

FY 2019 Simplified Ex-Post Evaluation Report of Japanese ODA Loan Project

External Evaluator: Miho Kawahatsu OPMAC Corporation (September 2020)

Duration of the Study: October 2019-September 2020

Duration of the Field Study: February 9, 2020-February 29, 2020

Country Name	North-West Sumatra Inter-connector Transmission Line Construction Project
Republic of Indonesia	



Project Site



The Padang Sidempuan Substation expanded by the project
(North Sumatra)

I. Project Outline

Background	In 2005, actual peak power demand in the North Sumatra system was recorded at 1,054 MW. However, accompanying economic growth in the region, the power demand was expected to increase to 1,910 MW in 2011. Additionally, peak demand in the West Sumatra system was recorded at 1,294 MW in 2005, with the demand projection expected to increase to 2,586 MW in 2011. On the other hand, supply reliability in terms of duration and frequency of power outages in Sumatra was low in comparison to the national average for Indonesia. Therefore, the development of power transmission facilities was deemed to be urgent in establishing an adequate power supply system in that region. It was considered more economical to develop as a single power system through interconnection rather than to develop power generation facilities within each system. Especially, despite being the backbone of power supply and distribution systems in Sumatra, the North Sumatra system and West Sumatra system were not yet interconnected.
Objectives of the Project	To connect two existing substations, the Padang Sidempuan Substation in North Sumatra and the Payakumbuh Substation in West Sumatra, through the construction of 275 kV double transmission lines; and to expand existing facilities to elevate the substations' voltage level from 150 kV to 275 kV, the project aimed to improve power supply capacity in order to meet the increasing power demand and improve reliability in the Sumatra power system in both regions, thereby contributing to regional economic development through an improvement in the investment environment.
Contents of the Project (Actual)	<ul style="list-style-type: none"> Construction of high voltage transmission lines (275 kV double circuit transmission lines, approx. 276 km), and 747 transmission towers Expansion of existing 2 substations, elevating the voltage level from 150 kV to 275 kV Consulting Services (preparation of tender documents, supervision of works, etc.)
Loan Approved Amount/ Disbursed Amount	16,119 million yen/10,046 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 28, 2007/ March 29, 2007
Terms and Conditions	Interest Rate: 1.5%, Repayment Period: 30 years (Grace Period: 10 years), Conditions for Procurement: International competitive bidding (ICB)
Borrower/Executing Agency	Republic of Indonesia / PT. Perusahaan Listrik Negara (PLN)
Disbursement Completion	January, 2017
Project Completion	February, 2019
Target Area	North Sumatra, West Sumatra
Main Contractors	Construction work: HYUNDAI ENGINEERING & CONSTRUCTION LTD. (Korea) / PT MULTIFABRINDO GEMILANG (Indonesia) (JV) PT REKADAYA ELEKTRIKA (Indonesia) [PLN's portion] Procurement and Installation of Equipment: PT SIEMENS INDONESIA (Indonesia)
Main Consultant	NEWJEC Inc. (Japan)

II. Result of the Evaluation

Summary

This project aimed to connect two existing substations, the Padang Sidempuan Substation in North Sumatra and the Payakumbuh Substation in West Sumatra, through the construction of 275 kV interconnector transmission lines, and to expand existing facilities to elevate the existing substations' voltage level from 150 kV to 275 kV. The project would, therefore, improve power supply capacity in order to meet increasing power demand and improve reliability in the Sumatra transmission system in both regions, thereby contributing to regional economic development through an improvement in the investment environment. The project was consistent with the development policy and development needs of Indonesia, and the Japanese ODA policy at the time of the ex-ante evaluation. Thus, the relevance of the project is high. However, during the course of implementation, the project cost slightly exceeded the plan, and the project period substantially exceeded the plan. Therefore, efficiency is low. As for the project effects, power supply reliability improved to achieve the target both in North Sumatra and West Sumatra. Furthermore, through the interconnection of power transmission between the two provinces, power supply stability also improved. In terms of impact, the number of corporate customers of PLN increased considerably in both provinces since the project contributed to improving the investment environment essential for corporate activities in the private sector through the provision of a stable power supply. Therefore, the effectiveness and impact of the project are high. Regarding sustainability, operation and maintenance were systematically carried out in the transmission facilities in line with PLN's work program and standards. Thus, no major problems were observed in terms of institutional, technical financial aspects, and the status of operation and maintenance. Therefore, sustainability is high.

Considering all of the above points, this project is evaluated to be satisfactory.

Overall Rating ¹	B	Relevance	③ ²	Effectiveness & Impact	③	Efficiency	①	Sustainability	③
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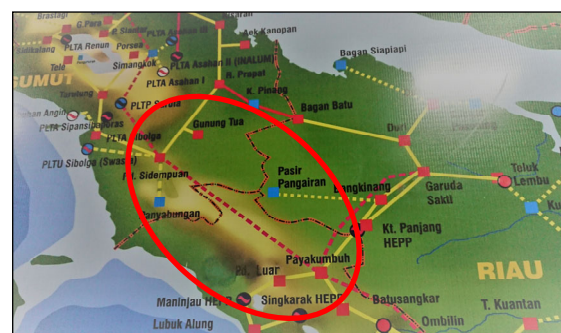
<Special Perspectives Considered in the Ex-Post Evaluation>

The timing of the final disbursement of the loan (January 2017) did not coincide with project completion due to significant delays in the project. After the final disbursement of the loan, the remaining portion of the construction work was continued at the expense of the executing agency. The project was finally completed in 2019, which was a significant delay from the original completion date of 2011. As described in "3. Efficiency" below. Therefore, in order to examine the quantitative effects of the project in terms of effectiveness, the actual number and related information as of the completion year in 2019 were to be mainly verified, instead of data from two years after project completion as stated in the initial plan.

1 Relevance (Rating: ③ High)

<Consistency with the Development Policy of Indonesia at the Time of the Ex-Ante Evaluation>

The project was consistent with the development policy of Indonesia: it was highlighted as one of the priority power development projects in *the National Electricity General Plan (2006-2020)* of the Ministry of Energy and Mineral Resources of Indonesia. As per the plan, the construction of the backbone power supply and transmission was highly prioritized in the power interchange/supply system development in the country. Thus, to create an interconnected power system was essential for the realization of efficient and high-quality power supply. In Sumatra, it was deemed urgent to develop interconnection transmission lines between the power systems of North Sumatra and West Sumatra in particular.



The transmission lines constructed by the project shown in the Sumatra power system diagram

<Consistency with the Development Needs of Indonesia at the Time of the Ex-Ante Evaluation >

The project was consistent with the development needs to have a stable power supply in response to the increase in demand in Indonesia. At the time of the ex-ante evaluation, the interconnection system for power interchange remained vulnerable in the target area of Sumatra, as the North Sumatra power system and the West Sumatra power system had not yet been connected and there was no power interchange between them. It was therefore difficult to provide a stable power supply in the region. Furthermore, both power systems were predicted to have a tight supply in 2011 based on the level of peak demand for power in 2005. As such, it was deemed necessary to improve reliability in the power supply in Sumatra.

<Consistency with Japan's ODA Policy at the Time of the Ex-Ante Evaluation>

The project was consistent with Japan's ODA policy for Indonesia at the time of the ex-ante evaluation. According to *the Country Assistance Program for Indonesia* (November 2004), "private sector-led sustainable growth" was highlighted as one of the priority areas for assistance to the country, with emphasis placed on the "improvement of economic infrastructure" for the investment environment as a measure. In addition, one of the priority areas for JICA (formerly Japan Bank for International Cooperation), which was set out in *the Medium-Term Strategy for Overseas Economic Cooperation Operations* (April 2005), was to develop infrastructure providing "a foundation for sustainable growth." It intended to provide support to improve socio-economic infrastructure to promote sustainable development, including in the energy sector. Also, as stated in *the Country Assistance Strategy*, as Indonesia was undergoing a transition from a stage of stabilization to growth following the Asian financial crisis, it was to assist in the development of imperative economic infrastructure that would help to improve the investment environment as one of its priority areas.

¹ A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

² ③: High, ②: Fair, ①: Low

<Evaluation Result>

In light of the above, the relevance of the project is high.

2 Effectiveness/Impact (Rating: ③ High)

<Effectiveness>

At the time of the ex-post evaluation, it was confirmed that the actual values of the operation indicators for the project mostly achieved the target values.

As shown in Table 1 below, the intended project effects (reliability and stability of power supply) were measured quantitatively using four indicators, whose target values were set at the time of the appraisal. The actual value of the availability factor (Indicator 1) in 2019 was 30.4%³, and the achievement level was 71%, which turned out to be slightly lower than expected. On the other hand, the annual forced power outage time (Indicator 2), was 0 minutes/year, indicating that no forced power outage had occurred in the operation record and that the achievement level was 100%; the stability of the power supply had therefore been realized. Furthermore, the actual value of the voltage drop at the end-user (Indicator 3), was 98.6%, with an achievement level of 99%. Since the voltage drop at the end-user is related not only to the performance of power transmission facilities but also to power distribution facilities, the value itself could not be attributed exclusively to the project. Nonetheless, confirmed favorable operation status after project completion indicates a general improvement of the power infrastructure of the entire target area. As for transmission loss (Indicator 4), as the actual rate was only 0.2%, it should be noted that the level of transmission efficiency between the two systems had been achieved by the project. Based on the above, on the whole, the achievement of the quantitative effects is considered to be high.

According to PLN, the project also contributed to the reduction of rolling power outages. Thus, as reference data related to the effectiveness of the project, the number of the rolling power outages⁴ was also verified in the target area at the time of the ex-post evaluation. According to the record of PLN, as shown in Table 2 below, a rolling power outage occurred more than 100 days per year in both provinces in 2017. However, after project completion in 2019, the annual number decreased to 40 days in the North Sumatra system and 6 days in the West Sumatra system, and it remained at zero in both systems as of February 2020. As indicated in Table 4 below, the total power generation capacity of the power plants located in Sumatra had not increased significantly. Therefore, a reduction in the number of rolling power outages indicates the stability of the power supply as a direct result of the power system improvement typified by this project.

Moreover, it was assumed that the project would contribute to the following two points through the power interchange of the inter-connector transmission lines: (1) to eliminate the imbalance in the electric power source structure due to the uneven distribution of existing power plants; (2) to fulfill the required power supply reliability through smaller-scale facilities, compared to a power supply through separate systems.

In order to determine whether the project had contributed in terms of the two points above, the trend of the reserve margin based on the power supply capacity in both target systems was examined. Furthermore, using data on the capacity extended by the development of power generation and transmission respectively in Sumatra, the variation on the year-on-year change ratio in the power infrastructure during the implementation period was cross-checked.

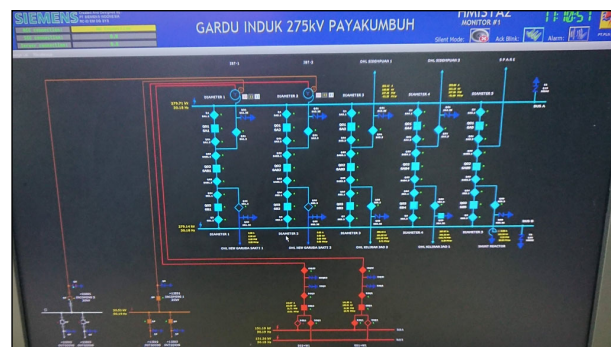
As indicated in Table 3, based on the variation of power supply in the target area, the reserve margin of the North Sumatra power system increased after project completion in 2019. On the other hand, in the West Sumatra power system, the power supply, which had been extremely unstable in 2015 and 2016, had improved to allow a reserve margin of more than 4-5% since 2018, specifically after the start of the test and commissioning at the end of 2017. From a broad perspective, the PLN's power development plan for Sumatra⁵ had positioned the project as an integrated part of the development of the entire power system which was meant to interconnect the North and South Sumatra power systems. The aim was to enable power interchange between the two target systems: primarily transmission from the West Sumatra power system to the North Sumatra power system, which was ridden with relatively higher power demand. Then, to outline a process towards the achievement to date, as a result of an increase of a reserve margin in the West Sumatra power system stemmed from other undertakings of development on the total system in Sumatra over the same period, the project ultimately contributed to stabilizing the power interchange between the two target systems.

Furthermore, based on the achievement of power interchange described above, the year-on-year change ratio in power generation and transmission lines in Sumatra was verified as shown in Table 4 below. According to the data in 2017 and 2018, which coincided with the period when the construction of transmission towers was fully underway as part of the project, the output growth of the transmission line development was greater than that of the power generation development. It can, therefore, be concluded that as a result of prior optimization of power transmission over power generation, the stabilization of power supply as shown in Table 3, was achieved by increasing the reserve margin in each region.

From the above, it was confirmed that the project contributed to the power system development in Sumatra.

<Impact>

It was confirmed that the project contributed to an improvement in the investment environment in the target areas, as well as the feasibility



A monitor of 275 kV power transmission surveillance installed at the substation in the project

³ PLN plans and operates the power system under the “N-1 criteria.” Using a double-line, it planned a power system that was to withstand an unexpected failure or outage of a single system component in the system integration planning. The maximum availability factor of the facilities of the project was assumed to be about 50%, and the target value was set at 43%, as it was necessary to use another line in the transmission network as a contingency. Therefore, the actual value was calculated based on the criteria.

⁴ Rolling power outages are implemented by an electric power company, as a rotational load shedding measure to avoid a total blackout through power shutdown where electricity delivery is stopped over different parts of the distribution area when demand for electricity exceeds supply. The shortage of power supply capacity occurs either due to insufficient power generation capacity at the power plants, or insufficient transmission capacity of a transmission network (transmission lines, transformers, etc.).

⁵ Regardless of the regional administrative boundary, PLN divided the total Sumatra transmission network in the plan into two power systems: The North Sumatra power system and the South Sumatra power system. Aceh and North Sumatra are part of the North Sumatra power system; West Sumatra, where one of the target substations for the project is located, is part of the South Sumatra power system, along with Riau, Riau Islands, Bangka-Britung, Jambi, South Sumatra, Bengkulu, and Lampung.

of a wider inter-regional power system.

As for the investment environment in Sumatra, the annual number of corporate customers in each province categorized as “industry” (defined as a private company above a certain size) in the tariff table of PLN was verified. As indicated in Table 5, the number of customers temporarily declined the first year after the start of the project in 2011, presumably due to the Sumatra Earthquake which occurred in 2012, it increased steadily in both North and West Sumatra from 2013 to 2019, when the project was completed, with a significant increase noted in both provinces in 2018. This was especially the case for West Sumatra, where the numbers had almost doubled by 2019 in comparison to the initial number of customers in 2011; by the project completion year in 2019, the cumulative total number of the customers increased by 22.5% in North Sumatra, 102.4% in West Sumatra, and by 28.4% in both provinces, respectively. The stable power supply in the wider area as a result of the improvement of the power infrastructure system created a favorable investment climate, resulting in an increase in the number of industrial customers in Sumatra.

Furthermore, as mentioned in “effectiveness” above, PLN was able to optimize the entire power system in Sumatra by the sequential completion of the extension work of the transmission network, which allowed power to be transmitted between the power systems of South and North Sumatra. This project was a linchpin to the network: the project was not just limited to providing an interconnection between North Sumatra and West Sumatra, but enabled to connect South and East (Central) Sumatra through the Payakumbuh substation upgraded by the project in West Sumatra. It is therefore believed to have contributed to the infrastructural power system development of the entire Sumatra region.

At the time of the ex-post evaluation, while PLN did not forecast a rapid increase in power demand in Sumatra, it was considered urgent to address a tight power supply in Java. In the framework of nationwide power infrastructure development, having completed the project and others in Sumatra, the entire regional power system made feasible to aim for the development of a wider-scale power system; such as inter-island interconnection, that would enable PLN to transmit surplus electricity from Sumatra to Java.

As for the impact on the natural environment, this project fell under category B in *the Guidelines for Confirmation of Environmental and Social Considerations* (established in April 2002). The project was considered unlikely to have a significant adverse impact on the environment due to the sector and characteristics of the project per se. Also, the region was not susceptible to such an impact. Nonetheless, according to PLN, the effect on the forests within the target area caused by the construction of a considerable number of transmission towers was well-recognized from the initial stages of the project. Furthermore, after project completion, at Unit Pelaksana Transmisi (UPT), the regional transmission service units located in Pematang Siantar in North Sumatra and Padang in West Sumatra, assigned the identification number to each of wild trees around transmission towers. Then with the close cooperation of the local resident groups living around the transmission towers, PLN’s dedicated monitoring app “SRINTAMI” was used to methodically implement vegetation management and monitoring in the target area without delay.

Regarding the impact on the social environment (land acquisition and resettlement), it was necessary to acquire about 4,700 m² of land from approximately 1,000 landowners for the construction of the 747 transmission towers that were built in total. According to a construction manager at Unit Induk Pembangunan (UIP), the Central Development Unit located in Medan, as indicated in the special perspectives above, it took a long time to acquire the land, mainly due to the revision of related laws and regulations of Indonesia amid ongoing project implementation. However, having individual and deliberate negotiations with the landowners made it relatively easy to proceed once consensus was reached, and the acquisition of land was implemented in compliance with domestic law. On the other point of concern, there was no resettlement caused by the project, thus no ramifications in this aspect. The job creation effect for local residents was confirmed as an unintended positive impact of the project. Some of the construction sites for the transmission towers were in forest areas which were inaccessible by vehicles; it was thus essential to elicit the assistance of local residents during construction. In addition, the collaborative working relationships with the local resident groups have continued after project completion, allowing for the commissioning of ground patrols for surveillance and to monitor the transmission towers.

No negative impact was confirmed.

<Evaluation Result>

Therefore, the effectiveness/impact of the project is high.

<Quantitative Effects>

Table 1: Operation Indicators of the Project

Indicator	Baseline 2006 Year of Planning	Target 2013 2 Years after Completion	Actual (achievement level %) 2019 Completion Year*5	
Availability factor (%) *1	N/A	43	30.4	(71%)
Forced power outage time (min/year)*2	120	0	0	(100%)
Voltage drop at the end-user (%) *3	92	100	98.6	(99%)
Transmission loss (%) *4	N/A	1.3	0.20	(100%)

Source: PLN

Note 1: newly constructed transmission lines by the project [peak load (MW) / supply capacity (MW)] of 275 kV]

Note 2: Annual forced outage time at the Padang Sidempuan substation of North Sumatra Power system (min/year)

Note 3: [Maximum voltage drop (V)/voltage baseline (V)] at the Padang Sidempuan substation of North Sumatra Power system

Note 4: Newly constructed transmission lines by the project [(Power sent at the sending end (kWh) -Substation power consumption (kWh) -Power delivered at the receiving end (kWh)/Power sent at the sending end (kWh)]

Note 5: Project completion was defined as the expiration of the defect liability period. Test and commissioning started at the end of 2017.

Table 2: The Annual Number of Rolling Power Outages in North and West Sumatra Power Systems

Indicator		2017	2018	2019 Completion year	2020 As of February
The number of rolling power outages (day)	North Sumatra Power System	105	7	40	0
	West Sumatra Power System	115	0	6	0

Source: PLN

Table 3: Balance of Power Supply and Demand in North and West Sumatra Power Systems

Indicator		2015	2016	2017	2018	2019
North Sumatra Power System	Peak demand (MW)	1593.9	1691.9	1673.3	1794.2	1841.0
	Supply capacity (MW)	2345.1	2182.9	2650.3	2576.3	3038.7
	Reserve margin (%)	5.8	8.9	32.3	6.4	17.3
West Sumatra Power System	Peak demand (MW)	552.3	559.9	646.1	579.9	596.8
	Supply capacity (MW)	635.4	658.9	635.6	672.6	646.1
	Reserve margin (%)	0.0	1.0	4.6	5.4	5.8

Source: PLN

Table 4: The Development Status of Power Infrastructure (Power Generation/Transmission) in Sumatra

Indicator	Actual				Planned	
	2015	2016	2017	2018	2019	2020
Power Generation (MW) (Year-on-Year Change Ratio (%))	7,415.14	8,171.31	9,074.06	9,084.79	9,958.79	11,680.79
		10.2	11.0	0.1	9.6	17.3
Transmission line (km) (Year-on-Year Change Ratio (%))	11,076.33	11,969.10	14,024.64	16,159.82	19,809.82	23,380.82
		8.1	17.2	15.2	22.6	18.0

Source: PLN

<Impact>

Table 5: The Annual Number of Corporate Customers of PLN in North and West Sumatra

	2011 Start of the project	2012	2013	2014	2015	2016	2017	2018	2019 Project Completion
North Sumatra (Year-on-Year Change Ratio (%))	3,555	3,492	3,691	3,698	3,724	3,867	4,031	4,313	4,356
		-1.8	5.7	0.2	0.7	3.8	4.2	7.0	1.0
West Sumatra (Year-on-Year Change Ratio (%))	283	277	312	336	370	395	427	521	573
		-2.1	12.6	7.7	10.1	6.8	8.1	22.0	10.0
Total (Year-on-Year Change Ratio (%))	3,838	3,769	4,003	4,034	4,094	4,262	4,458	4,834	4,929
		-1.8	6.2	0.8	1.5	4.1	4.6	8.4	2.0

Source: PLN

3 Efficiency (Rating: ① Low)

The output of the project was mostly produced as per the plan, and the project achieved the planned design capacity. The intended project effect was unaffected by changes from the planned output, due to revisions and changes to the number of materials and equipment that had to be adjusted in line with the status at substations, and decrease in the number of transmission towers due to the route changes with the shorter length of the transmission lines.

The total project cost was planned to be 21,645 million yen (of which the ODA loan portion was 16,119 million yen), while the actual project cost was 21,799 million yen (of which 10,046 million yen was by ODA loan disbursement) which slightly exceeded as 101% of the plan. When the final loan disbursement deadline was approaching in 2017 prior to project completion, PLN decided to use its funds to implement the remaining portion without extension of the deadline. Thus, the loan disbursement ratio was low.

The actual project period was 144 months as opposed to 62 months planned period (232% of the plan), and therefore, significantly exceeded the plan. During the process of land acquisition, it was necessary to assess the land price individually for approximately a thousand landowners by complying with the domestic law of Indonesia; also, there were villages in certain areas that opposed the idea of selling the land and it took an exceedingly long time to resolve these issues. As mentioned in the special perspectives section above, the construction of transmission towers had to be put on hold for quite a while due to the delay in antecedent land acquisition. The reconstruction of several transmission towers was also required due to a natural disaster. As a result, the project period was significantly extended to completion.

As indicated above, the project cost only slightly exceeded the plan, but the project period significantly exceeded the plan. Therefore, efficiency is low.

4 Sustainability (Rating: ③ High)

<Institutional Aspect>

The O&M system had changed at the time of the ex-post evaluation due to the organizational restructuring of PLN, which had taken place after the time of the appraisal. However, there were no institutional issues raised by PLN as the basic framework of the system had mostly remained unchanged. Also, considerable time had already passed as the restructuring was enforced during project implementation.

At the time of the ex-post evaluation, the responsibilities for the O&M of the project were clearly defined and shared among the related organizational units; they were carried out by UPT Padang (West Sumatra) and UPT Pematang Siantar (North Sumatra) from the start of

test and commissioning, following the completion of construction work. In compliance with PLN's internal regulations, each of the UPTs managed the Payakumbuh substation in West Sumatra and the Padang Sidempuan substation in North Sumatra. It should be noted that although the power transmission facilities of the project were planned to be officially owned by UPT Padang and UPT Pematang Siantar respectively, the ownership transfer procedure has not been completed, and the Central Development Unit, UIP Medan which was in charge of the construction work, retained ownership status at the time of the ex-post evaluation⁶. Therefore, UIP3BS, the Dispatch Center of Sumatra located in Pekanbaru, Riau was procedurally in charge of budget control of transmission facilities under UIP, in addition to the primary responsibilities of transmission management, data collection, and analysis for the entire power network of Sumatra.

There are two specific perspectives for the O&M in line with the manpower allocation for the project: "operation of two substations" and "maintenance of two substations and 747 transmission towers and transmission lines." Regarding the operation of the substation, 5 staff (including 1 supervisor) were deployed at the Padang Sidempuan Substation in North Sumatra and 8 staff (including 1 supervisor) were deployed at the Payakumbuh Substation in West Sumatra. As there were no accidents or failures reported according to the track record in operation at UIP3BS, personnel distribution for the operation was considered to be generally appropriate⁷. With regards to the maintenance of the substations, transmission lines, and transmission towers, 8 staff were deployed at the Padang Sidempuan Substation and 9 staff were deployed at the Payakumbuh Substation. There were no problems with the maintenance of the substations as a result of mutual cooperation between the staff in charge of the operations at each substation. As for surveillance of the transmission lines and transmission towers located in the widespread area, UPT Pematang Siantar contracted 18 local residents to conduct ground patrols to check on the 338 towers in North Sumatra and UPT Padang contracted 23 local residents to check on the 409 towers in West Sumatra. The maintenance was duly executed, based on real-time remote monitoring and surveillance by utilizing the specialized "SRINTAMI" app distributed to the commissioned residents in the area.

<Technical Aspect>

As for the technical aspects of O&M for the facilities of the project, there were no problems as existing staff were experienced in power transmission. The supervisors of the two substations had been deployed since the start of the test and commissioning phase, so at the time of the ex-post evaluation, had gained a lot of experience and hands-on practice in operating the newly introduced equipment. Furthermore, there was a common understanding among all staff in charge that the high voltage transmission of the project was considered essential for the entire transmission system of Sumatra. Therefore, the supervisor conducted staff management through careful assessment of attendance and performance status in regularly held PLN's training programs. In addition, regarding the organizational efforts to retain the technical level in PLN, not only were all assigned staff qualified in each technical field, but each of them was also required to take training at least once a year. The refresher training that was needed has been held every month since. According to the training course and attendance record submitted at the time of the ex-post evaluation, training on the operation of substations and the maintenance knowledge required (for transmission lines, etc.) were systematically executed in accordance with PLN's training program. The training contents related to the O&M of power transmission was considered to be standardized and uniformly executed throughout the entire organization.



Staff engaged the maintenance at the Payakumbuh substations (West Sumatra)

<Financial Aspect>

There have been no problems regarding the financial aspects of O&M related to the project. *The National Electricity General Plan (2006-2020)* referred to at the time of appraisal was still valid and effective at the time of the ex-post evaluation. Therefore, the improvement of the overall Sumatra power system including the project remained to be of national importance. Both UPT Padang and UPT Pematang Siantar accordingly applied to UIP3BS for all operation costs, including the O&M of the substations and the transmission towers. The applications were approved, and the monies disbursed promptly without any delay. It was acknowledged that there were no financial issues in both UPTs. PLN Headquarters also confirmed that the operation and maintenance budget was secure, so there was no discrepancy in recognition in terms of financing the O&M of the project.

On the other hand, in order to verify the overall debt solvency of PLN, the following items were analyzed based on the data calculated from the balance sheet of PLN since 2016. As the current ratio was below 100%, there was some concern about short-term cash flow, but this improved significantly in 2019. Regarding long-term solvency, there was no outstanding issue since the debt to equity ratio, which is the percentage of the interest-bearing debts to the entire equity, was consistently less than 100%. Although the equity ratio was on a downward trend, it was still considered to be generally stable. Based on all the above, there were no outstanding financial problems at the time of the ex-post evaluation. Considering that the transmission lines of the project were a crucial part of the overall power system in Sumatra, it can be concluded that the O&M budget for the project would continue to be duly secure and disbursed.

⁶ Due to current ownership, UIP3BS was responsible for the budget application and expenditure management for the O & M of the project. When the registration of the asset transfer is completed, each of the UPTs will become the budget control entity for the facilities.

⁷ According to the field survey, there was some concern that the Padang Sidempuan Substation may run short on manpower and would be stretched too thin for a 24/7 operation if an unexpected situation or accident were to occur, as there was no backup staff deployed. Likewise, at the Payakumbuh Substation, the high-voltage transmission lines were to be extended to two other substations aside from Padang Sidempuan. For this reason, suggestions were made to increase the number of supervisors involved in each operation oversight.

Table 6: The Outline of Profit-and-Loss Statement and the Financial Stability Analysis of PLN

	Unit: Billion IDR			
	2016	2017	2018	2019
Revenue	222,822	255,295	272,898	285,641
Operating Expenses	254,550	275,474	308,189	315,440
Government's Electricity Subsidy	58,043	45,738	48,102	51,712
Income	8,150	4,428	11,576	4,322
Current Ratio (%)	81.04	67.44	71.83	95.02
Debt to Equity Ratio (%)	44.83	53.55	60.93	70.54
Equity Ratio (%)	69.04	65.12	62.13	58.63

Source: PLN

<Current Status of Operation and Maintenance>

There were no problems regarding the O&M status of the project. With regards to the two substations and the overhead transmission lines of the project, the implementation status of the O&M of facilities and equipment was confirmed. No power transmission accidents or failures due to abnormalities or breakdowns in the substations were reported from project completion to the time of the ex-post evaluation. It should be noted that a transmission tower in West Sumatra had collapsed due to massive flooding that occurred in 2018. UIP Medan promptly responded to the reconstruction of that tower, which was to be located 80 meters away from the original site. As for maintenance activities, in accordance with the maintenance rules of PLN, regular inspections were conducted daily by following the level of the inspections internally specified based on each type of equipment. Also, necessary spare parts and consumables were still amply stored in the warehouse. Problems to do with shortages have not occurred.

<Evaluation Result>

Therefore, the sustainability of the project's effect is high.

III. Recommendations & Lessons Learned

Recommendations to Executing Agency:

None

Recommendations to JICA:

None

Lessons Learned for JICA:

(1) In cases where the land acquisition of a widespread area is a prerequisite, due confirmation and support is needed for the process at an early stage

During the process of land acquisition, it was necessary to assess the land price individually based on the domestic law of Indonesia for approximately a thousand landowners; also, there were villages in certain areas that opposed the idea of selling the land and it took an extremely long time to resolve these issues. The construction sites of the power transmission towers came in a variety of prices. The asking price should be agreed on by the landowner based on the third-party assessment by the designated certified appraiser. As a result, it complicated the procedure. It should be noted that such an extensive delay of the project resulted in opportunity loss and a real increase in cost price, which would not have been incurred if the power supply had been realized as planned.

Regarding the acquisition of land for transmission lines, it was necessary to establish an efficient institutional structure for land acquisition, in order to deal with the local stakeholders right from the start when making a routing plan and examining details of each candidate site. As transmission was explicitly impossible if even one site had not been acquired along the route of the transmission lines between two substations, it was necessary to promptly share detailed local information with all parties and to set up a viable mechanism for prompt coordination among them. As in this project, the construction of transmission lines tends to be in widespread areas and requires the land acquisition of multiple plots of private land. Therefore, a considerable number of landowners, local governments, and groups of local communities become vital stakeholders, thus it must have substantially raised the consequent costs in coordinating with all those parties. Other alternatives should have been considered as soon as the process of land acquisition became long and arduous, and adjustments made for the local conditions by the consultant and contractor responsible for the project's technical and construction work. This alternative should have resolved this site-procurement issue, as this was a major premise of technical design. Nonetheless, the project was under irregular circumstances that occurred in Indonesia during implementation, involving a revision of the relevant law. It should be noted that in any country, land acquisition for transmission lines and compensation of the land under the line is known to be a complicated and time-consuming process.

Thus, in case that land acquisition involves a considerable number of private landowners and is a prerequisite for the power transmission project in widespread areas, the progress of land acquisition and compensation plan and preparation carried out by the executing agency should be confirmed. And then if deemed necessary, provide prudent assistance to expedite the process from the early stages of project planning (preferably by the time of detailed design study, in case if ODA loan project preparatory survey has not been conducted). In addition, it is important to establish a project implementation mechanism with contractors and consultants, to allow for the project to be carried out smoothly throughout implementation.

(2) Monitoring the portion of the project implemented by the Partner Government/Executing Agency is needed

After the construction of the transmission lines by PLN was completed, one of the transmission towers built near the river in West Sumatra collapsed due to the eroded foundation when flooding occurred in November 2018. Also, the four towers connected to the collapsed tower were beveled. As a result, it was necessary to rebuild them on different plots from the original sites, which caused a further delay in power

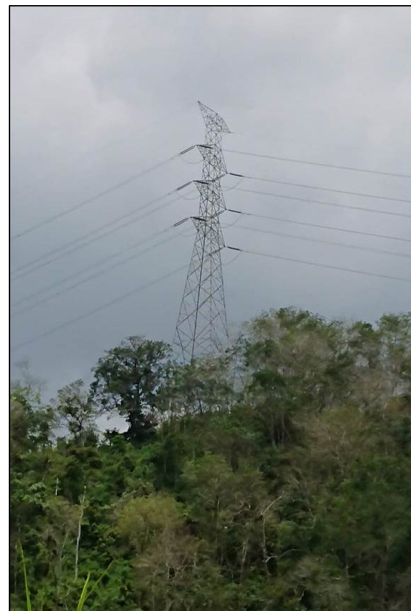
transmission between the systems. PLN considered the extreme flood as a force majeure event. Nonetheless, at the time of the ex-post evaluation, it was not possible to confirm the detailed causes of the accident that had led to property damage or might have caused serious injury if the worst had happened.

It should be noted that the progress of land acquisition by PLN and the subsequent construction of the towers by the contractor could not be aligned with the milestones of the project. As such, since 2016, PLN decided to shoulder the costs of the remaining portion of the construction work alone, and this was positioned outside of the scope of the ODA loan. However, it was reported that PLN was engaged in the construction since 2016, by following the original detailed design covering transmission tower specifications, construction methods, and routing submitted by the contractor under the supervision of PLN and the consultant.

As described above, one of the transmission towers collapsed in the section implemented by PLN. This resulted in a need for reconstruction, which further delayed launching power transmission and delayed the project effects. Although the accident occurred in a section outside the scope of the ODA loan, it remained an integral part of the project. It is thus considered that the project should have been monitored and verified as a whole, in light of appropriateness of the route selection and construction method adopted in the detailed planning and implementation stages.



The Payakumbuh Substation expanded by the project
(West Sumatra)



A power transmission tower constructed on a hill in the forest
area of Sumatra along the transmission route of the project