Republic of Indonesia

FY 2015 Ex-Post Evaluation of Japanese ODA Loan Project

"Tanjung Priok Gas Fired Power Plant Extension Project"

External Evaluator: Masumi Shimamura,
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0. Summary

This project constructed new gas-fired combined cycle generating facilities at the Tanjung Priok Gas Fired Power Station with the aim of increasing power supply and improving stability of power supply in the Java-Bali system. The project objective – to convert energy source from oil to gas and to cope with tight power supply-demand condition – is consistent with Indonesia's power policy and with the development needs, as well as Japan's ODA policy; thus, the relevance of the project is high. Although the project cost was within the plan, the project period exceeded the plan; thus, efficiency of the project is fair. Operation and Effect Indicators set at the time of appraisal have achieved around 90% of the target figures. It is worthy of special mention that the project is located in Jakarta Capital Region and supplying power to industrial area in the east and to Tanjung Priok Seaport in the north, and is playing an important role to reduce power loss and to maintain quality of power supply in the Java-Bali system. The power plant has largely generated its planned effects; thus, effectiveness and impact of the project are high. No negative impact on natural environment has been observed, and neither land acquisition nor relocation has taken place. As regards impacts of four ODA loan projects[1] including this project, it can be pointed out that past achievements of gas-fired combined cycle power plant projects utilizing ODA loans have facilitated introduction of Japan's high quality infrastructure technology in Indonesia as well as encouraged conversion of energy source from oil to gas in Indonesia. No major problem has been observed in the institutional, technical and financial aspects of the operation and maintenance system as well as in the current status; thus, sustainability of the project effects is high.

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

[1] Four projects are: "Tanjung Priok Gas Fired Power Plant Extension Project", "Muara Karang Gas Power Plant Project", "Muara Tawar Gas Fired Power Plant Extension Project" and "South Sumatra-West Java Gas Pipeline Project".

1. Project Description

Project Location

Tanjung Priok Gas Fired Power Plant (Block 3)

1.1. Background

Demand for power in Indonesia has increased sharply with the economic recovery following the currency crisis which occurred in 1997, and the easing of power supply-demand in the Java-Bali system, which accounted for about 80% of all annual power sales in Indonesia, was a particularly pressing issue. However, power source development using funding from the State Electricity Company, PT. PLN (Persero)[2] (hereinafter referred to as "PLN") and privately-funded power source development, was limited. Therefore, it was necessary to develop power sources using overseas public funds. Responding to the tight power supply-demand condition in the Java-Bali system, the project was expected to ensure stable power supply by newly constructing power generating facilities in the suburbs of Jakarta Capital Region.

1.2 Project Outline

The objective of this project is to increase power supply in the Java-Bali system by constructing new gas-fired combined cycle generating facilities (720MW class: 250MW class gas turbine generator×2units, 220MW class steam turbine generator×1unit) at the Tanjung Priok Gas Fired Power Station located in the suburbs of the Special Capital Region of Jakarta, thereby contributing to improve stability of power supply in the Java-Bali system.

Loan Approved Amount/ Disbursed Amount	58,679 million yen / 56,647 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March, 2004 / March, 2004

[2] PT. Perusahaan Listrik Negara (Persero)

Terms and Conditions	Interest Rate 1.3% Repayment Period 30 years (Grace Period) (10 years) Conditions for Procurement General Untied
Borrower / Executing Agency	Republic of Indonesia / State Electricity Company (PT. PLN)
Final Disbursement Date	March, 2014
Main Contractor (Over 1 billion yen)	Mitsubishi Corporation (Japan)
Main Consultant (Over 100 million yen)	Fichtner GMBH & Company KG. (Germany) / PT. Jaya CM Manggala Pratama (Indonesia) / PT. Kwarsa Hexagon (Indonesia) / PT. Connusa Energindo (Indonesia) / PT Hasfarm Dian Konsultan (Indonesia) / Tokyo Electric Power Company Holdings, Incorporated (Japan) / Tokyo Electric Power Services Co., Ltd. (Japan) (JV)
Feasibility Studies, etc.	F/S (2002)
Related Projects	Japanese ODA Loan (Loan Agreement signing year and month in parentheses) ・ South Sumatra-West Java Gas Pipeline Project (March, 2003) ・ Muara Karang Gas Power Plant Project (July, 2003) ・ Muara Tawar Gas Fired Power Plant Extension Project (July, 2003) Technical Cooperation ・ Study on the Effective Use of Captive Power in Java-Bali Region (2002) ・ Electric Power and Energy Policy Adviser dispatched to the Ministry of Energy and Mineral Resources Grant Aid (Exchange of Notes signing year and month in parentheses) ・ The Project for Rehabilitation of Gresik Steam Power Plant Units 3 and 4 (July, 2004) World Bank ・ Technical Cooperation (Supporting PLN's Corporate and Financial Restructuring) ・ Java-Bali Power Sector Restructuring and Strengthening Project Asian Development Bank ・ Power Transmission Line Improvement Sector Project ・ Renewable Energy Development Sector Project

2. Outline of the Evaluation Study

2.1 External Evaluator

Masumi Shimamura, Mitsubishi UFJ Research and Consulting Co., Ltd.

2.2 Duration of Evaluation Study

Duration of the Study: October, 2015 – December, 2016

Duration of the Field Study: February 18, 2016 – March 25, 2016, June 16, 2016 – June 29, 2016

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

3.1 Relevance (Rating: ③[4])

3.1.1 Relevance to the Development Plan of Indonesia

At the time of appraisal, PLN's Long Term Electricity Development Plan (hereinafter referred to as "RUPTL") 2003-2010, stipulated the necessity to construct additional generation facilities of about 8,500MW by 2010 in the face of power demand increase in the Java-Bali system – power demand was expected to increase on an average of 8.3% per year by 2010 and the forecasted maximum power demand in 2010 was 27,073MW. However, of which, financial sources to develop 4,000MW power generation facilities was undecided. In addition, in RUPTL, there was a plan to increase the ratio of gas fuel utilization, and to reduce the ratio of oil usage in the energy mix for power generation. The project objective to contribute to increase power supply in the Java-Bali system by constructing new gas-fired combined cycle generating facilities is consistent with the above policy.

At the time of ex-post evaluation, according to RUPTL 2015-2024, power demand is expected to increase on an average of 7.8% per year in the Java-Bali system – the forecasted maximum power demand would increase to 53,707MW in 2024 from 27,061MW in 2015 – and coping with the tight power supply-demand condition continues to be an urgent issue. In addition, the Additional 35GW Power Development Plan 2015-2024, which the Jokowi administration considers as priority, allows additional gas fuel – natural gas and LNG[5] – allocation to PLN. The project objective continues to be consistent with Indonesia's power policy at the time of ex-post evaluation.

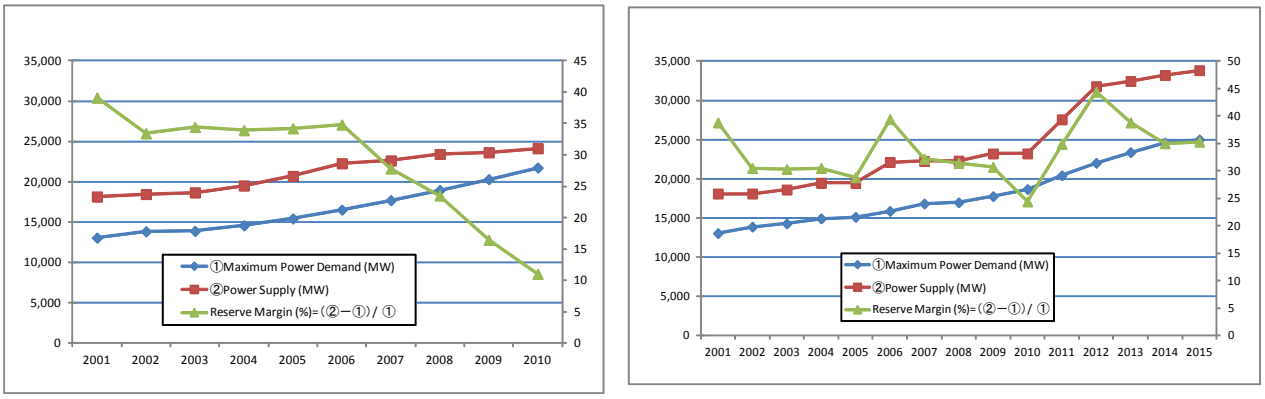
3.1.2 Relevance to the Development Needs of Indonesia

At the time of appraisal, coping with tight power supply-demand in the Java-Bali system

[3] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[4] ③:High, ②:Fair, ①:Low
[5] Liquefied Natural Gas.

and establishing stable power supply system were a pressing issue. PLN's financial situation worsened and development of power resources stagnated due to the effects from the Asian Financial Crisis in 1997. For such reasons, the plan to construct new power generation facilities was not enough to cope with growing demand in the future. Reserve margin was expected to decrease from 33% in 2002 to 11% in 2010 even if development of new power sources was taken into consideration[6]. Trend of power supply and demand balance, and reserve margin in the Java-Bali system is shown in Figure 1.

At the time of ex-post evaluation, facilitation of development of power sources in the Java-Bali system, which supplies power to Jakarta Capital Region, continues to be a pressing issue. According to RUPTL 2015-2024, the demand for power in Java-Bali system is expected to increase from 165.4TWh in 2015 to 324.4TWh in 2024, and the easing of power supply-demand is an urgent issue to tackle with.



Source: Results from questionnaire survey of executing agency

Figure 1: Trend of Power Supply-Demand Balance and Reserve Margin in the Java-Bali System
(Figure on the left is the estimation at the time of project planning and figure on the right is the actual)

3.1.3 Relevance to Japan's ODA Policy

The Medium-Term Strategy for Overseas Economic Cooperation Operations of JICA (April, 2002) indicated "economic infrastructure development" as priority area for assistance in Indonesia. In addition, JICA put up "improvement of enabling environment for private investment-led economic growth" as one of the priority issues in its Country Assistance Strategy for Indonesia (prepared in October, 2003). Furthermore, the ODA Country Data Book for Indonesia (2002) by the Japanese Ministry of Foreign Affairs

[6] At the time of appraisal, there was a plan to develop new power sources, totaling 5,035MW, including this project, "Muara Karang Gas Power Plant Project", "Muara Tawar Gas Fired Power Plant Extension Project" (these three projects were ODA loan projects) and other power generation projects from different funding sources. However, reserve margin was expected to go down to 11% in 2010 even if taking into account these new development plan. But the actual reserve margin in 2010 was 24.4% (not 11%) because the maximum power demand turned out to be less than the forecasted level.

pointed out economic recovery and stability of people's livelihood as issues to cope with since the Asian economic crisis. The project objective to provide support for power supply which serves the industrial base and stability of people's lives was consistent with the above policy.

This project has been highly relevant to the country's development plan and development needs, as well as Japan's ODA policy. Therefore its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The project newly developed a 2:1:2 structured combined cycle power generation, consisting of two gas turbine generators, one steam turbine generator and two heat recovery steam generators in the existing Tanjung Priok Gas Fired Power Station Block 3. Table 1 shows the comparison of planned and actual project outputs.

Table 1: Comparison of Planned and Actual Project Outputs

Plan	Actual
Civil Works, Procurement of Equipments etc.	
・ Construction of two gas turbine generators (250MW class×2units)	・ As planned
・ Construction of one steam turbine generator (220MW class×1unit)	・ As planned
・ Construction of two heat recovery steam generators	・ As planned
・ Associated equipments for the above construction and related works	・ As planned
・ Installation of two terminal towers for the 150kV double-circuit cables	・ As planned
・ Change of the connection of two transmission lines to the Plumpang substation	・ As planned
・ Extension line bus at the Plumpang substation	・ As planned
・ Installation of related equipments including additional circuit breakers at the Plumpang substation	・ As planned
・ Spare parts for two years after the commencement of operation	・ As planned < Additional scope > ・ Installation of shoring protection ・ Rehabilitation of existing oil dike ・ Construction of additional gas piping
Consulting Services	
・ Detailed design, assistance in tendering, construction supervision, inspection, testing and delivery control, assistance in O&M, assistance in environmental management, transfer of knowledge and technology, and human resource development etc.	・ As planned

Source: Results from questionnaire survey of executing agency

As regards civil works, (1) installation of shoring protection, (2) rehabilitation of existing oil dike, and (3) construction of additional gas piping were added to the scope. (1) Shoring protection was installed to protect the power plant from inundation against big waves from the Java Sea, and to secure smooth operation of the power plant. This measure was carried out as a result of flood damages due to big waves caused by the recent strong wind. (2) Rehabilitation of existing oil dike was conducted in order to prevent oil leak from the existing oil dike. The fuel of this power plant is dual-use – both gas and HSD[7] can be utilized. Therefore, in case of shortage of gas fuel, HSD can be utilized for power generation. (3) Construction of additional gas piping was an additional work from the gas supply point to the power plant, which had not been included in the original scope. (The scope was added based on the actual situation in order to transmit gas smoothly.) Total inputs have increased for consulting services as a result of the additional project scope. The additional output is deemed appropriate, commensurate with inputs, in light of ensuring smooth operation of the power plant.

As regards MM of consulting services, while the initial plan was 984MM, it turned out to be 1,080MM in actuality – about 10% increase. This was due to the extended period for detail design as a result of additional outputs, as well as the delay of gas supply. For the latter, although the situation can not necessarily be regarded as efficient, it was deemed necessary for consultants to be on board including prolonged project period, which resulted in increase of their inputs.

Facility where Gas Turbine is Installed

Heat Recovery Steam Generator

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total project cost was initially planned to be 69,252million yen (out of which

[7] High Speed Diesel.

58,679million yen was to be covered by Japanese ODA loan). In actuality, the total project cost was 68,999million yen (out of which 56,647million yen was covered by Japanese ODA loan), which is lower than planned (100%[8] of the planned amount).

3.2.2.2 Project Period

The overall project period was planned as 78months, from March, 2004 (conclusion of Loan Agreement) to September, 2010 (completion of warranty period) as opposed to 106months in actuality, from March, 2004 (conclusion of Loan Agreement) to January, 2013 (completion of warranty period), which is longer than planned (136% of the initial plan). Loan period was extended due to project delay.

Main reasons for project delay were: (1) delay of gas supply[9] and (2) delay in detailed design period due to additional project outputs.

3.2.3 Results of Calculations of Internal Rates of Return (Reference only)

Financial Internal Rate of Return

The financial internal rate of return (FIRR) calculated at the time of project appraisal was 22.6%, on the assumption that sales from power generated from the project to be considered as benefit, expenses for construction cost, operation and maintenance cost and fuel cost to be regarded as cost, and project life assumed to be 25years. The FIRR recalculated at the time of ex-post evaluation based on the same assumptions as the appraisal turned out to be 21.1%. The reason for the lower result in comparison with the figure at the time of appraisal can be attributed to the increase in gas fuel cost.

Although the project cost was within the plan, the project period exceeded the plan. Therefore, efficiency of the project is fair.

3.3 Effectiveness[10] (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

Table 2 summarizes the operation and effect indicators with targets set at the time of

[8] This percentage was calculated by comparing the actual cost after the scope change and the planned cost before the scope change.

[9] Background for the delay of gas supply, and measures taken by the executing agency: The executing agency initially planned to utilize natural gas to be transmitted through the gas pipeline connecting South Sumatra and West Java, in addition to the gas supply from the existing gas field in the off-shore of Java to secure necessary gas fuel. However, negotiation broke down without reaching an agreement between the executing agency and a private company over risk-taking of the gas pipeline which was under construction. For this reason, the executing agency had to revise the original gas procurement plan, and to secure gas fuel from a state-owned gas enterprise in Indonesia (PGN) as well as from the LNG Terminal (FSRU) in the end. A set of such processes required considerable time, resulting in delay of gas supply as well as the commencement of the power plant operation.

[10] Sub-rating for Effectiveness is to be put with consideration of Impact.

project appraisal and their actual figures between 2013 and 2015.

Table 2: Operation and Effect Indicators (Block 3 power plant)

	Baseline Note 1)	Target	Actual					
	2003	2011	2013		2014		2015	
	Baseline Year	1 Year After Completion	Completion Year Note 2)		1 Year After Completion		2 Years After Completion	
Maximum output	—	720MW Note 3)	757MW		721MW		718MW	
Plant load factor	—	70% or more	57.65%		65.57%		64.48%	
Availability factor	—	80% or more	88.95%		93.92%		95.95%	
Gross thermal efficiency	—	48% or more	47.94%		49.67%		48.86%	
Net Electric Energy Production	—	4,305GWh or more/year	2,986GWh		3,743 GWh		3,850 GWh	
			Target	Actual	Target	Actual	Target	Actual
Percentage of outage hours due to periodic maintenance and inspection Note 4)	—	—	2.84%	4.72%	6.85%	5.83%	3.56%	3.81%
Percentage of outage hours due to machine trouble Note 4)	—	—	0.88%	12.36%	1.54%	0.87%	0.86%	0.84%
Outage hours due to human error Note 4)	—	—	0hour	0hour	0hour	0hour	0hour	0hour

Source: Information provided by JICA, and results from questionnaire survey of executing agency

Note 1) Baseline figures did not exist at the time of appraisal because the project is a construction of new power plant.

Note 2) The figures in 2014 shall be compared with target figure, and the figures in 2013 (the year of project completion: i.e., at the year of completion of Warranty Period) were provided as reference.

Note 3) Maximum output and annual power production were subject to change, depending on the difference in actual specification from planned specification as a result of bidding.

Note 4) Percentages of outage hours due to periodic maintenance or due to machine trouble in total availability hours, respectively. Although these indicators had not been established at the time of appraisal, the target figures [11] set within the executing agency and their actual figures were provided as reference.

Since the commencement of power plant operation up to the time of ex-post evaluation, the operational condition is satisfactory, generating electricity smoothly. While actual figures for plant load factor and net electric energy production of the power plant have not reached their targets set at the time of appraisal, they have achieved either more than 90% of the target (plant load factor) or a little less than 90% of the target (net electric energy production) in 2014 and 2015. According to executing agency, this was not because of

[11] The target figures were established in the yearly signed Asset Management Contract between the executing agency and the Indonesia Power (a generation affiliate company of PLN. It undertakes operation and maintenance of the project after completion.). The Indonesia Power reports the actual figures (monitoring results) to the executing agency every year.

technical problem of the power plant but because power generation was controlled by dispatchers. In other words, in view of saving generation costs of the entire Java-Bali system, dispatchers controlled the operation of this power plant for which generation cost was relatively expensive in light of rising LNG cost[12]. Thus, executing agency indicated that such control by no means reduces the effectiveness of the project.

As regards percentage of outage hours due to periodic maintenance and inspection/machine trouble, which were provided as reference indicators, executing agency pointed out that the reason for the actual figures in 2013 exceeding the target was because of more maintenance works were carried out/initial trouble in the electric system and turbine system occurred during start-up period of the power plant operation. In this regard, the executing agency considers it should not be regarded as a problem. Target figures are mostly achieved in 2014 and 2015. No outage hour due to human error has occurred after the commencement of power plant operation.

3.3.2 Qualitative Effects

Table 3 summarizes the share of net capacity[13] of the power plant in the entire Java-Bali system and in Jakarta Capital Region, respectively.

Table 3: Share of Tanjung Priok Gas Power Plant (Block 3)

Net Capacity: (2015)	Net Capacity of the Power Plant (2015)	Share
Entire Java-Bali System: 31,694MW	720MW	2.27%
Jakarta Capital Region: 5,996MW		12.01%

Source: Information provided by JICA, and results from questionnaire survey of executing agency

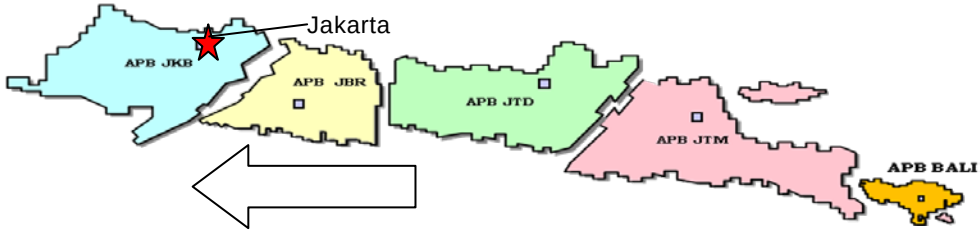
The electricity generated is supplied to the Jakarta Capital Region, and this power plant carries an extremely important role to supply power to industrial area in the east (Bekasi Area) and to Tanjung Priok Seaport in the north. The net capacity of the power plant has a share of more than 12% of the net capacity in Jakarta Capital Region, and this figure also shows that it has a critical role in securing power supply and demand balance in the country's capital. Furthermore, considering that the power plant is located in Jakarta Capital Region, the largest power demand center, it can be said that it plays an extremely

[12] The main fuel source of the power plant is LNG. The assumed fuel costs written in each RUPTL are listed below. While the cost of natural gas is within the range of U$6-7/MMBTU, LNG cost has been rising from U$10 to 16/MMBTU.
RUPTL 2010-2019 Natural gas: USD6/MMBTU, LNG: USD10/MMBTU
RUPTL 2012-2021 Natural gas: USD6/MMBTU, LNG: USD13/MMBTU
RUPTL 2013-2022 Natural gas: USD7/MMBTU, LNG: USD16/MMBTU
RUPTL 2015-2024 Natural gas: USD7/MMBTU, LNG: USD16/MMBTU

[13] Net capacity is equivalent to gross capacity or installed capacity minus amount of power consumed within a power plant.

important role to reduce power loss and to maintain quality (voltage) of power supply in the Java-Bali system [14].

Net capacity and load for each of the five service/load dispatch area of the executing agency in the Java-Bali system are shown in Figure 2. Because load (demand) exceeds net capacity in the West Java area (JKB [15]) where Jakarta Capital Region is located, it means that power supply to this area is covered by electricity produced in other areas. Such power interchange beyond business/load dispatch areas would cause voltage drop and power loss [16] of trunk power system, and would become a bottleneck for stable and efficient power supply. Hence, it is important to supply power within the same business/load dispatch area as much as possible so as to secure stability and appropriate power quality in the entire power system. In this regard, it is extremely significant that the power plant is located in Jakarta Capital Region.



	JKB	JBR	JTD	JTM	BALI
Net Capacity (MW)	9,282	7,673	5,216	8,561	962
Load (MW)	9,987	5,074	3,884	5,260	808

Source: Prepared by the evaluator based on the information provided by executing agency

Figure 2: Comparison of Net Capacity of Power Plant and Load by Area in the Java-Bali System (2015)

3.4 Impacts

3.4.1 Intended Impacts

Table 4 shows the trend (actual and projection) of energy sales, transmission and distribution losses and peak load in Jakarta Capital Region. Since the power plant commenced its operation in October, 2012, comparison was made before (before 2011) and after (after 2013) the start of power generation. Energy sales and peak load have been increasing steadily, while percentages of transmission and distribution losses have

[14] Among power plants constructed with a support of ODA loan in the same period, this project, "Muara Karang Gas Power Plant Project", and "Muara Tawar Gas Fired Power Plant Extension Project" are located in Jakarta Capital Region, and are playing an extremely important role for stable power supply in Capital Region/West Java Region.

[15] Jakarta and Bandung Load Dispatch Area

[16] The executing agency explained the following as its logic: "When the place for power generation is far from power consuming area (when power transmission distance is long) ➔ electric resistance increases ➔ power loss increases ➔ power voltage reduces."

decreased. Therefore, it can be considered that to a certain extent, additional power supply from this project has been contributing to push up energy sales and power supply at a peak load. Also, given the gradual increase of share of energy production of the power plant (Net Electric Energy Production, refer to Table 2) in Jakarta Capital Region, 10.4% in 2013, 12.3% in 2014 and 12.8% in 2015, it can be said that the project has been contributing to the increase of power production in Jakarta Capital Region.

Table 4: Trend of Energy Sales, Transmission and Distribution Losses and Peak Load in Jakarta Capital Region

	Actual						Projection		
	2010	2011	2012	2013	2014	2015	2016	2017	2018
Energy Sales (GWh)	23,788	25,012	26,959	27,733	28,378	27,992	29,029	33,108	35,374
Transmission and Distribution Losses (%)	8.04	7.55	6.74	6.76	6.64	6.24	6.15	6.05	5.96
Peak Load (MW)	3,383	3,970	4,070	4,208	4,345	4,356	4,643	5,287	5,641

Source: Prepared by the evaluator based on the information provided by executing agency

3.4.2 Other Impacts

3.4.2.1 Impacts on the Natural Environment

The project falls under A category of "Japan Bank for International Cooperation Guidelines for Confirmation of Environmental and Social Considerations" (established in October, 1999) because it is a development project of a large-scale power plant. At the time of appraisal, impact on natural environment in the project surrounding area was considered to be small, given that habitat of ecologically precious species did not exist, and anticipated results regarding project impacts on ambient air quality, water quality etc. were minimal. Environmental Impact Assessment Report (AMDAL), Environmental Management Plan (RKL), and Environmental Monitoring Plan (RPL) have been approved on October 15, 2002 by Regional Assessment Commission of Environmental Impact Analysis of DKI[17] Jakarta Province.

The executing agency conducted environmental monitoring (ambient air, noise, vibration etc.) during the project preparation and implementation as well as after the commencement of operation, and no particular negative environmental impact has been reported at the time of ex-post evaluation. In addition, no negative project effect has been identified from the results of interview with the local residents.

[17] Daerah Khusus Ibukota

3.4.2.2 Land Acquisition and Resettlement

At the time of appraisal, necessary land was already acquired and neither land acquisition nor relocation was expected. In actuality, relocation and land acquisition did not take place.

3.4.2.3 Impacts on Local Residents

Through interview survey with the executing agency and local residents, creation of employment after project completion and benefits to the local community, generated from CSR (Corporate Social Responsibility) activities by Tanjung Priok Power Plant, were confirmed. For example, as part of its CSR activities, Tanjung Priok Power Plant has been providing funding for "Health Village Program" activities, a participatory, proposal type program undertaken by the local community for initiatives such as segregation and disposal of garbage, health education in elementary schools and kindergartens, and health management and promotion activities. The activity incorporates a mechanism to facilitate competition among different villages and to provide funding to a village which serves as a model for others. As a result, it has contributed to provision of incentives to community activities, reinforcement of unity among residents and activation of interaction among residents. Also, Tanjung Priok Power Plant has been providing other CSR services such as improvement of school buildings and mosques, free healthcare services by visiting physicians in the community.

Interview with Local Residents

3.4.2.4 Impacts of Four ODA Loan Projects in Package

In addition to this project, three ODA loan projects implemented around the same time – "Muara Karang Gas Power Plant Project", "Muara Tawar Gas Fired Power Plant Extension Project" and "South Sumatra-West Java Gas Pipeline Project" – were taken up to analyze their integrated impacts. The analysis revealed that gas-fired combined cycle power plant projects utilizing ODA loans have set a precedent for introducing Japan's high quality infrastructure technology in Indonesia. Also, a gas pipeline project utilizing ODA loan has encouraged conversion of energy source from oil to gas, through facilitation of

domestically produced gas in Indonesia.

PLN is planning to construct 800MW class gas-fired combined cycle power plant, utilizing its own funds plus private funds[18] in Block 4, an adjacent area to this power plant in Block 3. A joint venture consisting of Japanese and local companies has been awarded from PLN to undertake the construction work etc. with full turnkey contract[19]. Following Muara Karang Gas Power Plant and this project, which have been constructed utilizing the ODA loans, Japanese gas turbine combined cycle technology, the world's highest technology, will be introduced in Block 4. It can be pointed out that past achievements of gas-fired combined cycle power plant projects utilizing ODA loans have facilitated Japan's high quality infrastructure technology in Indonesia[20].

Total gas supply in West Java – total amount of natural gas and LNG – is 601MMSCFD[21] as of 2015. Of which, about 43%, equivalent to 260MMSCFD, is transmitted from Sumatra Island through the gas pipeline developed by the ODA loan. Thus, the gas pipeline project is contributing to enhance utilization of unused gas from Sumatra Island as well as to increase gas supply in West Java. Furthermore, the analysis on the state of fuel utilization for the entire generating facilities of Muara Tawar, Muara Karang and Tanjung Priok Power Plants, including three power plant units constructed by the ODA loans (total of about 1,700MW), has shown following results – energy production utilizing gas has increased by about 1.5 times, from 13,763GWh (2009) to 20,893GWh (2015), whereas HSD has decreased from 5,886GWh (2009) to 169GWh (2015). This fact shows that conversion of energy source from oil to gas has been facilitated.

As of now, Muara Tawar Gas Fired Power Plant is the only power plant which utilizes gas fuel transmitted through ODA loan assisted South Sumatra-West Java Gas Pipeline. On the other hand, Pertagas, an affiliate company of Pertamina, is constructing an open access gas pipeline connecting Muara Tawar Power Plant and Muara Karang Power Plant (expected to be completed in August, 2016). When construction of this gas pipeline is completed, three power plants, Muara Tawar, Muara Karang and Tanjung Priok, will be connected physically[22]. This will enable three power plants to utilize natural gas transmitted from Sumatra Island through South Sumatra-West Java Gas Pipeline[23]. Through new power plant construction, further utilization of gas is expected in the future.

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[18] Proportion of PLN's own funds will be 30%.

[19] A type of contract agreement for which a single contract for engineering, procurement of equipments, construction and commissioning to be provided by the same party.

[20] Refer to the website of Ministry of Foreign Affairs of Japan. http://www.mofa.go.jp/files/000095681.pdf

[21] Million Standard Cubic Feet per day.

[22] Tanjung Priok Power Plant is already connected to Muara Karang Power Plant through an existing pipeline.

[23] Various adjustments, including gas pressure, are necessary for the pipeline to become available. According to PLN, negotiations between PLN and Pertagas are carried out regarding amount of gas supply, gas prices and so on.

From the above results, this project has largely achieved its objectives. Therefore effectiveness and impact of the project are high.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

The operation and maintenance of the power plant after project completion is undertaken by Indonesia Power (hereinafter referred to as "IP"). IP is an affiliate company of PLN, the executing agency, and is undertaking operation and maintenance of the existing Tanjung Priok gas fired power plants. The total number of employees at the Tanjung Priok Power Plant is 306, of which 160 are engineers in charge of operation and maintenance. 89engineers, more than half of total engineers, are undertaking operation and maintenance of this project – Block 3 power plant (as of February, 2016). According to power plant staffs, number of engineers necessary for operation and maintenance has been secured.

Also, Asset Management Contract based on performance has been concluded between PLN and IP and is renewed every year, and operation and maintenance budget has been allocated to IP from PLN based on the contract.

In addition, an operation contract has been concluded between IP and Tanjung Priok Power Plant and is renewed every year. Table 5 summarizes the authorities among PLN, IP and Tanjung Priok Power Plant. Since 2016, "Asset Manager" role of PLN has been transferred to IP. Responsibilities and decision making process within and among organizations are clear.

Therefore, no particular problem has been identified regarding the institutional structures of operation and maintenance of this power plant.

Table 5: Authorities among PLN, IP and Tanjung Priok Power Plant

Organization	Between 2013 and 2015	After 2016
PLN	Asset Owner, Asset Manager	Asset Owner
IP	Asset Operator	Asset Manager, Asset Operator
Tanjung Priok Power Plant	Implementer for actual operation and maintenance of the power plant	Implementer for actual operation and maintenance of the power plant

Source: Prepared by the evaluator based on the information provided by executing agency

3.5.2 Technical Aspects of Operation and Maintenance

Engineers who have gained sufficient experiences through operation and maintenance of the existing power plants are undertaking the operation and maintenance work of the power plant after completion of this project. In addition, during project implementation,

contractors and consultants have provided necessary training and actual equipment exercises for operation and maintenance of Block 3 power plant to 34 IP staffs[24]. Moreover, on the job training is provided to engineers in charge of operation and maintenance work. They are also required to attend training at the PLN Learning Canter[25] more than twice a year and to receive relevant training in accordance with their areas in charge and qualification levels. Therefore, it can be observed that adequate management system for human resource development has been established.

Also, manufacturer of generating facilities has prepared manuals for staffs and they have been utilized for daily operation and maintenance work as well as periodic inspections. Furthermore, IP has acquired ISO 90001 (quality management system), ISO 14001 (environmental management system), ISO 55000 (asset management system/risk management system), OHSAS 18001(occupational health and safety management system), and operation and maintenance of Tanjung Priok power plant has been taken place in conformity with these management systems.

Therefore, no particular problem has been identified regarding the technical aspects of operation and maintenance.

3.5.3 Financial Aspects of Operation and Maintenance

The operation and maintenance costs are estimated by Tanjung Priok power plant, and via IP, the estimation will be reviewed by PLN, which allocates budget to the Power Plant in conformity with the performance based Asset Management Contract concluded between PLN and IP. Table 6 shows comparison of actual budget allocation and actual expenditure of operation and maintenance cost of the power plant after project completion. The power plant's maintenance cost has been properly secured, and is well operated and maintained.

Therefore, no particular problem has been identified regarding the financial aspects of operation and maintenance.

Table 6: Operation and Maintenance Cost of the Power Plant (Block 3)

(Unit: million IDR: Indonesian Rupiah)

2013		2014		2015	
Actual Allocation	Actual Expenditure	Actual Allocation	Actual Expenditure	Actual Allocation	Actual Expenditure
206,316	19,371 Note 1)	275,735	256,732	121,619	120,161

Source: Results from questionnaire survey of executing agency

Note 1) According to executing agency, actual expenditure in 2013 was significantly below the actual

[24] Of which, 12staffs have participated in training and site inspection in Japan, and 22staffs have received on-site training. Until now, most of these engineers have been in charge of operation and maintenance work of the power plant constructed by the project.

[25] It is a training institute of PLN which is located in three areas within the country (Jakarta, Palembang and Surabaya).

allocation because payments to vendors were made in the subsequent year due to late issuance of relevant invoices.

3.5.4 Current Status of Operation and Maintenance

The power plant facilities have been maintained well and operated smoothly. Continuous discussion has been carried out with the manufacturer for smooth operation of the power plant. Maintenance activities have been conducted appropriately and no particular problem has been observed. With the aim of increasing efficiency of the entire operation, a maintenance plan called "52 Weekly Planning" for the power plant has been introduced. It sets down planned activities for preventive maintenance (target assets for maintenance, frequency, duration and schedule for maintenance work, list of consumable supplies, staff assignment etc.) and is updated every three months based on the actual situation.

As regards power plant inspections, (1) inspections concerning combustion facilities are conducted for every 8,000hours of operation, (2) inspections related with turbine are conducted for every 16,000hours of operation, and (3) major inspections are conducted for every 48,000hours of operation. According to executing agency, no problem has been observed and facilities have been well maintained as a result of inspections (1) and (2). Inspection (3) will take place for the first time in 2017.

As regards spare parts, the power plant has introduced a system called MAXIMO[26] for the management. Daily consumable supplies and specified spare parts are stored in the warehouse in the power station site. Other spare parts have been procured on a timely basis based on long-term service contract with the manufacturer. In addition, cooperation system with neighboring power plants has been established to accommodate spare parts.

Therefore, no particular problem has been identified regarding the current status of operation and maintenance.

From the above results, no major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance system. Therefore sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project constructed new gas-fired combined cycle generating facilities at the Tanjung Priok Gas Fired Power Station with the aim of increasing power supply and improving stability of power supply in the Java-Bali system. The project objective – to

[26] IP has introduced an integrated system (MAXIMO) in 1998 for comprehensive management of the entire organization including asset management, personnel management, management and procurement of maintenance system and spare parts, fuel management, safety management etc. This system has permeate across staffs in Tanjung Priok Power Plant.

convert energy source from oil to gas and to cope with tight power supply-demand condition – is consistent with Indonesia's power policy and with the development needs, as well as Japan's ODA policy; thus, the relevance of the project is high. Although the project cost was within the plan, the project period exceeded the plan; thus, efficiency of the project is fair. Operation and Effect Indicators set at the time of appraisal have achieved around 90% of the target figures. It is worthy of special mention that the project is located in Jakarta Capital Region and supplying power to industrial area in the east and to Tanjung Priok Seaport in the north, and is playing an important role to reduce power loss and to maintain quality of power supply in the Java-Bali system. The power plant has largely generated its planned effects; thus, effectiveness and impact of the project are high. No negative impact on natural environment has been observed, and neither land acquisition nor relocation has taken place. As regards impacts of four ODA loan projects including this project, it can be pointed out that past achievements of gas-fired combined cycle power plant projects utilizing ODA loans have facilitated introduction of Japan's high quality infrastructure technology in Indonesia as well as encouraged conversion of energy source from oil to gas in Indonesia. No major problem has been observed in the institutional, technical and financial aspects of the operation and maintenance system as well as in the current status; thus, sustainability of the project effects is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

<u>The importance of risk analysis and taking measures accordingly to ensure fuel supply for thermal power plants</u>

The delay of gas supply was one of the main reasons for the project delay. It is critical that the executing agency extensively conducts cross-sectoral and comprehensive risk analysis on fuel supply, urges the central government based on the analysis as required, and encourages the government to take appropriate actions including cross-ministerial coordination.

End

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs	1) Civil Works, Procurement of Equipments etc. ・ Construction of two gas turbine generators (250MW class×2units) ・ Construction of one steam turbine generator (220MW class×1unit) ・ Construction of two heat recovery steam generators ・ Associated equipments for the above construction and related works ・ Installation of two terminal towers for the 150kV double-circuit cables ・ Change of the connection of two transmission lines to the Plumpang substation ・ Extension line bus at the Plumpang substation ・ Installation of related equipments including additional circuit breakers at the Plumpang substation ・ Spare parts for two years after the commencement of operation 2) Consulting Services ・ Detailed design, assistance in tendering, construction supervision, inspection, testing and delivery control, assistance in O&M, assistance in environmental management, transfer of knowledge and technology, and human resource development etc.	1) Civil Works, Procurement of Equipments etc. ・ As Planned ・ As Planned ・ As Planned ・ As Planned ・ As Planned ・ As Planned ・ As Planned ・ As Planned ・ As Planned < Additional scope > ・ Installation of shoring protection ・ Rehabilitation of existing oil dike ・ Construction of additional gas piping 2) Consulting Services ・ As Planned
2. Project Period	March, 2004 – September, 2010 (78months)	March, 2004 – January, 2013 (106months)
3. Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total Japanese ODA Loan Portion Exchange Rate	 49,854million yen 19,398million yen (1,385,539million IDR) 69,252million yen 58,679million yen 1IDR=0.014yen (As of October, 2003)	 56,647million yen 12,352million yen (1,215,986million IDR) 68,999million yen 56,647million yen 1IDR=0.0102yen (Average between 2005 and 2014)