Socialist Republic of Vietnam

FY2018 Ex-Post Evaluation of Japanese ODA Loan Project

"O Mon Thermal Power Plant Construction Project (E/S)"

"O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) (II) (III) (IV)"

"O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)"

External Evaluator: Mitsue MISHIMA, OPMAC Corporation

0. Summary

The aim of the project was to strengthen the power supply system in the Mekong Delta area in the south of Vietnam, by constructing a new thermal power plant with the facility of 330 MW ×2 units which can be fired by both gas and oil, near the Mekong river in Can Tho City, together with transmission and substation facilities, thereby contributing to an improvement in the total power supply and in the livelihoods of the local people in the area. The relevancy of the project is high at the time of project appraisal and ex-post evaluation, as it is consistent with development policy and development needs, as well as with Japan's ODA policies. However, the power plant of the project still has an emergent position in the power system in Vietnam as project implementation has been considerably delayed, and the gas supply has not been realized. The efficiency of the project is low, as there were significant delays in the project implementation period and an increase in project cost caused by the sharp rise in equipment prices due to the implementation delay. Since there has been no gas supply, the operation rate of the units 1 and 2 of the power plant was very limited in comparison to operation and effect indicators in the plan at appraisal. However, the purpose of emergent operation has been achieved and the transmission and substation facilities have been operating in a good condition. Thus, the project has contributed to the stable supply of electricity in southern Vietnam. Accordingly, the effectiveness and impacts of the project are fair. There are no problems in the organizational, technical, financial aspects of the operation and maintenance needed to continue to operate the project power plant and transmission and substation facilities to meet the needs of the power system, and therefore, sustainability is high.

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

1. Project Description

Project Location

O Mon Power Plant

1.1 Background

In 2000, while 60.5% of population in the south area of Vietnam was concentrated in the Mekong Delta area, due to the shortage of power generation and transmission and substation facilities, electricity consumption in the area was 25% of that of the total southern area and the electrification rate was 52.8%, in contrast to the national average of 70.8% (documents provided by JICA). The area produces abundant agricultural products and therefore there is a high demand for electricity for agricultural equipment and for water treatment made necessary by annual floods. Industrial estates and export processing zones have also become to be concentrated in the area, and in 2010, the industrial production volume of the south surpassed 50% of that of Vietnam in total. Coupled with these vigorous economic activities, there has been a high demand for power. However, in the Mekong Delta area in the south of Vietnam, there were only the Can Tho Thermal Power Plant (183 MW), which was started operation in the 1970s, and the Camau Thermal Power Plant, constructed by Petro Vietnam (hereinafter "PVN"). The reserve margin of power supply (the difference of installed power plant capacity minus peak demand, divided by installed power plant capacity) was predicted to be a minus figure between 2012 to 2015 and there was a serious concern about power supply shortage. Accordingly, power generation plant construction was urgently required to meet the power demands of the future. In addition, in terms of transmission loss and the reliability of transmission facilities, it was not desirable that electricity generated in the center be transmitted to the south and a demand and supply balance within each region was considered to be ideal[1].

[1] The 7th National Master Plan for Power Development (2011-2020)

1.2 Project Outline

The aim of the project was to strengthen the power supply system, mainly in the Mekong Delta area in the south of Vietnam, by constructing a new thermal power plant with the facility of 330 MW ×2 units (main common facilities for the use of 660 MW) which can be fired by both gas and oil, near the Mekong river at a position 18km upstream from Can Tho City, the largest city in the area. The project also included the construction of transmission and substation facilities for the power supply in the surrounding area, thereby contributing to an improvement in the total power supply and in the livelihoods of the local people in the area.

The O Mon power plant is planned to be a thermal power plant complex comprising power plant areas I to IV. Plant units No.1 and 2 of this project is the O Mon I power plant.

Loan Approved Amount / Disbursed Amount	O Mon Thermal Power Plant Construction Project (E/S)	636 million yen / 268 million yen	
	O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) (II) (III) (IV)	(I) 5,900 million yen / 5,148 million yen (II) 15,594 million yen / 15,594 million yen (III) 21,689 million yen / 21,676 million yen (IV) 9,364 million yen / 8,273 million yen	
	O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)	(I) 27,547 million yen / 27,350 million yen (II) 6,221 million yen / 5,617 million yen	
Exchange of Notes Date / Loan Agreement Signing Date	O Mon Thermal Power Plant Construction Project (E/S)	March 27, 1998 / March 30, 1998	
	O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) (II) (III) (IV)	(I) March 30, 2001 / March 30, 2001 (II) March 28, 2002 / March 29, 2002 (III) March 31, 2003 / March 31, 2003 (IV) March 30, 2007 / March 30, 2007	
	O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)	(I) March 31, 2004 / March 31, 2004 (II) March 22, 2013 / March 22, 2013	
Terms and Conditions	O Mon Thermal Power Plant Construction Project (E/S)	Interest rate	0.75%
	O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) (II) (III) (IV)		(I) Consultant: 0.75% Main portion: 1.80% (II) Main portion: 1.80% (III) Main portion: 1.80% (IV) Consultant and Main portion: 1.3%
	O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)		(I) Consultant and Main portion: 1.3% (II) Consultant: 0.01% Main portion: 1.4%
	O Mon Thermal Power Plant Construction Project (E/S)	Repayment period (Grace Period)	40 years (10 years)
	O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) (II) (III) (IV)		(I) Consultant :40 years (10 years) Main Portion:30 years (10 years) (II) Main Portion:30 years (10 years) (III) Main Portion:30 years (10 years) (IV) Consultant and Main portion: 30 years (10 years)
	O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)		(I) Consultant and Main portion: 30 years (10 years) (II) Consultant and Main portion: 30 years (10 years)
	All projects	Procurement Conditions	General Untied

Borrower / Executing Agency	All projects	Government of Social Republic of Vietnam / Vietnam Electricity:(EVN)
Project Completion	O Mon Thermal Power Plant Construction Project (E/S)	December 1999(Date of the Report)
	O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) (II) (III) (IV)	Unit 1: July 2009 Transmission and substations: July 2016
	O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)	October 2015
Main Contractor(s) (Over 1 billion yen)	O Mon Thermal Power Plant Construction Project (E/S)	—
	O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) (II) (III) (IV)	TBEA HENGYANG Transformer Co. LTD (People's Republic of China), Mitsubishi Heavy Industries (Japan) / Mitsubishi Corporation (Japan), TAY NAM BO Petroleum and Oil Company (Vietnam)
	O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)	Sojitz Corporation (Japan) / DAELIM Industrial Co. Ltd. (South Korea)
Main Consultant(s) (Over 100 million yen)	All projects	Tokyo Electric Power Services Co. Ltd. (TEPSCO)
Related Studies (Feasibility Studies, etc.)	—	Feasibility Study (F/S) by PIDC 2 (Power Investigation and Design Company No. 2) (January1997)
Related Projects	—	"O Mon IV Combined Cycle Project" was examined by ADB and KfW, however, it was not financed by them.

2. Outline of the Evaluation Study

2.1 External Evaluator

Mitsue, MISHIMA, OPMAC Corporation

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: November 2018 - December 2019

Duration of the Field Study: May 8 - 22 and July 14 - 20, 2019

2.3 Constraints during the Evaluation Study

As it was difficult to make a technical evaluation, the engineering service of O Mon Thermal Power Plant Construction was used as reference. The main target evaluation projects were the "O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) (II) (III) (IV)" and the "O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)".

Evaluation analysis was conducted within the scope based on existing documents and hearings from consultants in charge of the project together with those members of the executing agency's personnel who could be contacted.

3. Results of the Evaluation (Overall Rating: C[2])

3.1 Relevance (Rating: ③[3])

3.1.1 Consistency with the Development Plan of Vietnam

From the time of appraisal of the project to the present, the project facilities were consistent with the power development policies of Vietnam.

At the time of project appraisal, according to *The 5th National Master Plan for Power Development (2001 – 2010)* which was prepared in June 2001, new power plant construction (including this project) was planned, balancing thermal power generation as the base load with hydropower generation as the middle and peak load, and setting a target total installed capacity of 18,110 MW by 2010, which was 2.4 times that of the time. Thereafter, the revised *The 5th National Master Plan for Power Development (2001 – 2010)* in March 2003, described the plan for an increase in the total installed capacity to 22,089 MW by 2010, which was 2.6 times that of 2003. *The 6th National Master Plan for Power Development* (drafted in 2006) which had the support of JICA technical cooperation stated that hydropower project development would be completed between 2010 to 2015, with power demand thereafter being met by the development of thermal power plants, mainly coal fired ones. As a result, it was planned that by around 2020, thermal power generation would be the main source of power, occupying approximately 70%, while hydropower generation would be secondary to this.

In *The 7th National Master Plan for Power Development (2011 – 2020),* it was planned that the power generation capacity would be approximately 75,000 MW by 2020, increasing the approximate 50,000 MW of that time. At the time of appraisal for the project power plant unit No2, the plan revised in accordance with actual project progress showed that power demand in the south would be 26,822 MW (2020) from 9,518 MW (2011) and therefore the total installed capacity in the area was planned to be 30,652 MW. Later, in the *Revised 7th National Master Plan for Power Development (2011 – 2020)* announced on March 18, 2016 (Prime Minister's Decision 428/QD-TTg), the target figures were revised to a total installed capacity of 60,000 MW and power generation of 265 TWh per year in 2020. The same figures for 2030 were planned to be approximately 2.2 times those for 2020, with a total installed power generation capacity of 129,500 MW and 572 TWh per year. Regarding plans for the ratio of generation capacity by source in 2030, power generation by renewable energy such as wind, solar, etc., was planned to be 21%, with hydropower generation at 16.9%, and thermal power generation at 57.3% (of which, gas-fired generation 14.7%).

[2] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[3] ③: High, ②: Fair, ①: Low

3.1.2 Consistency with the Development Needs of Vietnam

Since the time of project appraisal, power demand has been increased rapidly in the Mekong Delta area of southern Vietnam along with economic development, and therefore the need for an improvement in the power supply has remained high.

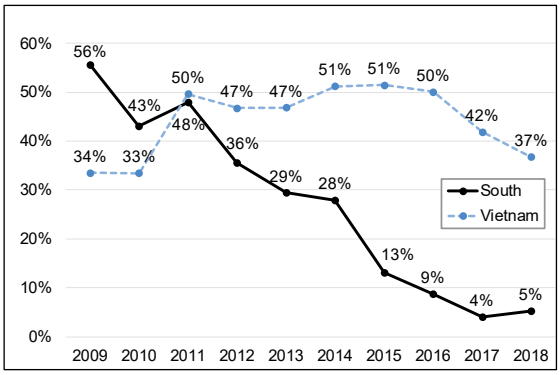
Many industrial estates and export processing zones are concentrated in the southern area of Vietnam, and thus the demand for electricity has been expected to be higher, coupled with vital economic activities. From 2001 to 2010, peak demand in the Mekong Delta area was forecasted to be increasing by 12.4% per year on average. Nonetheless, the only power generation plant in the area was the Can Tho thermal power plant (183 MW) which commenced operations in the 1970s. On the premise that the Camau thermal power plant, then under construction, would start to operate in 2007, the shortage of power was anticipated to be approximately 450 MW in 2008. In the south of Vietnam, the reserve margin of the power supply between 2012 and 2015 was predicted to be negative and there were concerns about a serious power shortage. Thus, construction of a power plant to meet the increase of the future power demand in the Mekong Delta area was an urgent issue.

On the other hand, in order to respond to the rapid increase in power demand, while improving power supply capacity, it was also critical to diversify energy sources and to make efforts to optimize the ratio of energy sources. The power plant planned by this project could shift its energy source to either gas or heavy oil depending on the situation, and it was planned that the gas would be procured in the new gas field offshore southwest of the Mekong Delta area, which was to be developed at that time. Thus, implementing this project would promote the energy development effect, that is, new gas field development and gas pipeline development by the private sector through assuring a minimum gas sales volume.

At the time of the ex-post evaluation, after commencement of the operation of units 1 and 2, it was discovered that peak demand in the south had reached at 8,051 MW in 2009 and continued to increase thereafter, finally achieving 18,474 MW, an increase of more than two times in 10 years. Meanwhile, the reserve margin ratio of power supply in Figure 1, at 37% in Vietnam as a whole, was 5% in the south in 2018, having constantly decreased since 2011. Still at the time of the ex-post evaluation, the needs for power development in the south was high.

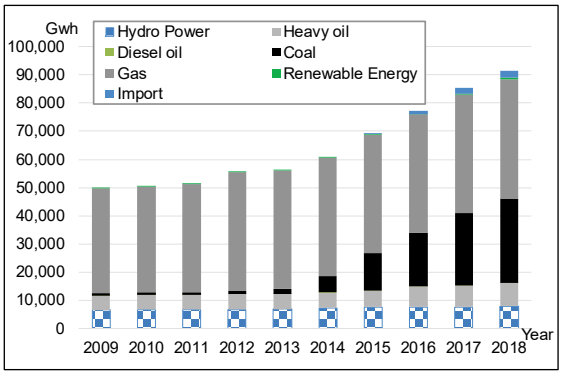
The original plan behind the project was that in 2 years the operation rate of both unit 1 and 2 would be a contribution of 89% of the base load. This was, however, based on the assumption that power plants other than the power plants owned by EVN would have been constructed by independent power producers (IPP), that is, that other thermal power plants such as coal-fired ones would be developed while there was a significant delay in starting the project in comparison with the plan. The percentage of the installed capacity of IPP power plants was 32% in 2009, increasing by 10 points to 42% in 2018, during 10 years since commencement of O Mon power plant operation in 2009. According to EVN, considering the characteristics of power

generation sources, cost, etc., the current general order of the operation of each power plant in the power system is: 1. Hydropower (base load), 2. Coal-fired thermal power (base load), 3. Gas-fired thermal power (base / middle load), 4. Oil-fired thermal power (Peak load). Reviewing the power supply volume by source since 2014 (Figure 2), it can be seen that the generation volume of coal-fired thermal power plants which were prioritized to operate next to hydropower has increased rapidly in the South of Vietnam. At present the power plant of this project is not supplied by gas and only uses oil, which costs more than gas or other fuels. Under this situation, the O Mon power plant is positioned as stand by operation to be used upon emergency.



Source: Answers in a questionnaire with GENCO 2 (as of July 2019)

Figure 1: Reserve Margin of Power Supply



Source: Answers in a questionnaire with GENCO 2 (as of July 2019)

Figure2: Power Generation by Source in the South of Vietnam

3.1.3 Consistency with Japan's ODA Policy

The Project was highly consistent with Japan's ODA policy in the following points.

At the time of the first appraisal, the *Country Assistance Policy for Vietnam* of June 2001 stated the intention to develop infrastructure, with the power and transportation sector as one of the five prioritized areas. Cooperation with the power sector to respond to future increases in power demand was also mentioned. In revisions to the *Country Assistance Policy for Vietnam* in April 2004, prioritized areas were "promotion of the growth", "improvement of living and social aspects" and "institutional development". Support for the power sector was discussed under economic infrastructure development for "promotion of the growth". The *Country Assistance Policy for Vietnam* of July 2009, discussed the stable supply of resources and energy under "promotion of economic growth and enhancement of international competitiveness (Ministry of Foreign Affairs. *Country-wise ODA Data Book, Fiscal Year 2002 – 2009, and 2013*)".

From the time of appraisal of the Unit 1 project and Transmission Project (I) to the Unit 2 project (II), support for the development of the economic infrastructure such as the power sector

to promote sustainable growth was one of the priorities of the ODA policy of the Japan Bank for International Cooperation and JICA. For assistance to the power sector, support for the following cases was discussed: 1) in cases where it is difficult by the IPP to respond under a tight power supply and demand situation, 2) in cases where an ODA loan project supports energy development (such as in gas fields) or adjacent power station construction, 3) for hydropower which requires a large initial investment and where finance by the private sector is difficult, 4) where effectiveness of the support is high such as in the improvement of existing facilities (electricity generation, saving, etc.) In terms of 1), in 2000, power development projects by IPP did not progress. As for 2), as the O Mon Power station was planned to be a thermal power plant complex, comprising I to IV, the first plant was to be constructed using public finance with the adjacent power plants to be constructed by private capital. In this context, the project was highly relevant to Japanese ODA policy.

3.1.4 Project Design and Approach

The relevancy of project design and approach was analyzed in the situation where the gas supply to the power station had not been realized and therefore neither oil nor gas fired operation was implemented.

Power generation by gas under the project had the premise of gas field development and pipeline construction. At the time of project appraisal, from lessons learned from other gas-fired power generation projects, it was recognized at that, ,as the gas supply project was implemented as a separate project, there was a risk that the timing of the gas supply would not match the completion of the construction of the power plant. During the period without a gas supply, heavy oil-fired power generation was the alternative. At the time of appraisal, since a gas supply from PVN was expected, an alternative gas supply from sources other than PVN was not examined.

Although gas field and pipeline development was significantly delayed in the planned schedule, in 2011, prior to the project appraisal for the O Mon Unit 2 Power Plant Project (II), gas field development had progressed in such a way that Front End Engineering Design (FEED) was prepared. Thus, gas burner facilities were added to the project scope for the Unit 2 power plant, for which the Loan Agreement (L/A) was signed in March 2013. Later, however, it was found that the gas sales price had not been agreed between PVN and a foreign company which was a main member of the consortium for gas field development. After long discussion, the foreign company resigned from the consortium in September 2013. Because of this, there was a further delay while development consortium members were coordinated and, as a conclusion, the gas supply had not yet been realized at the time of the ex-post evaluation. At the time of ex-post evaluation, the consortium of private developers and PVN had tried to make progress towards agreement with the guarantee of the Vietnamese government and it was planned that a gas supply agreement would be made within the 2019 Final Investment Decision (FID). The

selection of construction companies and project construction was to be implemented after the FID. It is scheduled that commencement of first gas supply will become possible right after September 2023. As for the gas supply itself, Power Generation Corporation 2 (GENCO 2) in charge of the operation and maintenance of the O Mon Power Station was negotiating a contract with PVN for gas supply for 12 years from the time of first gas availability, while the O Mon I Power Station was undertaking the process for approval of facility upgrade (placement of gas burners) for the commencement of the gas supply.

Under this situation, the plan for gas field development and pipeline construction was not canceled, even though there was a large delay, although it cannot be denied that it was difficult to examine an alternative gas supply and its implementation. At the time of the ex-post evaluation, gas field development and pipeline construction continued to progress, and it was finally decided that the large delay in the gas supply could not be a decisive reason to reduce the evaluation rating for the relevancy of project approach.

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

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

The L/A of the engineering service (E/S) of this project was signed in March 1998. As for the purpose of E/S, the survey was mainly conducted on points which supplement the F/S implemented by Vietnam and the detailed design report was completed in December 1999. The outputs of the project facilities are a 660 MW (330 MW x 2 Units) power plant, both heavy oil and gas fired, and transmission line and substation construction in the surrounding area. The installed capacity of the power plant was increased by 10% from 600 MW (300 MW x 2 Units); however, as the detailed design responding to the need for this was made within the scope and did not impact significantly the cost, the actual scope can be said to be almost as in the plan. The Unit 2 project had a shortage in ODA loan amount and additional finance in the second phase of the project was judged to be necessary for continuing construction work. When additional funding was discussed, the gas supply plan for the O Mon power plant was envisaged, and therefore the total ODA loan amount was reviewed with the additional cost for the gas burner facility. The output of the transmission line and substations was changed to become a completely different scope from the plan. The output plan and the actual are shown in Tables 1 and 2.

Table 1: "O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I)-(IV)" Output Plans and Actual

Items	Plan (at the time of appraisal)	Actual
Power Plant Construction (Unit 1)	Installed capacity 300 MW×1 Unit + Common facilities for 600 MW →At the time of phase IV, this was shifted to 330 MW×1 Unit + Common facilities for 660 MW <Main equipment facilities> • Boiler, Turbine, Power Generation Plant • Auxiliary equipment for the above (Electrostatic Precipitators (ESP), Ash processing equipment, Flue gas desulfurization (FGD), Electrical instrumentation equipment, and others) • 220kV & 110kV Switchyard equipment	Almost as planned (Installed capacity was 300 MW at the time of appraisal, then it became 330 MW during procurement; however, this was evaluated as almost as planned)
Transmission	• 220kV: Approx. 138km →EVN implemented this using their own funds, thus, at the time of Phase III loan, it had become 38 km from 138km, then at the time of Phase IV, it became 0.3km (Vinh Long S/S to O Mon P/S and Cai Lay S/S) • 110kV: Approx.384km →At Phase IV, 4 routes were changed and 1 route was added.	This changed significantly as follows: procurement of power facilities and equipment for new substations and transmission: • 500kV My Tho Substation • 500kV Duyen Hai Substation • 220kV Duc Hoa Substation • 220kV Duyen Hai – Tra Vinh Transmission Line • Spare Transformers (500kV – 300MVA 9 set and 220kV – 250MVA 7 sets)
Substations	• 220kV: New 4, Upgrade and Improvement 1, total 5 →At the time of phase IV, substations were to be implemented using EVN's own fund. Then 3 substations were constructed using EVN's own fund, giving a total of 2 substations. • 110kV: New 15 →At the time of Phase IV, 2 were constructed using EVN's own funds, bringing the total to 13. • Communication System	
Consulting Service	• Assistance to EVN for the bidding and contract • Supervision on construction • Countermeasures for the environment • Preparation of the Report • Technical transfer and training • During construction, advice for environmental monitoring and when defects were found, comment on countermeasures. • During operation, necessary technical transfer for EVN to continue environmental monitoring	As planned

Source: JICA Documents and answer to the questionnaire with EVN

Photo 1: O Mon Power Station Fuel Tanks

Photo 2: 220kV Duyen Hai – Tra Vinh Transmission

Photo 3: 500kV Duyen Hai Substation

Table 2: "O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)"

Output Plan and Actual

Items	Plan (at the time of appraisal)	Actual
Power Plant Construction (Unit 2)	Installed Capacity 300 MW×1 Unit →At the time of Phase II, this was changed to 330 MW×1 Unit <Main equipment facilities> • Boiler, Turbine, Power Generation Plant • Auxiliary equipment for the above (Electrostatic Precipitators (ESP) and the surrounding equipment, Ash processing equipment, Flue gas desulfurization (FGD), heavy oil tanks, transformers, Measurement control system, electric facilities, construction of power plant house, and others) →At the time of Phase II, in addition to the above, a gas burner facility was added. Other supplement equipment (spare parts, consumable goods, tools, etc.), and some of the spare parts were financed by the Vietnamese side using their own funds.	Almost as planned, to the point that installed capacity of 300 MW became 330 MW. Gas burner was added.
Consulting Service	(1) Support for Bidding and Contract, Supervision of main construction • Support for Bidding and Contract • Supervision of main construction • Consideration for Environment (support for environment monitoring during construction and advice on countermeasures when any incidents occurred and others) • Technical transfer and training for operation and maintenance of power plants (2) Support for knowledge related to establishment of O Mon One-Member Company • Organization planning • Recommendations for EVN on transfer of authority to O Mon One Member Company • Recommendations for EVN on financial system and operation and maintenance of O Mon One-Member Company →At the time of Phase II, this support was excluded from TOR because the executing agency were to carry it out by themselves.	Almost as planned. (Upon implementing the Unit 2 project, technical transfer and training for power plant operation and maintenance and support for knowledge for the establishment of the O Mon One Member Company were not implemented.)

Source: JICA Documents and answer to the questionnaire with EVN

With regards to the transmission and substation facilities, the initial output plan was totally changed. The reason for this change was that steel prices increased rapidly during the delay of approximately 3 years 8 months in comparison to those prices of the original plan, which was made at the phase of bidding process for equipment, transportation and construction. The price proposed by the successful bidder did not match the planned one and the contract was not finally agreed. Because of this delay, it was necessary to implement early the scope initially planned without waiting for a re-bidding process. Therefore, EVN implemented this scope themselves, using their own funds.

As for implementation of the new target to be financed within in the scope of the transmission and substation network, in accordance with other progress within the project, only the scope which had a high level of necessity at the that time was financed by the ODA loan. This was

relevant in light of the project purpose to strengthen the power supply system in the south of Vietnam, mainly in the Mekong Delta area. Since the initial scope was implemented using Vietnamese finance, the facilities have been operated without any problems and the purpose has been achieved.

In terms of consulting services, there were no important changes from the time of project appraisal for both the Unit 1 and Unit 2 projects, with one exception, and the consulting services were implemented almost as planned. The changes in the content of the services were judged to be adequate for the following reasons:

- Training in Japan, which was planned for the Unit 2 project, was not conducted technical transfer had already been implemented for the Unit 1 project.
- The knowledge support initially planned for establishing the O Mon One-Member Company was unnecessary as the schedule was moved forward by a year, and at that time, the consultant was still present under the procurement process. In the end, in June 2012, GENCO 2 was established as company 100% owned by EVN, and Can Tho Thermal Power Company Limited (Can Tho OMC) became a subsidiary company "Can Tho Thermal Power Company: (CTTP) "in charge of the O&M of the O Mon Power Plant.

3.2.2 Project Inputs

3.2.2.1 Project Cost

For the ex-post evaluation of this project, the power plants portion and the transmission and substation portion were examined using a comparative analysis of plan and actual.

Table 3 and Table 4 below showed the project plan and actual. The total cost of "O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) - (IV)" was planned to be 63,965 million yen (of which, the ODA loan covered 61,788 million yen) and was actually 61,735 million yen (with the ODA Loan remaining at 50,692 million yen). This was within the planned cost (96% of the plan). The total cost of "O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)" was planned to be 33,640 million yen (of which the ODA loan covered 27, 547 million yen) but was actually 43,795 million yen (of which, the ODA loan covered 33,050 million yen) (127% of the plan) . In a comparison of the total project cost, the actual cost was 105,470 million yen whereas the plan was 97,605 million yen, 108% of the plan. Therefore the sub rating of the project cost was evaluated to be ②.

As for "O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) - (IV)", while the cost of the power plant cost increased considerably from the plan, the cost of the transmission and substation was significantly reduced. The reasons for the increase were that there were increases in equipment price and fuel costs for the test run of the power plant which had not been included in the planned cost. The significant reduction for the transmission and substation portion can be explained by the revision of project scope due to the delay of the

original scope caused by the unsuccessful contractor selection. Due to the urgency of this original scope, EVN had to implement it by their own fund and replace it by other subprojects, which have smaller total project cost. Another factor, already mentioned, was that price of heavy oil increased rapidly making it difficult for EVN to finance the purchase of heavy oil for the trial run of O Mon power plant Unit No.1. A part of the cost planned for transmission and substation construction (2,720 million yen, about 17% of the total transmission and substation cost) was reallocated to fuel cost.

As (II) of "O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)" was an additional loan, comparison of the plan and actual cost was conducted with the cost at the time of (I). Therefore, the increase in the actual cost was due to mainly to the rapid increase of equipment costs during the significant delay in the bidding for the power plant, other than addition of gas burner facility.

Table 3: "O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) - (IV)" Project Cost (Plan / Actual)

Unit: million yen

Items	Plan (2000)		Actual (2009)	
	Total	ODA Loan portion	Total	ODA Loan Portion
Power Plant	35,556	35,556	44,293	44,292
Transmission and Substation	15,511	15,511	10,414	4,594
Price Escalation	1,151	1,145	—	—
Physical Contingency	2,715	2,612	—	—
Consulting Service	1,664	1,664	1,320	1,320
Land Acquisition	963	—	2,947	—
Administration Fee	200	—	95	—
Tax	905	—	2,181	—
Interest during construction	5,300	5,300	434	434
Service charge	—	—	51	52
Total	**63,965**	**61,788**	**61,735**	**50,692**

Source: JICA, GENCO 2, SPMB Documents

Note: Exchange rate at the time of project appraisal: US$1 = VND.14,100 (VND = Vietnamese Dong), US$ = JPY108, VND1 = JPY0.00766 (Base time of cost calculation: October 2000),

Exchange rate for actual cost 1) Power Plant: VND1 = JPY0.00600, (weighted average of International Financial Statistics (IFS) by IMF, annual average rate during disbursement period 2001 to 2018), 2) Transmission and substation portion: VND1 = JPY0.00499 (weighted average of IFS by IMF during disbursement period 2007 to 2017)

Land acquisition cost includes tax and administration cost for transmission line and substations.

Table 4: "O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)"

Project Cost (Plan / Actual)

Unit: million yen

Items	Plan (2004)		Actual (2019)	
	Total	ODA Loan portion	Total	ODA Loan Portion
Power Plant	23,325	23,325	31,194	31,194
Price Escalation	1,217	1,217	—	—
Physical Contingency	1,486	1,227	—	—
Fuel oil for commissioning	—	—	6,033	—
Consulting Service	998	998	653	653
Administration Fee	1,288	0	184	0
Tax	3,892	0	4,528	0
Interest during construction	1,434	780	1,159	1,159
Commitment charge	—	—	17	17
Service charge	—	—	27	27
Total	**33,640**	**27,547**	**43,795**	**33,050**

Source: JICA, GENCO 2 Documents

Note: Exchange rate at the time of project appraisal: US$1 = VND 15,500 (VND = Vietnamese Dong), US$1 = JPY119, VND1 = JPY0.00768 (Base time of cost calculation: October 2003),

Exchange rate for actual cost VND1 = JPY0.005343, (weighted average of International Financial Statistics (IFS) by IMF, annual average rate during disbursement period 2008 to 2018), (I) required service charge and (II) required commitment charge.

3.2.2.2 Project Period

The planned project period for "O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) - (IV)" was 61 months, from March 2001 (L/A signed) to April 2006 (commencement of commercial operation). The actual project period was 185 months, from March 2001 to July 2016, greatly exceeding the plan (303% of the plan). "O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)" was planned to take 65 months, from March 2004 (L/A signed) to July 2009 (commencement of commercial operation). The actual implementation required 140 months, from March 2004 to October 2015, significantly beyond the plan (215% of the plan). The total project period was planned to be from March 2001 (O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) L/A signed) to July 2009 (commencement of commercial operation of Unit 2, planned at phase I) (8 years 4 months: 100 months). Against the plan, the actual period was March 2001 to October 2015 (commencement of commercial operation of Unit 2) (14 years 8 months: 176 months, 176% of the plan). Accordingly, the rating for project period was evaluated as ①.

Reviewing the documents provided by, and hearings with, the executing agency, JICA, and personnel related to the project, it was judged that the causes for the delay were as follows:

(1) Power Plant Unit 1

The main reason for the long delay for Unit 1 was, as shown in Table 5 , delay in the bidding for equipment transportation and construction work. Due to the delay in the bidding, while the planned bidding period was 14 months, the actual period was 45 months, 31 months longer

than the plan. Completion of the bidding was delayed by 40 months. As a reason for the delay in bidding evaluation, there was a claim from the bidder about the bidding result and the price re-bidding was implemented because of the high rise in equipment price. However, this was a very exceptional case.

Table 5: Project Period Plan and Actual (Power Plant Unit 1)

	Plan	Actual	Delay incompletion date (Difference implementation period)
L/A signing (Phase I)	March 2001	March 2001	-
Selection of Consultant and Contract	January 2001 - July 2001 (7 months)	March 2001 - November 2002 (21 months)	+17 months (+14 months)
Consulting Service	August 2001 - March 2006 (56 months)	November 2002 - July 2009 (81 months)	+41 months (+25 months)
Detailed survey and bidding preparation (including implementation of P/Q*)	November 2000 - July 2001 (9 months)	September 2001 - April 2002 (8 months)	+10 months (-1 Month)
Bidding for Equipment transportation and construction work	August 2001 - September 2002 (14 months)	April 2002 - December 2005 (45 months)	+40 months (+31 months)
Equipment transportation and construction work	September 2002 - September 2005 (37 months)	February 2006 - July 2009 (42 months)	+47 months (+5 months)
Project Completion	October 2005	July 2009	+46 months

Source: JICA document and EVN documents and answer to questionnaires
Note: Definition of the project completion is the commencement of the commercial operation of all project facilities.
* P/Q = Pre-qualification

(2) Transmission and Substations

As for the initial planned scope, as shown in Table 6, there was already remarkable delays in the stages of bidding preparation to evaluation, The reason for the delay in the preparation of bidding documents was that EVN took time for decisions on the scope of the transmission and substation. Although completion was planned for October 2001, it did not come until January 2004. At this phase, there was a 29 months delay, with a long delay even after the bidding was implemented, and the bidding evaluation result was revealed. Because of the rises in the price of steel during the bidding period, the awarded price greatly surpassed the one scheduled by EVN and it took more time to negotiate with the successful company. Had bidding preparation, implementation, and evaluation been conducted more quickly, there would have been the possibility that the impact of the rise in steel prices would have been avoided to some extent.

As a result of all this, EVN did not reach agreement with the successful bidder. The initial transmission and substation scope was cancelled and EVN themselves implement the work using their own funds. As the package for this portion was arranged again based on the necessity at the time, the scope for this component was totally different scope to the initial

scope and consequently, a comparison of plan and actual is impossible. However, while the construction period of the 220kV substation was 49 months, from preparation bidding (November 2000) to construction completion (November 2004), the same period for the 220kV Duc Hoa substation was 51 months (November 2010 to January 2015). As there is not so great a difference, it can be said that the schedule of construction appears to have been implemented relatively smoothly.

Table 6: Project Period Plan and Actual (Mekong Delta Transmission and Substations)

	Plan	Actual	Delay in completion date (Difference in implementation period)
L/A signing (Phase I)	March 2001	March 2001	—
Detailed survey and bidding preparation (including implementation of P/Q*)	October 2000 - July 2001 (10 months)	October 2000 - January 2004 (40 months)	+31 months (+30 months)
Bidding for Equipment transportation and construction work (Initial scope)	August 2001 - June 2002 (11 months)	March 2004 - February 2006 (24 months)	+45 months (+13 months)
Cancellation of All procurement package (2-5)	—	July 2006 (Package 2 - 4) November 2006 (Package 5)	—
Change in scope and procurement package	—	August 2006 - November 2006	—
Bid preparation after the change of scope	—	August 2010 - December 2011	—
Bidding after change of scope	—	December 2010 - September 2012	—
Transportation of equipment and construction work	June 2002 - March 2006 (46 months)	December 2010 - July 2016 (68 months)	+113 months (+22 months)
Project Completion	March 2006	July 2016	+113 months

Source: JICA document and SPMB documents and answer to questionnaire
Note: Definition of the project completion is the commencement of the commercial operation of all project facilities.

(3) Power Plant Unit 2

The delay in project completion, as indicated in Table 7, was due to the significant delay in the transportation of equipment and construction work. Re-bidding was implemented due to the delay in the bidding evaluation, at the phase of bidding. The schedule was extended by approximately 3 years (33 months) in comparison to the initial plan, and completion of bidding was delayed 71 months in comparison with the initial plan. The reason for re-bidding was that only one company bid, and they were disqualified because their bidding documents had serious deficiencies. In addition, when JICA confirmed the re-bidding evaluation, inquiries were made several times, requiring extra time for examination and correction. Also, the schedule was affected by the fact that the bidding price increased to more than that scheduled by EVN

scheduled due to high rises in the cost of equipment. This required time for recalculation and approval of the scheduled price on the Vietnamese side.

Table 7: Project Period Plan and Actual (Power Plant Unit 2)

	Plan	Actual	Delay in completion date (Difference in implementation period)
L/A signing (Phase I)	March 2004	March 2004	-
Selection of Consultant and Contract	August 2004 - May 2005 (10 months)	July 2006 - January 2008 (19 months)	+33 months (+9 months)
Consulting Service	June 2005 - June 2009 (49 months)	January 2008 - November 2015 (95 months)	+66 months (+46 months)
Detailed survey and bidding preparation (including implementation of P/Q*)	June 2005 - November 2005 (6 months)	February 2008 - January 2009 (12 months)	+39 months (+6 months)
Bidding for Equipment transportation and construction work	December 2005 - October 2006 (11 months)	January 2009 - August 2012 (44 months)	+71 months (+33 months)
Equipment transportation and construction work	November 2006 - June 2009 (32 months)	November 2012 - October 2015 (36 months)	+77 months (+4 months)
Project Completion	June 2009	October 2015	+77 months

Source: JICA document and EVN documents and answer to questionnaires
Note: Definition of the project completion is the commencement of the commercial operation of all project facilities.

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

At the time of appraisal, the Economic Internal Rate of Return (EIRR) was not calculated and therefore recalculation was not conducted. The Financial Rate of Return (FIRR) was calculated as 7.85% for Unit 1 and 13.76% for Unit 2, on the conditions of 30 years project life, the benefits of electricity and gypsum sales revenue, the cost of construction, and of fuel and O&M.

At the time of the ex-post evaluation, due to a very low operation rate from commencement of operation to the present, if the benefit is calculated as electricity sales price at market transaction as it was at the time of appraisal, since electricity sales revenue is limited, even when gypsum sales revenue is added, yearly cash flow would be at a minus.

However, the O Mon power plant has made a power purchase contract with the Electric Power Trading Company, which is the only power transaction company under EVN, for the ancillary service[4] as stand by operation for emergencies. Therefore, operation and maintenance costs have been paid based on plant capacity by this company. Accordingly, based on the electricity sales contract with this company and the assumption that the future power generation volume will be as the average power generation in the past, the recalculation of FIRR has become positive.

[4] The service to contribute the power system operation, voltage and frequency adjustment, etc., in order to assure the quality of electricity in power supply. In case of O Mon power plant, it means to maintain a standby position to be able to supply electricity to the power system, generating the power according to the system's requirement.

Both the project cost and the project period significantly exceeded the plan. Therefore, the efficiency of the project is low.

3.3 Effectiveness and Impacts[5] (Rating:②)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

[Power Plants]

Table 8 shows the electricity generation volumes of Unit 1 and 2 constructed by the project, planned at the time of appraisal and actual. As for Unit 1, in the initial 3 years of power generation, 2009 to 2011, the operation rate was from 20 to 40%. Later, however, except for 20% in 2016, it was approximately from 1% to 8%. As for Unit 2, although the operation rate was approximately 27% in 2016, it was generally from 1% to 5%. According to GENCO 2, the reason why both Unit 1 and 2 generated more electricity in some years than others was that the time was during the guarantee period, and therefore generation hours took place with the purpose of confirming the trial run and operation situation. Also, no forced outage hour occurred by human error in Unit 1, while these were also at a minimum in Unit 2. As for forced outage hour caused by machine trouble, there was almost no trouble in Unit 2. Unit 1 had long forced outage hours (approx. 457 hours) in 2011, however, thereafter the outage hours did not last for such a long time. According to GENCO 2, the long period was caused by damage caused by leakage in the boiler tube. This was completely fixed during the force outage hours.

The operation rate of both Unit 1and 2 was low, not reaching 50% of the initial target power generation volume. However, as examined at “Relevancy”, the current position of the O Mon power plant in the national power system is “to meet the power supply for emergency needs”. This means two things: 1) that it must respond to the reduction in hydro power generation around the end of the dry season (April to May) and to supplement power supply at times of drought when hydropower generation drops even further; 2) that it must generate power when other power plants stop operation, due to disorder or periodical inspections. In fact, the O Mon power plant operated and contributed to the power demand when droughts occurred in 2011 and 2016.

Moreover, when transmission from the north to the south had problems because of forest fires in Ha Tinh Province in June 2019, the overall power supply was made stable by the operation of the O Mon power plant. According to Power Transmission Company No.4 (PTC4) of National Power Transmission Corporation (NPT), under EVN, which is in charge of the transmission and substations constructed by the project, power outage was avoided because of the contribution of the O Mon Power Plant and meaning that the O Mon Power Plant is important within the southern power system in terms of energy security.

[5] Sub-rating for Effectiveness is to be put with consideration of Impacts.

As described above, the project achieved the purpose of responding emergency needs in order to strengthen the power supply system in the south of Vietnam. Thus, the effectiveness is high. However, the planed gas supply has not been realized, even after a long time, and the plant load factor and operation ratio are limited. Considering this fact, the effectiveness of power plant is fair.

Table 8: Operation and Effect Indicators of O Mon Power Plant Unit 1 & 2

[O Mon Unit 1]

Operation and Effect Indicators	Plan (2011) (2 years after completion)	Actual									
		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Net Electric Energy Production (GWh/Year)	1902.8	596.6	1,010.8	553.5	40.8	40.3	88.2	51.7	383.5	5.3	37.5
Maximum Output (MW)	330	330.0	330.0	330.0	330.0	330.0	330.0	330.0	330.0	330.0	330.0
Plant Load Factor (%)	68.49	21.4	36.3	19.9	1.5	1.4	3.2	1.9	13.8	0.2	1.3
Availability Factor (%)	89.04	34.4	44.5	29.0	3.6	5.5	8.5	4.3	21.2	0.7	1.8
Auxiliary Power Ratio (%)	3.9	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Gross Thermal Efficiency (%)	41.9	41.9	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1
Forced Outage Hours (human error) (hours)	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Forced Outage Hours (machine trouble) (hours)	-	6.8	1.8	457.8	0.0	0.0	0.0	24.6	74.4	0.0	0.0
Planned Outage Hours by Periodical Inspection (hours)	-	235.8	461.7	1,439.2	221.5	0.0	548.3	0.0	0.0	55.7	535.0

[O Mon Unit 2]

Operation and Effect Indicators	Plan (2017) (2 years after completion)	Actual			
		2015	2016	2017	2018
Net Electric Energy Production (GWh/Year)	1,924.56	348.1	487.5	17.5	86.5
Maximum Output (MW)	330	330	330	330	330
Plant Load Factor (%)	68.49	12.5	17.5	0.6	3.1
Availability Factor (%)	89.04	4.0	27.8	1.5	5.5
Auxiliary Power Ratio (%)	5.03	3.4	3.4	3.4	3.4
Gross Thermal Efficiency (%)	41.97	42.3	42.3	42.3	42.3
Forced Outage Hours (human error) (hours)	240	0	0	0	0
Forced Outage Hours (machine trouble) (hours)	0	0	0.47	0	0.85
Planned Outage Hours by Periodical Inspection (hours)	720	0	220.00	1,431	24

Source: Answer to questionnaire with GENCO 2. Planned figure of Unit 1 from Ex-ante evaluation in 2006 for Phase 4 project and planned figure of Unit 2 was the target set in 2013 at Phase 2 project. Planned figures for the auxiliary power ratio and gross thermal efficiency were the target in case of using heavy oil.

[Transmission and Substations]

Operation of the transmission line and substation has been good, as shown in Table 9. The planned target indicators have been achieved and effectiveness is high.

Table 9: Operation and Effect Indicators of the Transmission and Substation Facilities by the Project

Operation and Effect Indicators		Plan (2013) 2 years after completion	Actual				
			2014	2015	2016	2017	2018
Transmission Loss (%) (220kV Duyen Hai – Tra Vinh)		0.9.	0.35	0.31	0.40	0.30	0.22
Substation Loss (%)	500kV My Tho	0.3	—	—	0.16	0.18	0.17
	500kV Duyen Hai		—	0.04	0.05	0.05	0.05
	220kV Duc Hoa		—	—	0.24	0.24	0.24
Availability Factor of S/Ss (Time) (%)	500kV My Tho	99	—	—	100.00	99.89	100.00
	500kV Duyen Hai		—	42.6 (since July)	99.72	99.96	99.96
	220kV Duc Hoa		—	—	99.90	99.91	99.82
Availability Factor of S/Ss (Capacity) (%)	500kV My Tho	n.a.	—	—	71.43	82.46	85.67
	500kV Duyen Hai		—	—	83.33	88.00	95.11
	220kV Duc Hoa		—	—	78.00	92.00	93.00
Outage Rate for Transmission Line (220kV Duyen Hai – Tra Vinh) (times/100km/Year)		1-2	0	1	2	1	0

Source: Answer to questionnaire to NPT- PTC4

Considering 90% of the project cost is allocated for the power plant, the total evaluation on the power plant and transmission line and substations was evaluated to be fair.

3.3.1.2 Qualitative Effects (Other Effects)

Contribution by the project to "Improvement of livelihood of local people" and "Promotion for growth of regional economy", which were aimed at the time of appraisal are described in the next section "3.3.2 Impacts".

3.3.2 Impacts

3.3.2.1 Intended Impacts

As the case of new power plant construction in general, the project did have an impact on employment creation during project construction and operation. However, it cannot be said that there was a large impact on the improvement of the livelihoods of local people or on the promotion for regional economic growth, because annual power generation volume by the project has remained limited until the time of ex-post evaluation, Nonetheless, as described in "Effectiveness", it is possible to say that the O Mon power plant is positioned as a source of emergency power supply source in the power system and that it has contributed to the stabilization of power supply in the south such as supplying the power when hydropower generation has been reduced by drought.

In addition, although the *Revised 7th National Master Plan for Power Development* planned that installed power generation capacity would be increased by renewable energy, such as mainly wind and solar power in the central and south areas particularly, power generation by

renewable energy fluctuates largely; therefore, this project, which has a high capability to adjust the load, seems to have contributed to a stable power supply in the south.

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on the Natural Environment

It is judged there was no negative impact on the natural environment regarding the following points.

- According to the South Power Management Board (herein after referred to as "SPMB") of NPT in charge of the project implementation, GENCO 2 and PTC4, there has been no negative impacts of the power plant and substations during construction and operation period to the present, and no claims have ever been received.
- Environmental monitoring has been conducted at the power plant, since the commencement of operations, with the collection of the data such as air (SO_2, NOx, SPM), water quality, noise etc. This has been a designated by the Vietnamese laws and regulations, and there have never been reports of results largely surpassing the standard figures.
- GENCO 2 outsources the processing gypsum ash to specialized company.

(2) Land Acquisition, resettlement, other social considerations

The following points were confirmed regarding the implementation status and results of land acquisition and resettlement caused by the power plants and transmission and substations, and no particular problems were found. Countermeasures for AIDS were implemented for construction workers as planned.

[Power Plant]

- Regarding land acquisition, according to a document on the land acquisition decision of the Can Tho People's Committee, there was a total of 230 inhabitants who were eligible for compensation for housing, land, etc. for the land acquisition for power plant land and access roads. While the number of people who were relocated could not be using existing documents, however, the number of people who were compensated for housing was 61 people. According to documents submitted by the Can Tho People's Committee and GENCO 2, cash compensation was appropriately provided to all those eligible for compensation under the Vietnamese law and regulation.
- According to the GENCO 2 report, there were no complaints from residents who were compensated for land acquisition during and after the project.
- Although two was a limited number, two resettled residents near the power plant interviewed during the ex-post evaluation survey commented that compensation had been

implemented smoothly and without problems and that their livelihoods had improved after resettlement in comparison with the situation before.

[Transmission and Substations]

According to records, the initial scope of the transmission and substation part changed completely due to delays in implementation, and only compensation for those under the transmission line was implemented. As there was a change of route in the final scope, resettlement of residents was no longer necessary. According to the field survey at the time of the ex-post evaluation, however, the following number of residents were resettled and compensated for the land acquisition for the construction of substations and transmission lines.

- 500kV My Tho Substation: 14 resettled households, 112 compensated household (including resettled residents)
- 500kV Duyen Hai Substation: 55 resettled households, 84 compensated residents (including resettled residents)
- 220kV Duc Hoa Substation: No resettlement, 11 compensated households
- 220kV Duyen Hai – Tra Vinh Transmission Line: No resettlement, 57 compensated households

- As confirmed with SPMB and PTC4, the compensation procedure was undertaken without any particular complaint when land acquisition occurred. No complaints were received afterwards.
- As confirming with SPMB and PTC4, the compensation procedure was undertaken without particular complaint when land acquisition was occurred. Also, no complaints were received after that.
- Although the scope of the interview survey was limited, 4 resettled residents living around the 500kV My Tho Substation and 500kV Duyen Hai Substation at the time of the ex-post evaluation were interviewed and commented that the resettlement procedure had been conducted smoothly and that their livelihoods remained unchanged / became better. There were no negative impacts indicated by them.
- Through interviews with the executing agency during the field survey at the time of the ex-post evaluation and verification of the official documents, it was confirmed that cash compensation was implemented for all target affected households according to Vietnamese domestic laws (land law and related regulations, etc.).

Photo 4: Interview to Resettled Resident by O Mon Power Plant

Photo 5: Interview to Resettled Resident by 500kV My Tho Substation

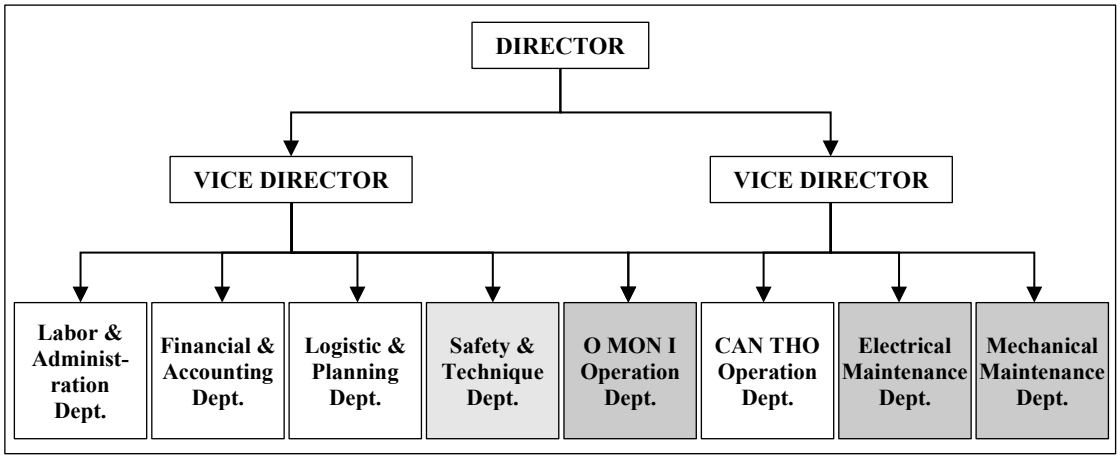
This project has achieved its objectives to some extent. Therefore, effectiveness and impacts of the project are fair.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional / Organizational Aspect of Operation and Maintenance

[Power Plant]

At the time of the ex-post evaluation, Can Tho Thermal Power Company (hereinafter referred to as "CTTP"), a subsidiary of GENCO 2, which had been established in 2012, was operating and maintaining the O Mon Power Station together with Can Tho Power Station. The company operates and maintains the O Mon Power Station with 83 employees in the O Mon I Operation Department, 40 employees in the Mechanical Maintenance Department, and 63 employees in the Electrical Maintenance Department.



Source: Answer to the questionnaire with GENCO 2 (As of July 2019)

Figure 3: Can Tho Thermal Power Company (CTTP) Organization Chart

[Transmission and Substations]

NPC PTC4 is in charge of maintenance. PTC4 has 1,526 staff members, 20 staff at the 500kV substation and 11 staff at the 220kV substation are assigned as a standard. The maintenance and management of the 220kV Duyen Hai – Tra Vinh transmission line (44.7km), targeted by this project is handled by the Tri Vinh branch of PTC4, which is also in charge of the transmission line of the Duyen Hai-Mocay transmission line (68km) (total length: 112.7km) and 26 staff are allocated this.

The operation of the transmission and substation facilities is divided by region into Ho Chi Minh City, West 1-3, and East 1-2. The Duc Hoa Substation is under the management of Ho Chi Minh City, The 500kV My Tho and Duyen Hai substations and the 220kV Duyen Hai – Tra Vinh transmission line are under the jurisdiction of the West 2 department. This organization setting of personnel is considered to be appropriate.

3.4.2 Technical Aspect of Operation and Maintenance

[Power Plant]

Of the total 73 employees, more than half, 44 staff are engineers (graduated from university). In a self-evaluation, the GENCO 2 and O Mon power plant operators consider that they had sufficient knowledge of the necessary technology. Operators seem to have acquired the skills required for operation and maintenance through training programs or on-the-job training. In addition to regular training, operators also undergo weekly training to improve operational problem-solving skills. In the field survey, it was seen that the operation and maintenance was being carried out appropriately in line with the determined manuals.

[Transmission and Substations]

All the operators of 500kV substations are the level of engineers (university graduates) or higher. It was confirmed that interviews with each substation and transmission line maintenance manager, that, through their own assessment, that the technical level is sufficient. Daily and periodic inspections are performed in accordance with the determined manuals.

Thus, the technical level of technical staff and the implementation status of regular training are considered to be adequate, and there are no particular technical problems.

3.4.3 Financial Aspect of Operation and Maintenance

[Power Plant]

GENCO 2 sells electricity based on a long-term power purchase agreement with Electric Power Trading Company, an affiliated company of EVN. According to GENCO 2, the O & M costs, including fuel costs, are covered by a cost calculation method within EVN, and thus the amount necessary for O & M is basically paid by Electric Power Trading Company. There is no

financial problem that hinders the operation of facilities. Although they are not being disclosed, upon confirming the key financial indicators of GENCO 2, the expenses necessary for power plant O & M are considered to be allocated.

[Transmission and Substations]

As a result of hearings from the head office, each substation, and the branch in charge of transmission lines, the budget required for operation and maintenance of the facilities is confirmed to have been covered, and no problems were found.

3.4.4 Status of Operation and Maintenance

Through the visits in the field survey, as a result of visiting the O Mon power station, My Tho and Duyen Hai 500kV substation, and 220kV Duyen Hai – Tra Vinh transmission line, those facilities are confirmed to be operated properly. At the power plant it was verified that the daily operation record sheet was properly filled in. In addition, daily and periodic inspections were carried out as planned at each facility, and there was no problem in the procurement of spare parts. In interviews with the staff in charge of each facility, it was mentioned that no accidents have occurred so far, and it is thought that there was also a result of technology transfer and training during the construction of Unit 1. Therefore, it was judged that the operation and maintenance of each facility was performed appropriately.

Photo 6: O Mon Power Plant Operation Center

Photo 7: My Tho 500kV Substation Operator Room

Photo 8: PTC 4 Tri Vinh branch office

The operation and maintenance of power plants and transmission and substation facilities are evaluated as appropriate from the organizational and technical aspects. On the financial side, no problem was found with the operating costs of the transmission and substation facilities. The operating costs of the power plant facilities are covered by EVN, and it seems that no problems such as a serious shortage of the O & M budget will not occur in the immediate future. Although the gas supply had not been realized at the time of the ex-post evaluation and the operating rate was lower than originally planned, the power supply function at the present time was being fulfilled sufficiently and, as as EVN is preparing to upgrade the functions for the gas supply, the facility will be used continuously in the future.

No major problems are observed in the institutional, technical, financial aspects and current status of the operation and maintenance system. Therefore, the sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project aimed to strengthen the power supply system in Mekong Delta area in the south of Vietnam, by constructing new thermal power plant with the facility of 330 MW × 2 units which can be fired by both gas and oil, near Mekong river in Can Tho City, the largest city in Mekong Delta area, together with transmission and substation facilities, thereby contributing to improvement of total power supply and livelihood of the local people in the area. Relevancy of the project is high at the time of project appraisal and ex-post evaluation as it is consistent with development policy, development needs are high, as well as with Japan's ODA policies. On the other hand, the position of the power plant of the project is emergent power supply in the power system in Vietnam at this moment because project implementation was delayed remarkably, and gas supply have not been realized. The efficiency of the project is low, as there were significant delay in project implementation period and increase of project cost by sharp rise of equipment price due to the implementation delay. Since there has been no gas supply, operation rate of the unit 1 and 2 power plant of the project were very limited in comparison to the plan at the appraisal time, however, the purpose of the emergent operation was achieved and transmission and substation facilities have been operated in good conditions, thus the project contributed to the stable supply in the southern Vietnam. Accordingly, the effectiveness and impacts of the project are fair. In order to continue to operate the project power plant and transmission and substation facilities for meeting to the needs in the power system, there have been no problem in organization, technical, financial aspects of the operation and maintenance, and therefore, the sustainability is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency (EVN GENCO 2)

The initial plan for the O Mon Thermal Power Station assumes a gas supply, and it is difficult to increase the operation rate if the supply is not ensured. It is recommended that discussions with PVN are continued to ensure that gas is supplied based on the gas supply plan at the time of the ex-post evaluation.

4.2.2 Recommendations to JICA

As for the O Mon Thermal Power Station, it is recommended that to the progress of the gas purchase contract under discussion between EVN and the gas field developer is pursed at the correct time and at the current ongoing monitoring is continued so that the power generation by the gas as planned by this project can be achieved. .

4.3 Lessons Learned

Mitigation / Alleviation of Significant Delays in Procurement Period

Regarding the project implementation period, the delay in the procurement period (bidding preparation or evaluation period) of all the project components of Power Plant Unit 1, the transmission and substation part, and Unit 2 caused to a delay in the entire project, which in the end took significantly longer than the planned period. The significant delay during the procurement period was affect by the time it took for the Vietnamese side to examine the project scope as well as by organizational reform on the EVN side. However, when such a significant delay was foreseen in the procurement period, for example for the transmission and substation component, if JICA had promptly reacted and managed the project, taking countermeasures to accelerate implementation such dispatching a procurement support consultant, it might have been possible to shorten the long project period. In this case, the increase of bidding price due the rapid rise in equipment price would have been avoided, and thereafter the bidding evaluation and contract negotiation could have been more conducted more rapidly.

A significant delay in project completion can lead to a significant loss of benefit. If a significant delay occurs at the bidding stage, it is highly likely that the project will be affected by price changes. The power plant of this project has generated electricity only by heavy oil. However, if the power plant had started operation as in the plan before the construction of other thermal power plants, it could have been operating for a longer period of time until the other thermal power plants were constructed. At the time of project ex-ante evaluation, it is critical that the importance of schedule management is fully recognized, with the reminder that the schedule can affect the project evaluation. If this is the case, then both JICA and the executing agency can conduct project management considering a significant extension of the project period as a serious risk. If such risks are predicted, it is essential to monitor them with particular attention during project implementation and to take countermeasures as soon as possible.

Ensuring Gas Supply for Power Generation

Regarding the gas supply for this project, gas field development and gas pipeline construction were planned as separated projects at the time of project appraisal. However, the gas supply had not been realized at the time of the ex-post evaluation. As far as this evaluation in concerned, at the time of project appraisal, as gas field development and gas pipeline construction were highly

expected to be implemented, and this plan was not canceled although the project was delayed in its implementation several times, while the signs of progress were observed in the gas project implementation, it seemed difficult to consider other gas suppliers. Therefore, in evaluation analysis of the project design and approach, the problem of gas supply should not cause a lowering in the rating of relevancy. However, taking the experience of this project as a precedent, when the source of gas fuel for power generation has not been determined, it would be better if JICA and the consultants in charge make a more careful examination of alternative scenarios for securing the gas supply (supply from other domestic gas fields, import of LNG, etc.) at the stage of the feasibility study.

END

Comparison of the Original and Actual Scope of the Project

O Mon Thermal Power Plant Construction Project (E/S)

Item	Plan	Actual
1. Project Output	Engineering Service Report	The same as planned
2. Project Period	—	March 1998 – May 2001 (39 months)
3. Project Cost Total Amount Paid (Foreign Currency) Exchange Rate	636 million yen 1 VDN = 0.01 yen (As of October 1997)	268 million yen The same as planned
4. Final Disbursement	July 2001	

O Mon Thermal Power Plant and Mekong Delta Transmission Network Project (I) (II) (III) (IV)

Item	Plan (at the time of Appraisal for Phase I)	Actual
1. Project Output		
(1) Power Plant Construction (Unit1)	Installed Capacity 300 MW×1 Unit + 600 MW Common facilities <Main equipment facilities> • Boiler, Turbine, Power Generation Plant • Auxiliary equipment for the above (Electrostatic Precipitators (ESP), Ash processing equipment, Flue gas desulfurization (FGD), Electrical instrumentation equipment, and others) • 220kV, 110kV Switchyard equipment	Almost as planned (Installed Capacity 330 MW×1 Unit + Common facilities for 660 MW)
(2) Transmission and substations (S/S)	• 220kV: approx.138km • 110kV: approx.384km • 220kV substation: New 4, Upgrade and Improvement 1, Total 5 • 110kV substation: New 15	• 500kV My Tho S/S • 500kV Duyen Hai S/S • 220kV Duc Hoa S/S • 220kV Duyen Hai – Tra Vinh Transmission Line • Spare Transformers (500kV – 300MVA 9 sets and 220kV – 250MVA 7 sets)
(3) Consulting Service	• Assistance to EVN for the bidding and contract • Supervision on construction • Countermeasures for the environment • Preparation of the Report • Technical transfer and training • During construction, advice for environmental monitoring and when defects were found, comment on countermeasures. • During operation, necessary technical transfer for EVN to continue environmental monitoring	As planned
2. Project Period	March 2001 – April 2006 (61months)	March 2001 – August 2016 (186 months)
3. Project Cost		
Amount Paid in Foreign Currency	50,675 million yen	47,840 million yen
Amount Paid in Local Currency	13,290 million yen (1,734,986 million VND)	13,895 million yen (2,608,522 million VND)
Total	63,965 million yen	61,735 million yen
ODA Loan Portion	54,369 million yen	50,692 million yen
Exchange Rate	1 VDN = 0.00766 yen (As of October 2000)	<Power Plant Unit1> 1 VND = JPY0.00600 (2001 – 2018 Weighted average of IFS annual average exchange rate) <Transmission and substations> 1 VDN = 0.00499 yen (2007 – 2017 Weighted average of IFS annual average exchange rate)
4. Final Disbursement	July 2012	

O Mon Thermal Power Plant Unit No. 2 Construction Project (I), (II)

Item	Plan (at the time of Appraisal for Phase I)	Actual
1. Project Outputs		
(1) Power Plant Construction (Unit2)	Installed Capacity 300 MW×1 Unit <Main equipment facilities> • Boiler, Turbine, Power Generation Plant • Auxiliary equipment for the above (Electrostatic Precipitators (ESP) and the surrounding equipment, Ash processing equipment, Flue gas desulfurization (FGD), heavy oil tanks, transformers, Measurement control system, electric facilities, construction of power plant house, and others)	As planned except for the below • Installed capacity330 MW×1 Unit • Addition of Gas burner facilities
(2) Consulting Service	(1) Support for Bidding and Contract, Supervision of main construction • Support for Bidding and Contract • Supervision of main construction • Consideration for Environment (support for environment monitoring during construction and advice on countermeasures when any incidents occurred and others) • Technical transfer and training for operation and maintenance of power plants (2) Support for knowledge related to establishment of O Mon One-Member Company • Organization planning • Recommendations for EVN on transfer of authority • Recommendations for EVN on financial system and operation and maintenance of O Mon One-Member Company	Almost as planned • Technical transfer and training for power plant operation and maintenance were not implemented. • Support for knowledge for the establishment of the O Mon One-Member Company was excluded from TOR at the time of Phase II.
2. Project Period	March 2004 – July 2009 (63 months)	March 2004 – October 2015 (76 months)
3. Project Cost		
Amount Paid in Foreign Currency	23,703 million yen	32,313 million yen
Amount Paid in Local Currency	9,937 million yen (1,293,880 million VND)	11,482 million yen (2,150,187 million VND)
Total	33,640 million yen	43,795 million yen
ODA Loan Portion	27,547 million yen	33,050 million yen
Exchange Rate	1 VDN = 0.00768 yen (As of March 2003)	1 VDN = 0.00534 yen (2008 – 2018 Weighted average of IFS annual average exchange rate)
4. Final Disbursement	July 2020, planned due date of final disbursement	