled by means of human-wave tactics mobilizing sizable amount of manpower to remove the mud, which has been taken up as a serious problem in some technical magazines. This problem had been already anticipated before the commencement of project implementation and a spillway to flush the mud back to the main river has been installed for this particular purpose with its operation manual. Therefore, there is no fear of much mud inflow into the head-race tunnel for generation (if happens, it will stuff up the intake gate and also bring serious sedimentation problem at the tunnel and regulating pond later) or clogging the gate of intake if the operation is properly handled by periodically opening spillway and flushing the muddy water. However it may naturally cause insufficient water supply for generation lifting the canal bed by the residual sediment at the main intake. PLN is doing effort following the above operational requirement, but the contained volume of mud in the river flow is significant and consequently the sedimentation is progressing much faster than anticipated. It is a cumbersome problem anyhow for PLN.

The sediment at the regulating pond has to be dredged by making the pond entirely empty and it will take about one month suspending the power operation. The consultant's procedural manual for operation and maintenance instructs the dredging every 10 to 15 years showing its detailed procedure. However, the sedimentation is proceeding two or three times faster than forecasted, and the first dredging work is already budgeted and planned to be conducted in 2010.

This sedimentation problem is mainly caused by the sand mining jobs by local residents upstream the river. PLN has been discussing this issue with the district government and reached an agreement on March 6, 2009 to carry out joint monitoring and to request the government to take appropriate actions for the river basin management.

Sand Mining Site Upstream
Renun River
Muddy water from mining

Although a nuisance of the sedimentation issue is prevailing, it is being properly countered by PLN in cooperation with relevant agencies. No major problem has been observed in the capacity of the executing agency nor its operation and maintenance system, therefore, sustainability of this project is high.

## 3. Conclusion, Lessons Learned and Recommendations

### 3.1 Conclusion

This Project has been highly relevant in line with the Indonesia's national policy to cope with the country's growing power demand concurrently aiming at alleviation of oil dependency, and consistent with the development needs. Although the efficiency of the Project is moderate with significant delay in its implementation, the effectiveness is high supplying more electricity than planned with full operation to cope with prevailing insufficient power supply in Sumatra Island, concurrently contributing to activation of local economy and people's welfare as side effect by the access roads constructed under the Project. No major problem has been observed in the capacity of the executing agency nor its operation and maintenance system, therefore, sustainability of this project is high.

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

### 3.2 Lessons Learned

1. Project Implementation with Due Consideration for Environmental Conservation

Due consideration has been paid for natural environment (issue of water quality of Lake Toba) and social environment (issue of coexistence with local agriculture and people's living) to avoid or alleviate negative impacts of the Project. In this context, afforestation effort has been also taken by PLN itself. It is essential for any hydroelectric power plant projects to be prudently implemented with such environmental care.

2. Submission and Receipt of Accurate Project Completion Report (PCR)

The “Project Completion Report” which has been submitted to JICA is a completion report prepared by the consultant and lacks a number of items which are required by JICA in the loan agreement. JICA should remind implementing agencies to submit a right PCR in accordance with the agreement on the loan agreements.

### 3.3 Recommendations

1. Implementation of River Basin Management

Proper devices to tackle the problem of mud sedimentation at main and other intakes are being practiced by PLN. The sedimentation problem is mainly caused by the sand mining by local residents upstream the river, which necessitates proper river basin management especially on regulation to control illegal jobs by local residents under cooperation with the district government. The action has just got started reaching agreement among PLN, district government and the independent third party (North Sumatra University) on the river basin management based on the discussion to keep step with each other. PLN should urge the local governments to implement the agreement and should also act as a facilitator. The local governments are requested to actively respond and take necessary actions. [to PLN, Local Governments]

2. Water Transparency Monitoring of Lake Toba

The water transparency measurement and monitoring conducted during the consulting services up to 2005 (cf. section 2.4.2) should be resumed and continued by the Indonesian side. [to PLN and other relevant agencies ]

3. Establishment and Proper Practice of Project Accounting

Revenue and expenditure regarding project implementation must be systematically recorded and managed in a proper project accounting system separately established out of a general accounting system. However, the proper management was not being practiced in this project. It is required to arrange a rational project accounting system and fix clear responsibility for record keeping during the establishment of the total management structure for project implementation. The state of practice is to be monitored under the JICA’s mid-term review and other supervision schemes during the project implementation and to be remedied if inappropriate. [to PLN]

4. Issues of Operation & Maintenance Manuals

The operation & maintenance manual for the facilities constructed under the Project was prepared by the consultant, however it was not delivered to the Renun Power Station. In such a case that project implementation and operation are executed involving different agencies within PLN, effective communication and collaboration among them are essential for aiming for the achievement of maximal project effect. [to PLN]

**Comparison of the Original and Actual Scope**

| Item | Original | Actual |
|---|---|---|
| 1. Project Output | Water Intakes: 11 units<br>Headrace Tunnels<br>Upstream Tunnel: 8,800m<br>Downstream Tunnel: 11,000m<br>Regulating Pond<br>Power Station<br>Maximum output: 82MW<br>Transmission Lines: 70.7km<br>Substation Expansion: 2 units<br><br>Consulting Service: 1,314M/M | Water Intakes: 11 units<br>Headrace Tunnels<br>Upstream Tunnel: 8,800m<br>Downstream Tunnel: 11,200m<br>Regulating Pond<br>Power Station<br>Maximum output: 82MW<br>Transmission Lines: 70.7km<br>Substation Expansion: 2 units<br>Irrigation Facilities: Weir, Water Gates, Canals Rehabilitation<br>Consulting Service: 2,333M/M |
| 2. Project Period | September 1991 ~ October 1999 (98 months) | September 1991 ~ November 2006 (183 months) |
| Project Cost<br>Foreign Currency<br>Local Currency<br>Total<br>Japanese ODA Portion<br>Exchange Rate | <br>19,547 million yen<br>11,875 million yen<br>31,422 million yen<br>26,607 million yen<br><br>(I) Rp.1= 0.046 yen<br>(April 1991)<br>(II) Rp.1= 0.059 yen<br>(April 1993)<br>(III) Rp.1= 0.050 yen<br>(April 1994) | Amount of total project cost was not available at Ex-post Evaluation.<br><br>24,300 million<br><br>Rp.1= 0.016 yen<br>(Average rate March 1995 ~ August 2005) |

Indonesia

**Ex-Post Evaluation of ODA Loan Project "Multipurpose Dam Hydroelectric Power Plants Project"**

External Evaluator : Masami Sugimoto
(SHINKO Overseas Management Consulting, Inc.)

Field Survey : Feb. 2009 - Jun. 2009

## 1. Project Profile and Japanese ODA Loan


Map of Project Area

Distant view of Wonorejo Hydroelectric Power Plant

### 1.1 Background

This Project is to construct three hydroelectric power plants to cope with the growing electricity demand in corresponding power supply areas. The Project is implemented as a part of the master projects whose major components are multi-purpose dams to supply multiple public services comprising domestic and industrial clean water supply and irrigation in surrounding areas of the cities of Surabaya (East Java Province), Bandar Lampung (Lampung Province) and Makassar (South Sulawesi Province). The Project was formulated under the PT. PLN (Persero), a state-owned power company of Indonesia, combining the power plants portion of the multipurpose dam and their supporting projects under the Ministry of Public Works. The 6$^{th}$ Five-year National Development Plan under which the Project was formulated aimed at power development utilizing potential hydropower resources coupled with construction of coal-fired thermal power plants to supply base-load electricity demand.

**1.2 Objective**

The objective of this project is to construct 6.2MW (Java Bali System), 28MW (Wilayah IV <Lampung>) and 17.2MW (Wilayah VIII <South Sulawesi>) hydroelectric power plants aiming to meet growing electricity demand in each region, and thereby contributing to the regions' economic development and improvement of the people's standard of living.

**1.3 Borrower/Executing Agency** : Government of Indonesia／Directorate General of Water Resources, The Ministry of Public Works

**1.4 Outline of the Loan Agreement**

| | |
|---|---|
| Approved Amount/Disbursed Amount | 6,291million yen/4,044 million yen |
| End Notes Exchange Date/Loan Agreement Signing Date | December 1996 / December 1996 |
| Terms and Conditions | Interest Rate: 2.7%（Consulting Service 2.3%）<br>Repayment Period: 30 years<br>Grace Period: 10 years<br>Procurement: General Untied |
| Final Disbursement Date | March 2007 |
| Main Contractor<br>(over 1 billion yen) | Sumitomo Corporation (Japan) |
| Main Consultant<br>(over 100 million yen) | PT. Kwarsa Hexagon (Indonesia)<br>CTI Engineering, Co. Ltd. (Japan),<br>Electric Power Development Co., Ltd (Japan) |
| Feasibility Studies, etc. | Brantas River Basin Development Master Plan, OCTA, 1973 (Wonorejo Dam)<br>Engineering Service (E/S) for Wonorejo Dam, 1991<br>Feasibility Study (F/S) for Bili-Bili Dam, 1982<br>Engineering Service (E/S) for Bili-Bili Dam, 1988 |

| | |
|---|---|
| Related Projects | Wonorejo Multipurpose Dam Construction Project<br>Way Sekampung Irrigation Project (I) (II) (III)<br>Bili-Bili Dam Project<br>Bili-Bili Irrigation Project |

## 2. Evaluation Results (Rating: A)

### 2.1 Relevance (Rating: a)

#### 2.1.1 Relevance at Appraisal

The 6th Five Year National Development Plan (REPELITA VI, 1994~1998) aimed at improving power supply reliability and power development in line with the policy to get rid of the oil dependency based on regional resource endowment throughout the country. Volume of power consumption was growing with the annual rate of far more than 10%, and it was an urgent issue to develop potential hydropower resources coupled with construction of coal-fired thermal power plants to supply base-load electricity demand. It also urged restructuring of the power sector including private sector participation and organizational changes to achieve improved efficiency in power supply.

The following table articulately indicates the critical conditions of power supply against demand under such circumstances stated above.

Table 1: Power Supply-Demand Conditions in Indonesia

(Unit: Peak Load <MW>, Installed Capacity <MW>)

| PLN Supply Area | | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|
| Jawa -Bali | Peak Load | 5,756 | 7,093 | 8,273 | 9,645 | 11,285 | 13,203 |
| | Existing Capacity Installed | 6,223 | 6,223 | 6,118 | 5,898 | 5,578 | 5,538 |
| IV | Peak Load | 301 | 343 | 374 | 416 | 483 | 561 |
| | Existing Capacity Installed | 571 | 566 | 565 | 545 | 538 | 511 |
| VIII | Peak Load | 176 | 194 | 215 | 239 | 286 | 342 |
| | Existing Capacity Installed | 349 | 348 | 347 | 319 | 300 | 296 |

Source: Appraisal Documents

Note: At the time of Appraisal in 1996, power supply areas of PLN were Jawa-Bali for Wonorejo, Area IV for Batutegi and Area VIII for Bili-Bili respectively. The PLN supply areas have been rearranged into

Wilayah (regional offices) which covers each responsible area assigned. (Cf. Table 2)

### 2.1.2 Relevance at Ex-Post Evaluation

The "Medium-Term National Development Plan (Rencana Pembangunan Jangka Menengah Nasional: RPJM-N) <2004-2009>", which announces the necessity of the development of the power sector for overall national development, puts continued emphasis on the development of alternative power resources including hydropower aiming for alleviating the dependency on oil as a main energy source. The growth of power demand has been also remarkable. The high rate of growth at 10% per annum in 1997 was once suspended by the economic crisis experienced in the same year, however, constant consumption with annual rate of 7.6% has been continuing afterwards. From the aspect of the diversification of power sources under the policy to alleviate oil dependency, hydroelectric power generation utilizing potential hydraulic resources is strengthened coupled with extended conversion to coal-fired thermal power generation for meeting base-load power demand. They occupy 39% and 11% respectively in total installed capacity, which turned to exceed the oil and gas fired generation that occupy 46%[1]. The potential capacity of hydroelectric power generation throughout Indonesia was estimated to be about 75,000MW ("Hydroelectric Power Potentiality Study," 1982), however, the total power volume developed up to the year 2008 amounts to 4,125MW, only 5.5% of the total potential.

PLN nominates areas whose peak-load demand can not be met with installed capacity of power generation as "Daerah Krisis (Critical Area)," and prioritize their power development in the Long-Term Power Development Plan (PUPTL, 2009~2018). South Sumatra (Batutegi) and South Sulawesi (Bili-Bili) are two of the 10 Critical Areas.

The power supply-demand conditions in respective supply areas of the three power stations[2] are critical. PUPTL forecasts 2 to 3-time increase in power demand represented by peak load in coming 10 years. To cope with this expanding power demand, estimated construction of needed power plants amounts to 57,442 MW (PLN, IPP inclusive) during the same period, among which hydroelectric power plant should occupy 4,740 MW, 3.8% of the capacity totally required (3,835, 10.9% for PLN only).The next table shows forecasted power demand of three re-

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1 Geothermal 4%. All the figures are taken from RUPTL

2 At the time of Ex-Post Evaluation, Batutegi and Bili-Bili Powaer Plants are connected to the power grids of Sumatra and Sulawesi. Whereas, Wonorejo Power Plant which belongs to the Jawa-Bali System supplies electricity to a part of District Tulungagung District (Kabupaten) through Tulungagung Sub-station.

gions to which the power stations of this Project belong.

Table 2：Forecasted Power Demand and Peak Load in Three Supply Regions

| Power Plant | Supply Area (Wilayah) | Power Demand (MWh) | | | Peak load (MW) | | |
|---|---|---|---|---|---|---|---|
| | | 2008 | 2018 (Note) | In-crease (%) | 2008 | 2018 (Note) | In-crease (%) |
| Won-orejo | East Java | 22,219 | 48,623 | 119 | 3,681 | 7,842 | 113 |
| Batutegi | Lampung | 1,985 | 5,027 | 153 | 420 | 963 | 129 |
| Bili-Bili | South/ Cen-tral Sulawesi | 3,292 | 9,834 | 199 | 592 | 1,744 | 195 |

Source：RUPTL, 2009-2018

Note）：East Java show 2007 figures

Table 3：Total Necessary Capacity during 2008~18

(Unit: MW)

| | Jawa-Bali | Sumatra | Sulawesi |
|---|---|---|---|
| PLN | 27,042 | 3,668 | 1,754 |
| (Hydroelectric Power) | 2,984 | 262 | 505 |
| IPP | 13,910 | 5,477 | 1,488 |
| (Hydroelectric Power) | 140 | 631 | 257 |
| Total | 40,952 | 9,145 | 3,242 |
| (Hydroelectric Power) | 3,142 | 893 | 762 |

Source：RUPTL, 2009-2018

This project has been highly relevant with Indonesia's national policies and development needs at the times of both appraisal and ex-post evaluation.

### 2.2 Efficiency (Rating: b)

#### 2.2.1 Output

The Project is to construct the hydroelectric power plants portion of the multi-purpose dams implemented under a yen loan (Wonorejo in East Java, Batutregi in South Sumatra and Bili-Bili in South Sulawesi), and consists of equipment procurement for power plants and related transmission and sub-station facilities, civil works and consulting services (only for Bili-Bili Power Station). Actual output has

no significant difference from the original plan except the following items.

(Major points of difference)

1. Substation Facilities of Batutegi

The originally designed transformer of the Batutegi Substation was 17,250kVA x 1 unit, but it was expanded up to 17.86MVA x 2 sets, 35.72MVA in total, to strengthen the system reliability.

2. Power plant and transmission facilities of Bili-Bili

Bili-Bili Power Plant additionally procured chromium-coated spare parts (about 300 million yen) in preparation to a possible damage on the turbine by impure water contaminated with earth and sand from the dam reservoir caused by the the large-scale landslide of Mt. Bawakaraeng upstream. Additionally, 2-kilometer double-circuit transmission lines connecting to the Rindam- Malino distribution lines were constructed to the upstream direction in addition to the 15-kilometer double circuit transmission lines (20kV) from the power plant to Borongloe in order to strengthen the system.

3. Consulting services for Bili-Bili

Bili-Bili Power Plant made a consulting contract with reduced man-month volume at 103.00 M/M for international consultants and 216.50 M/M for domestic consultants. Although the actual volume of man-month input turned out to increase up to 114.43 M/M due to the extension of the implementation period, the volume of the domestic consultants portion was saved up to 202.51 M/M partly replacing them with PLN engineers.

### 2.2.2 Project Period

Under the initial plan, the project period was from December 1996 to August 2003 (81 months), but the actual project period was from December 1996 to March 2007 (124 months) including 15-month extension of the loan disbursement period, which turned out 53.1% longer than planned. Major reasons of the implementation delay include (1) two-year delay in commencement of the consulting services due to the procedural delay affected by the economic crisis that attacked Indonesia in 1997 and succeeding political and administrative confusion, (2) one-year delay caused by prolonged contract negotiation with the second lowest bidder after terminating the negotiation with the lowest in the equipment procurement and (3) required additional one and a half years for additional procurement of coated spare parts (spray micronized chrome particles with high velocity oxygen-fuel thermal

process) in preparation to a possible damage on the turbine runner portion of the generator by contaminated water from the dam reservoir caused by the inflow of earth and sands from the large-scale landslide of Mt. Bawakaraeng upstream.

### 2.2.3 Project Cost

Planned project cost was 8,388 million yen (of which Japanese ODA loan was 6,291 million yen), and the total project cost at the time of ex-post evaluation was 4,922 million yen (of which Japanese ODA loan was 4,044 million yen), 41.3% smaller than planned. In spite of almost the same output performance compared to the original plan, the total project cost was much saved within plan. It is mainly due to the significant depreciation of Rupiah currency brought by the Asian currency crisis started in 1997, and transfer of a part of the Project to the Way Sekampung Irrigation Project which is funded under the budget of the Ministry of Public Works.

Although the project cost was held within the initial plan, the project period considerably exceeded the plan; therefore the evaluation for efficiency of this project is moderate.

Batutegi Hydroelectric Power Plant

The Ex-Post Evaluation Team is having a joint meeting with PLN officials for collective discussion on the Project performance.

## 2.3 Effectiveness (Rating: a)

### 2.3.1 Effectiveness Measurement with Operation and Effect Indicators

The following table summarizes the annual trend of the operation and effect indicators of the actual performance.

Table 4 : Annual Trend of Performance in Operation & Effect Indicators

| No | Indicators | Unit | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|
| Operation Indicators | | | | | | | | | |
| 1 | **Unplanned Outage Hours** | | | | | | | | |
| | Wonorejo | hours/year | 17.4 | 3.67 | 2.26 | 0.56 | 0.39 | 0 | 0 |
| | Batutegi | hours/year | 31.0 | 138.6 | 175.3 | 186.5 | 7.3 | 43.2 | 168.4 |
| | Bili-Bili | hours/year | - | - | - | - | 160 | 2 | 8 |
| 2 | **Capacity Factor** | % | | | | | | | |
| | Wonorejo | | 29.83 | 30.96 | 31.81 | 29.67 | 32.24 | 36.39 | 40.43 |
| | Batutegi | | 17.04 | 13.21 | 47.23 | 57.93 | 43.30 | 45.13 | 23.16 |
| | Bili-Bili | | - | - | - | - | 40.8 | 53.5 | 53.9 |
| 3 | **Annual Operating Hours** | hours/year | | | | | | | |
| | Wonorejo | | 3,260 | 4,565 | 4,946 | 4,588 | 3,519 | 3,939 | 4,535 |
| | Batutegi | | 284 | 2,886 | 7,012 | 10,250 | 8,153 | 10,197 | 8,858 |
| | Bili-Bili | | - | - | - | - | 10,326 | 11,551 | 11,501 |
| 4 | **Planned Outage Hours** | hours/year | | | | | | | |
| | Wonorejo | | 108.77 | 0 | 73.25 | 0 | 80.75 | 103.33 | 79.33 |
| | Batutegi | | 171.0 | 151.1 | 289.6 | 349.6 | 304.0 | 412.0 | 409.0 |
| | Bili-Bili | | - | - | - | - | 208 | 112 | 110 |
| 5 | **Maximum Water Use** | 1,000m3/second | | | | | | | |
| | Wonorejo | | 28,160 | 29,429 | 30,094 | 28,178 | 29,995 | 34,005 | 38,187 |
| | Batutegi | | 173,908 | 139,862 | 479,049 | 573,757 | 461,076 | 544,487 | 364,213 |
| | Bili-Bili | | | | | | | | |
| Effect Indicators | | | | | | | | | |
| 6 | Net Electric Energy Production | MWh/year | | | | | | | |
| | Wonorejo | | 16,000 | 16,721 | 17,099 | 16,010 | 17,043 | 19,321 | 21,697 |
| | Batutegi | | 42,681 | 33,103 | 118,332 | 145,136 | 108,489 | 113,063 | 58,016 |
| | Bili-Bili | | - | - | - | - | 70,897 | 92,334 | 93,189 |
| 7 | Actual Maximum Output | MW | | | | | | | |
| | Wonorejo | | 6.3 | 6.3 | 6.3 | 6.3 | 6.3 | 6.3 | 6.3 |
| | Batutegi | | | | | | | | |
| | Bili-Bili | | | | | | | | |

Source : Questionnaire Answers from PLN

Note : Data for blank columns are not available in the PLN recording system.

All the power plants under the Project are to carry out generation which is one of the functions of the multipurpose dams, and the water use for generation is subordinate to the other uses for irrigation and clean water supply for domestic and industrial uses. Available volume of water for generation is subject to the volume of water supplied to other purposes, accordingly the plant capacity factors tend to be low and unstable in general.

Minor technical problems brought relatively long hours of unplanned outages at the initial stage of operation of Batutegi and Bili-Bil, however, proper remedies enabled prompt recovery and smooth operation up until the moment.

Temporary drop in Batutegi capacity factor (CF)[3] in 2008 is a result of the reduction of generation affected by the significant sinking of the reservoir's water level caused by the rainfall shortage in that year, however, it was recovered and returned to normal afterwards.

As a conclusion, all the hydroelectric power plants under the Project are generating electricity optimally and their operational conditions are favorable.

### 2.3.2 Results of Financial Internal Rate of Return

Update of the Financial Internal Return (FIRR) was attempted based on the same method of estimation at Appraisal and obtained the result as follows. The update for Bili-Bili Power Plant was unable due to the lack of accurate accounting record under unreliable project accounting system on disbursements from the state budget and annual amounts of disbursement of the total project cost at the time of Ex-Post Evaluation. Economic Internal Rate of Return (EIRR) for all the power plants under the Project was not possible either due to the lack of appropriate financial data necessary for the calculation.

Table 5 : Assumptions & Results of FIRR Update

| | | |
|---|---|---|
| Project Life | | 50 years after commencement of project implementation |
| Cost | | 1. Investment Cost (Civil Works, Equipment Procurement, Consulting Services)<br>2. Operation & Maintenance (O&M) Cost (15% of total investment cost) |
| Benefit | | Revenue from power sales |
| FIRR | Appraisal | Wonorejo: 18.9%, Batutegi: 10.4%, Bili-Bili: 12.8% |
| | Ex-Post Evaluation | Wonorejo: 16.1%, Batutegi: 25.0% |

The main reason of the considerable increase in Batutegi FIPP is the drastic reduction in its total project cost.

### 2.3.3 Qualitative Effect

(1) Shares of Power Plants and Relevant Indicators

Connected power supply transmission systems and corresponding areas of power supply of each power plant of the Project are summarized in the following

[3] CF = Annual Energy Production / (Maximum Power) x (Annual Hours)

Table 6, and respective share of each power plant is shown in Table 7 as follows.

Table 6：Connected Systems & Power Supply Areas

| Power Plant | Connected System or Sub-station | Power Supply Area of Connected System |
|---|---|---|
| Wonorejo | Tulungagung Substation | 4 Sub-districts (Kecamatan) of Tulungagung District (Kabupaten) |
| Batutegi | South Sumatra System | Whole Sumatra Island |
| Bili-Bili | South, Southeast, West Sumatra System | Whole Sulawesi Island |

Table 7：Capacity Share of Each Power Plant in Respective Supply Regions

(Unit: MW) 2007

| **Wonorejo（6.5 MW）** | | | | Share of Wonorejo |
|---|---|---|---|---|
| (Jawa Bali) | PLN Total | IPP | Total | |
| Hydropower | 2,386 | 150 | 2,536 | 0.26% |
| Mini Hydro | 0 | 0 | 0 | |
| Steam | 7,320 | 3,050 | 10,370 | |
| Combined Cycle | 6,143 | 0 | 6,143 | |
| Gas | 2,086 | 150 | 2,236 | |
| Diesel | 76 | 0 | 76 | |
| Geothermal | 360 | 515 | 875 | |
| Jawa Bali Total | 18,371 | 3,865 | 22,236 | 0.03% |
| **Batutegi（28 MW）** | | | | Share of Batutegi |
| (Sumatra) | PLN Total | IPP | Total | |
| Hydropower | 850 | | | 3.3% |
| Mini Hydro | 13 | | | |
| Steam | 945 | | | |
| Combined Cycle | 818 | | | |
| Gas | 481 | | | |
| Diesel | 832 | | | |
| Geothermal | 40 | | | |
| Sumatra Total | 3,979 | 361 | 4,340 | 0.65% |
| **Bili-Bili（20.1 MW）** | | | | Share of Bili-Bili |
| (Sulawesi) | PLN Total | IPP | Total | |
| Hydropower | 172 | | | 11.69% |
| Mini Hydro | 38 | | | |
| Steam | 25 | | | |
| Combined Cycle | 0 | | | |
| Gas | 123 | | | |
| Diesel | 440 | | | |
| Geothermal | 40 | | | |
| Sulawesi Total | 838 | 195 | 1,033 | 1.95% |

Source：PUPTL 2009-2018

Note 1: Wonorejo belongs to Jawa Bali System, but supplies electricity only to 4 sub-districts of Tulungagung District via Tulungagung Substation. The share of Wonorejo is indicated only for reference.

Note 2: Due to the lack of classified data according to energy resources for IPP, the figures on shares of Batutegi and Bili-Bili in Sumatra and Sulawesi indicate the shares in PLN total.

While the generated electricity by Batutegi and Bili-Bili is supplied, being mixed with electricity from other power sources, to whole islands of Sumatra and Sulawesi respectively through intra-island power grids, electricity from Wonerejo under the Jawa-Bali power transmission system is distributed in a limited area of Tulungagung District via Tulungagung Substation being connected with the 20kV transmission lines. Although it is difficult to measure direct benefit derived from the power stations under the Project as stated above, except Wonorejo, due to their negligible shares among the corresponding areas of power supply, the "Electrification Ratio" and "Gross Regional Domestic Projects (GRDP)" are presented in the following tables just for reference.

Table 8: Annual Trend of Electrification Ratio

(Unit: %)

| Power Supply System | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|
| Jawa Bali | 62.3 | 63.1 | 63.9 | 66.3 |
| Sumatra | 54.9 | 55.8 | 57.2 | 56.8 |
| Sulawesi | 51.6 | 53.0 | 53.2 | 53.6 |
| Indonesia Total | 57.5 | 58.3 | 59.0 | 60.9 |

Source: RUPTL

Table 9: Annual Trend of GRDP

(Unit: billion Rupiah)

| Power Supply System | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|
| Jawa Bali | 927,599 | 977,537 | 1,033,670 | 1,093,320 | 1,160,726 |
| Sumatra | 346,715 | 356,879 | 369,612 | 389,067 | 403,377 |
| Sulawesi | 65,961 | 69,714 | 74,079 | 79,212 | 84,662 |
| Indonesia Total | 1,538,655 | 1,604,036 | 1,690,229 | 1,777,994 | 1,878,019 |

Source: Statistics BPS (Central Bureau of Statistics)

(2) Relevant Indicators of Power Supply Area of Wonorejo Power Station

Tulungagung District consists of 19 sub-districts, and four sub-districts among those get electric supply from Wonorejo Power Station; namely, "Campurdarat," "Sumburgempol," "Boyolangu" and "Kedungwaru" Sub-districts. GRDP and number of business entities are shown in the following table.

Table 10 : Annual Trend of Sectoral GRDP in Tulungagung District[4]

(Unit: billion Rupiah)

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | Growth Rate |
|---|---|---|---|---|---|---|---|---|---|---|
| Agriculture | 984 | 1,002 | 1,026 | 1,047 | 1,071 | 1,096 | 1,121 | 1,149 | 1,188 | 21% |
| Mining | 109 | 113 | 117 | 122 | 128 | 134 | 140 | 147 | 153 | 41% |
| Manufacturing | 810 | 855 | 882 | 915 | 965 | 1,020 | 1,077 | 1,141 | 1,208 | 49% |
| Public Service | 27 | 34 | 43 | 54 | 63 | 71 | 78 | 86 | 95 | 247% |
| Construction | 108 | 109 | 111 | 113 | 115 | 117 | 124 | 126 | 131 | 22% |
| Commerce, Tourism | 1,350 | 1,414 | 1,494 | 1,579 | 1,676 | 1,782 | 1,906 | 2,047 | 2,190 | 62% |
| Transportation | 142 | 154 | 170 | 187 | 203 | 221 | 243 | 265 | 292 | 105% |
| Finance | 547 | 585 | 608 | 637 | 674 | 710 | 749 | 789 | 836 | 53% |
| Other Services | 609 | 624 | 640 | 658 | 684 | 715 | 752 | 794 | 831 | 36% |
| Total | 4,686 | 4,891 | 5,091 | 5,312 | 5,579 | 5,865 | 6,187 | 6,543 | 6,924 | 48% |

Source: Prepared from BPS Statistic "Tulungagung Dalam Angka" <Tulungagung in Figures>

The average growth rate of the public service sector including electric supply records the highest among others, but those of the manufacturing, commerce & tourism sectors exceeds the total average, which suggests that the contribution of the advent of power supply from Wonorejo Power Plant which started its operation in September 2002 could be significant.

[4] Figures of 2000~2003 and 2004~2008 are expressed in 1993 price and 2000 price respectively. In order for both figures to be consistent, the former has been adjusted to the latter applying annual growth rates.

Table 11: Growth Rates of Number of Business Entities in Tulungagung District

| | Growth Rate (2000~2008) | |
|---|---|---|
| | 4 Sub-districts, Consumers of Wonorejo | Tulungagung District Total |
| Large & Medium Size | 78.0% | 6.7% |
| Small Size and Individual | 25.7% | 4.8% |

Source: BPS Statistic "Tulungagung Dalam Angka" (Tulungagung in Figures)

Rates of growth during 2000~2008 in four sub-districts being supplied with the Wonorejo electricity are remarkably higher than the rates of the total, which could indicate significant contribution of newly built Wonorejo Power Plant.

(1) Effect on Oil Consumption Saving

Effect on oil consumption saving and accompanied generation cost reduction is expected to the Project as a source of alternative energy to replace oil consumption. The value of oil consumption saving is estimated US$ 58 million based on the actual generation performance of the three power stations applying unit diesel price for generation cited in RUPTL 2009-2018.

(2) Result of Beneficiary Survey

As mentioned earlier, the generated electricity by Batutegi and Bili-Bili is supplied, being mixed with electricity from a great number of other power sources, to whole islands of Sumatra and Sulawesi respectively through intra-island power grids and their shares are small as indicated in Table 8. Therefore it is not possible to specify influenced beneficiaries, and no meaningful beneficiary survey can be executed. On the other hand, the beneficiary survey was conducted for Wonorejo Power Station which supplies electricity to limited area only covering 4 sub-districts by way of Tulungagung Substation.

a) Method

Interview survey was conducted using a questionnaire for business entities and individual households. For the business entities the 5 biggest customers and 9 other businesses were picked out as samples voluntarily without sectoral bias (totally 14 samples). For individual households, 101 samples were selected voluntarily also avoiding biased selection. The total population of the benefited area in 4 Sub-districts is approximately 275 thousand people, while total population of Tu-

lungagung District is 1,020 thousand. Total number of customers using electricity from Wonorejo is about 30 thousand connections.

Wonorejo Hydroelectric Power Station
Residents being interviewed in the beneficiary survey in Tulungagung District.

b) Summary of Survey Result

Regarding the inquiry of general quality of power supplied, only 7% of business entities and 15% households evaluate the quality before the Project "Excellent" whereas 85% and 89% respectively answered that the quality became "Excellent" after the Project. About the frequency of power failure, 57% of business entities and 28% of households say "Scarcely happened" before the Project, but for the condition after the Project, 100% and 83% answer "Scarcely happens." For the voltage stability, 79% of business entities and only 17% of households appreciate it "Very stable," but the figures increased up to 100% and 73% on the condition after the Project.

The above result indicates that the conditions of power supply in the benefited area significantly improved in quantity as well as in quality in conjunction with the operation commencement of Wonorejo Power Plant.

Therefore, this project has largely produced the planned effects, and its effectiveness is high.

## 2. 4 Impact

### 2.4.1 Impact on Natural Environment

The Project is to construct relatively small-scale power stations to be attached to the multipurpose dams which are the main component of the comprehensive master projects, and therefore do not impose heavy burden on natural environment. It is also under careful environmental monitoring during implementation and after

operation, in which no significant adverse effect on the environment has been reported.

### 2.4.2 Impact on Social Environment

Same as above, no significant social impact has been reported. In the construction of the transmission lines from Batutegi Pawer Station to Pagalaran which is the only case where land acquisition took place, the process was smoothly executed without any serious problem. No relocation of residents was executed.

## 2.5 Sustainability (Rating: a)

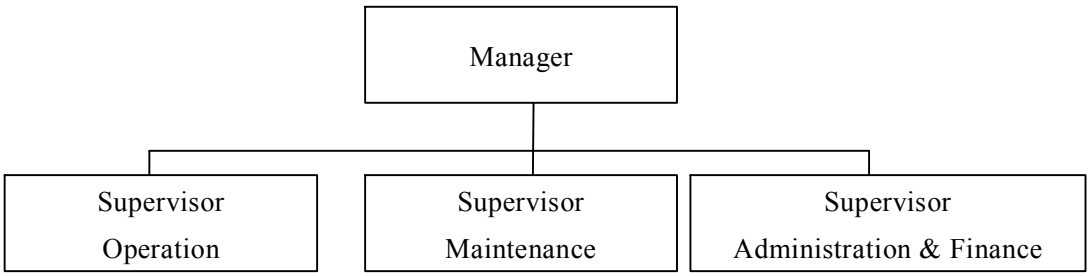
### 2.5.1 Structural Aspects of Operation and Maintenance

Each power station is operated and maintained under the layered responsibility of the relevant institutions under PLN as shown below.

Table 13：Institutional Structure of Operation & Maintenance (O&M)

| Power Plant | Institutional Structure of O&M |
|---|---|
| Wonorejo | - PT PJB：Pembangkitan Jawa-Bali ＜Subsidiary of PLN＞<br>- Wonerejo Power Station |
| Batutegi | -PT PLN (PERSERO) Pembangkitan Sumatra Bagian Selatan<br>-PT PLN (PERSERO) Sektor Pembangkitan Badar Lampung<br>- Batutegi Power Station |
| Bili-Bili | - PT PLN (PERSERO) Wilayah Sulawesi Selatan, Tenggara & Barat<br>- Sektor Bakaru<br>- Bili-Bili Power Station |

The organization of the power plants are simply structured basically as illustrated in the figure below with minor difference among the plants.



In Batutegi and Bili-Bili Power Plants under the direct management of PLN, three supervisors are assigned respectively in charge of "Operation," "Maintenance" and "Administration & Finance." In case of Batutegi, the operation department is further divided into four working teams. Numbers of assigned staff engineers are about 10 for operation, 3 for maintenance and one (excluding securities and cleaners) for administration & finance.

On the other hand, in Wonorejo Power Plant which is under management of PJB, a subsidiary company of PLN, totally 13 engineers are assigned under the Foreman (head of power station). Different from two other power plants, the O&M section is not segregated into operation and maintenance and staffed with relevant engineers with various expertise like "System Control," "Mechanical Engineering," "Electric Engineering," "Equipment Management" and "Civil Engineering."

### 2.5.2 Technical Aspects of Operation and Maintenance

Most of the staff assigned to the sections of operation and maintenance above have academic background of electrical or mechanical engineering at STM or other institutions of higher education. All follow technical training courses below specially prepared for the area of hydroelectric generation several times a year so as to continually upgrade their technical skills.

PLN makes much of staff education and training based on its internal regulation. The training is conducted systematically providing staff with such courses as below.

a. Freshman educational training
b. Professional training (Power generation, Transmission O&M, Distribution O&M, etc.)
c. Grade training (Managers, Strategic specialist, etc.)
d. Other supplementary training (Technical workshop, seminar, diffusion of knowledge, etc.)

Those training programs are carried out basically at PUSDIKLAT (Center of Education & Training) of PLN. Additionally courses especially focused on hydroelectric power generation are prepared in the training center in Padang, West Sumatra, and approximately 1,100 staff members were participated in more than 50 courses mainly on O&M and other technical training in 2008.

The engineers assigned to the three power plants under the Project were sufficiently trained following the special courses above. At the same time PLN applies a basic policy to assign staffs with enough experience in other power stations especially to new power stations. No technical problems or shortcomings were found

considering well-prepared institutional arrangement and practices as well as the current good conditions of the facilities under operation.

### 2.5.3 Financial Aspects of Operation and Maintenance

Operation and maintenance budgets of power stations under direct management of PLN are formulated at each location based on their requirement for O&M activities and requested to the headquarters through relevant Sektors and Wilayah (regional office). The approved amount is provided from the recurrent budget of PLN headquarters. PLN's financial difficulty as shown below does not allow those budgetary requests to be fully met, however, no significant cash flow shortage for operation and maintenance is prevailing in the field. Also being supported by their significantly cheap cost of operation, the three power plants under the Project are well operated and maintained without any significant financial obstacle.

Table 14: Trend of Financial Performance of PLN on Consolidated Basis

(Unit: billion Rupiah)

| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|
| Power Sales | 39,018 | 49,809 | 58,232 | 63,246 | 70,735 | 76,286 | 84,250 |
| Government Subsidy | 4,739 | 4,097 | 3,470 | 12,511 | 32,909 | 36,605 | 78,577 |
| Total Operation Revenue | 44,183 | 54,430 | 62,273 | 76,543 | 104,726 | 114,042 | 164,209 |
| Fuel & Lubrication Cost | 17,957 | 21,478 | 24,491 | 37,355 | 63,401 | 65,560 | 107,783 |
| Total Operation Cost | 52,345 | 55,876 | 59,710 | 76,024 | 105,228 | 111,505 | 160,598 |
| Operation Profit | -8,162 | -1,446 | 2,563 | 519 | -502 | 2,537 | 3,611 |
| Foreign Exchange Profit / Loss | 2,725 | 1,009 | -1,523 | -699 | 1,763 | -858 | -9,296 |
| Total Profit | -6,060 | -3,558 | -2,021 | -4,921 | -1,928 | -5,645 | -12,304 |

Source: Annual Report, PLN

PLN is chronically supported by a big amount of government subsidy and is hardly operating as a financially independent corporation, but could be regarded as a direct government's business. That state of affairs is also implicitly represented

by the attitude to categorize government subsidy as the company's operational revenue. One of the fundamental factors is a serious financial burden of fuel cost for generation. Especially in 2008, having been attacked by the soaring oil price, PLN received almost the same amount of gigantic government subsidy as the total power sales. PLN recorded a massive financial loss amounting to 12 trillion Rupiah in the same year incurring big foreign exchange loss caused by the significant depreciation of Rupiah currency, which could not be recovered even by the large scale government subsidy. That amount of PLN's loss occupied 83% of the entire amount of loss of all the state-owned companies incurred (23 companies, total 14.5 trillion Rupiah[5]). On the other hand, PJB, PLN's subsidiary company which operates Wonorejo Power Station has been enjoying favorable operational performance with positive operating and total profit in consecutive 5 years until 2006 (profit / sales ratio: 5~7%). Operation and maintenance of Wonorejo Power Plant is also running well with ample budget.

Thus PLN as a company faces a significant financial problem and much effort should be made in operation and management to improve the situation, however, it is the condition that the Indonesian power sector is under full financial support of the government with massive subsidy. The financial issue of operation and maintenance in the field belongs to a different dimension, and PLN's financial problem does not exercise direct influence at this stage on the power plants' cash flow for effective operation and maintenance.

### 2.5.4 Current Status of Operation and Maintenance

Constructed facilities of Bili-Bili Power Plant are well maintained and operated smoothly. The additionally procured spare parts of the generator in preparation to the possible damage by contaminated water have not been used yet and are kept in good condition, and smooth generation is going on with existing generators. In addition to the fact that the water inflow from the dam reservoir containing earth and sand has turned out to be not so serious as anticipated, the installation of a cyclone separator under a partially modified technical design, which removes the foreign substances and avoids their influx into the radiators, could effectively support the smooth operation. Wonorejo and Batutegi Power Plants are operated in good conditions under appropriate maintenance as well without any significant troubles. The two sets of governors of Batutegi Power Plant were facing a minor

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[5] The company that suffered from the second biggest financial loss was Merpati Nusantara, state-owned airline company, whose amount of loss was 500 billion Rupiah which is only 5% of the PLN's. (KOMPAS <internet version>, May 14, 2009)

technical trouble in a part of their function, or life has been expired according to the engineer, but it does not affect at all the automatic operation which is currently going on. Their replacement cost (about 16 million yen) has been already budgeted.

Minor operational problems, such as Japanese indication on the governors' display and lost password and back-up programs of the HMI (Human Machine Interface), were prevailing in the field. Those deficiencies do not impede anything as long as the generators are under automatic operation, but will reveal problems once the generation has been changed to manual operation under some unusual conditions. Although it can not be objectively identified whether it was due to the acceptance of imperfect equipment or improper procedural treatment during the internal transfer to the field, it has been obviously derived from such weakness in internal management as lack of careful acceptance based on the supply contract or predetermined procedural rules, miss-documentation after acceptance and so forth. An internal management system for careful inspection at acceptance should be strengthened in order to avoid such failures and secure transfer of perfect goods to the field of operation. The consulting services of Wonorejo and Batutegi Power Plants are provided under the corresponding multipurpose dam projects implemented by the Ministry of Public Works. Operation & maintenance manuals for power stations were prepared by the consultants within the said consultancy, however they are not delivered to the PLN's power stations concerned. In such a case that a part of project implementation is executed in a different agency, effective communication and collaboration are essential to maximize the project effect.

Although minor problems on equipment under unsatisfactory conditions and unused operational manual were found in the field, no major problem has been observed in the capacity of the executing agency nor its operation and maintenance system, therefore, sustainability of this project is high.

## 3. Conclusion, Lessons Learned and Recommendations

### 3.1 Conclusion

This Project has been highly relevant in line with the Indonesia's national policy to cope with the country's growing power demand concurrently aiming at alleviation of oil dependency, and consistent with the development needs. Although the efficiency of the Project is moderate with significant delay in its implementa-

tion, the effectiveness is high contributing to the improvement of prevailing insufficient power supply in respective power transmission systems and to activate regional economy and increase people's welfare through improved power supply in quantity as well as in quality. No major problem has been observed in the capacity of the executing agency nor its operation and maintenance system, therefore, sustainability of this project is high.

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

### 3.2 Lessons Learned

1. Cooperation among Implementing and Operating Agencies Involved

In case where multiple agencies are involved in project implementation and operation, achievement of sufficient project effect and sustainability are prevented without good cooperation among the agencies especially in the stage of transition from implementation to operation. (Cf. 3.3 Recommendations, Section 2 below)

2. Submission and Receipt of Accurate Project Completion Report (PCR)

In yen-loan projects, a project implementing agency is requested to prepare and submit a Project Completion Report (PCR) to JICA in accordance with the agreed format. However, what has been submitted to JICA is a completion report prepared by the consultant and submitted to PLN in accordance with their consulting contract, which is not the PCR officially requested by JICA based on the agreement reached in the Loan Agreement. Moreover, the completion report above is only for Bili-Bili and does not include contents on Wonerejo and Batutegi Power Plants whose consulting services are under the Ministry of Public Works. At any project completion in future, the PCR submitted to JICA should be the official one consistent with the prior agreement in L/A. JICA should also carefully inspect the contents on its acceptance.

### 3.3 Recommendations

1. Improvement of Management Practices

Internal management practices in PLN and inter-agency management arrangement among different implementation agencies should be improved. The internal management system should be totally strengthened in order to carry out implementation and operation of hardware facilities and to achieve sufficient operational results. The following are typical examples.

2. Issues of Operation & Maintenance Manuals

The consulting services of Wonorejo and Batutegi Power Plants are provided

in “Wonorejo Multipurpose Dam Project” and “Way Sekampung Irrigation Project (I)” under the Ministry of Public Works. The operation & maintenance manuals for the portions of power stations were prepared by the consultants under the contracts with the Ministry of Public Works, however those manuals have not been delivered not only to the power stations in question but even not to the PLN side. In such a case that a part of project implementation is executed involving multiple agencies, effective communication and collaboration are essential for aiming for the achievement of maximal project effect. (In this connection, an operation & maintenance manual for Bili-Bili Power Plant was not prepared based on the agreement with PLN.) The manuals currently in the custody of the Ministry of Public Works should be promptly sent to PLN and to be delivered to the respective power stations. [to PLN]

3. Issues on Equipment Inspection at Acceptance

Minor operational problems, such as Japanese indication on the governors’ display and lost password and back-up programs of the HMI (Human Machine Interface), were prevailing in the field. Those deficiencies do not impede anything as long as the generators are under automatic operation, but will reveal problems once the generation has been changed to manual operation under some unusual conditions. Although it can not be objectively identified whether it was due to the acceptance of imperfect equipment or improper procedural treatment during the internal transfer to the field, it has been obviously derived from such weakness in internal management as lack of careful acceptance based on the supply contract or predetermined procedural rules, miss-documentation after acceptance and so forth. An internal management system for careful inspection at acceptance should be strengthened in order to avoid such failures and secure transfer of perfect goods to the field of operation. [To PLN]

**Comparison of the Original and Actual Scope**

| Item | Original | Actual |
|---|---|---|
| 1. Project Output | Wonorejo Power Plant<br>(Installed Capacity: 6.3MW)<br>・Power Station 6.5MW<br>・Transmission & Substation Facility: Transmission Lines (20KV, 13km), Switchyard<br>Batutegi Power Plant<br>(Installed Capacity: 28MW)<br>・Power Station 28.9MW<br>・Transmission & Substation Facility: Transmission Lines (150KV, 30km), Switchyard, Transformer<br>Bili-Bili Power Station<br>(Installed Capacity: 17.2MW)<br>・Power Station 17.7MW<br>・Transmission & Substation Facility: Transmission Lines (20KV, 12km), Switchyard<br>・Consulting Services（IC：120MM, LC：239MM) | Wonorejo Power Plant<br>(Installed Capacity: 6.5 MW)<br>・Power Station 6.5MW<br>・Transmission & Substation Facility: Transmission Lines (20KV, 13km), Switchyard<br>Batutegi Power Plant<br>(Installed Capacity: 28MW)<br>・Power Station 29.8MW<br>・Transmission & Substation Facility: Transmission Lines (150KV, 30km), Switchyard, Transformer<br>Bili-Bili Power Station<br>(Installed Capacity: 20.1MW)<br>・Power Station 20.1MW<br>・Transmission & Substation Facility: Transmission Lines (20KV, 17km), Switchyard<br>・Consulting Services（IC：114.43MM, LC：202.51MM) |
| 2. Project Period<br><br>L/A Signing<br>Consultant Selection<br>Consulting Service<br>Procurement, Civil Works | December 1996~August 2003 (93 months)<br>November 1996<br>November1996~October 1997<br>November 1997~August 2003<br>November 1996~February 2003 | December 1996~March 2007 (124 months)<br>December 1996<br>November 1999<br>January 2000~December 2006<br>December 2000 (Bili-Bili) ~2006/12 |
| Project Cost<br>Foreign Currency<br>Local Currency<br>Total<br>Japanese ODA Portion<br>Exchange Rate | <br>4,875 million yen<br>3,513 million yen<br>8,388 million yen<br>6,291 million yen<br><br>US$1＝105.7 yen<br>Rp.1= 0.046 yen<br>(April 1996) | <br><br><br>4,922 million<br>4,044 million<br>US$1＝115.3 yen<br>Rp.1= 0.013 yen<br>(Actual rates 1997~2005) |