Case Study: Smart Community Demonstration Project at Industrial Park in Java Island, the Republic of Indonesia

1. Introduction

In Java Island of the Republic of Indonesia, a joint project with Japan was conducted from 2012 to 2017 to demonstrate smart communities, focusing on the establishment of advanced energy use methods in an industrial park where energy demand was growing rapidly.

It is one of the "Smart Community International Demonstration Projects," of NEDO. There was a cooperation request from the Ministry of Energy and Mineral Resources of the Republic of Indonesia (MEMR) to the state electricity company (PLN) for the implementation of the project which was carried out at Suryacipta City of Industry as a project site. Under the MOU (Memorandum of Understanding) concluded between NEDO and MEMR, the five Japanese companies (Sumitomo Corporation, Fuji Electric, Mitsubishi Electric, Sumisho Machinery Trade Corporation and NTT Communications) and PLN signed ID (Implementation Document) to jointly implement the demonstration (Figure 1).

In this demonstration, in addition to the introduction of a system for stabilizing power quality and a system for energy management in the industrial park, the ICT platform was established and its effectiveness was verified.

The purpose of this project is not only a technology demonstration but also a business demonstration that examines the feasibility of the technologies which were introduced in this project.

This case study summarizes social significance of the demonstrations and suggestions of smart grid related technologies obtained in this demonstration project.

2. Background

Power shortage situation in Java Island, the Republic of Indonesia when the demonstration started in 2011 was tight. There were 165 days of planned blackouts per year. This was due to the fact that the chronic electricity shortage had not been solved because of the long delay of financing and construction works of the 1st short-term electricity development plan formulated in the Republic of Indonesia in 2006, while the demand for electricity was growing rapidly.

The country's industrial parks are featured in "industrial cluster" that consumes about 1/3 of the country's total energy consumption and have seen remarkable growth in the energy consumption. Among others, the Suryacipta City of Industry, whose land sales is carried out by Sumitomo Corporation, has been occupied by many Japanese companies (more than half i.e. approximately 130 tenants are Japanese companies), and high-quality power sources were in demand.

Based on the above, this demonstration aims to create a new business model that provides high-quality services / distribution system stabilization services to electric power companies (PLNs) using Japanese technology.

In order to demonstrate this service, it is necessary to create a new power distribution system in the industrial park. However, it violates the country's regulations of one power supplier per area, so in cooperation with MEMR and PLN, NEDO conducted the project as a demonstration project.

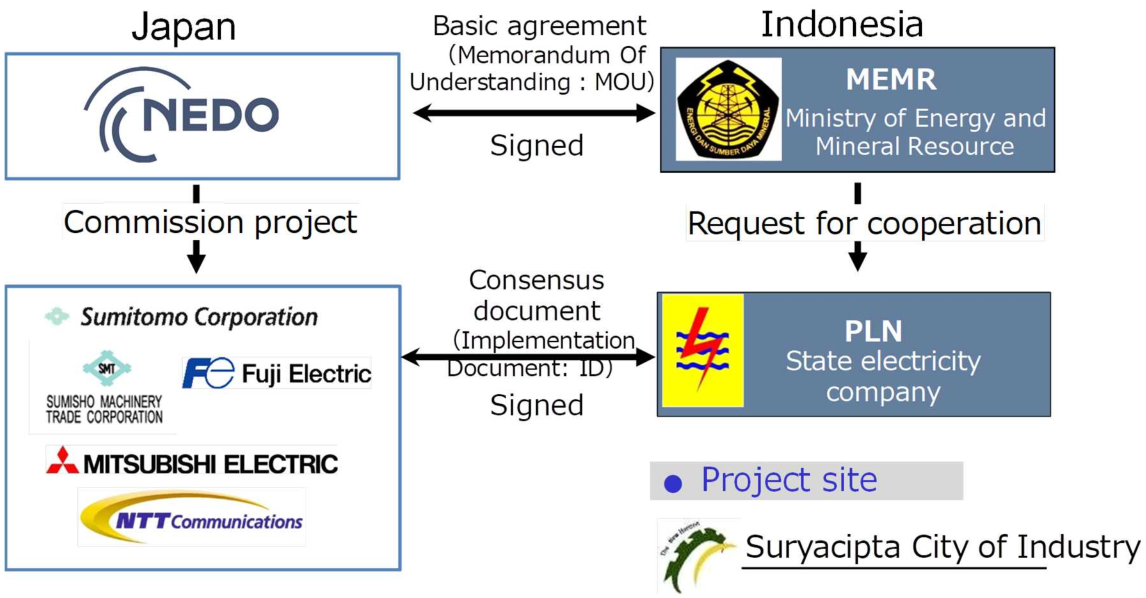


Figure 1 Demonstration system

3. Demonstration overview

This demonstration was based on four themes. The themes of the demonstration and the roles of the implementers are shown in Table 1.

Themes 1 and 2 are technological and business demonstrations based on the actual situation in Indonesia described above. Theme 3 is a technical demonstration of the infrastructure for implementing the system in Theme 2. In addition, Theme 4 examines the business structure for developing these technologies and businesses in the region.

Table 1 Demonstration theme and Roles of Japanese operators

Role	Description	Implemented by
1.Power quality stabilization technology	Technology and Business Demonstration of High-Quality Power Supply Systems	Fuji Electric
	Technical demonstration of power distribution automation system	
2.Energy management of industrial park	Technology and business demonstration of DSM system	Mitsubishi Electric
	Demonstration of factory-mounted FEMS and Simplified FEMS	
	Demonstration of cloud-based FEMS technology	Fuji Electric
3. Construction of ICT platform that serves as the foundation for Theme 2	Demonstration of ICT platform technologies	NTT Communications
4.Survey on establishment of local JVC	Business model analysis and JVC establishment survey	Sumisho Machinery Trade Corporation

The outline of each theme is shown below, and the overall image of the demonstration is shown in Figure 2.

3.1. Theme 1: Power quality stabilization technology

Theme 1 is a demonstration for power quality improvement. In this theme, two systems, High Quality Power Supply (HQPS) and Distribution Automation System (DAS), were introduced and verified.

In general, factories take self-defense measures such as installing individual uninterruptible power supplies (UPSs) and in-house power generation equipment in order to protect critical production facilities from major damage caused by power outages and instantaneous voltage drops. By installing a large-capacity power quality stabilizer in the distribution system to provide uninterruptible, high-quality power for individual factories, it is possible to reduce initial investment and maintenance costs through economies of scale compared to individual measures.

The power quality stabilizer was installed between PLN's distribution system and the industrial park, and a system (HQPS) to supply high-quality power of stable voltage to multiple factories through dedicated line was built to verify the effectiveness of power quality improvement and the feasibility of business development.

In addition, with the aim of improving supply reliability by improving SAIDI/SAIFI (average duration of power outages/average number of power outages) in the distribution system, the Distribution Automation System (DAS) with an fault recovery function to shorten power outage times in the distribution fault was constructed and installed at PLN offices, and its contribution to shortening power outage times was evaluated. In addition, the maintainability of the DAS database for expansion of the distribution system, such as the addition of equipment, was also evaluated so that the PLN can update the DAS for the distribution system that is expanding daily.

3.2. Theme 2: Energy management of industrial park

Theme 2 is a demonstration of energy savings. In this theme, two systems, the Demand Side Management (DSM) system and the Visualization of Electricity Consumption for Factories (FEMS; Factory Energy Management System), were introduced and verified.

In the demonstration, the Demand Side Management (DSM) system was introduced to dynamically control electricity demand from customers (multiple factories) in the industrial park using ICT technology, with the aim of reducing peak electricity demand during times of tight power supply and demand and controlling high cost power generation. In Indonesia, the liberalization of electricity market is not as advanced as in Europe and the United States, and there is no wholesale electricity trading market, so DSM was developed to flexibly set the unit price of incentives according to the collection of negawatts. In addition, in order to make effective use of the DSM, three types of FEMS (factory-mounted FEMS, simplified FEMS, and cloud-based FEMS) were introduced as a tool for visualizing electricity consumption and promoting energy savings at participating factories, and verification of the efficiency and effectiveness of electricity consumption

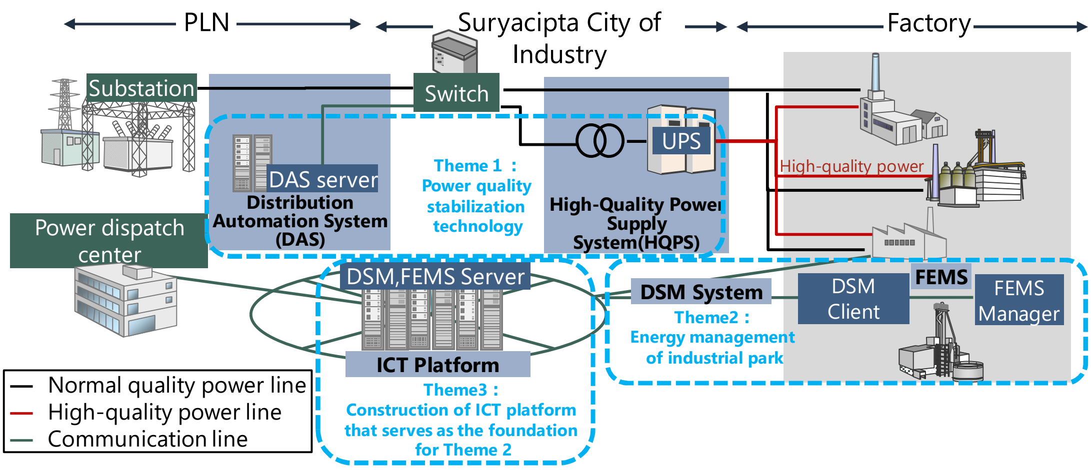


Figure 2 Whole picture of smart community demonstration in Java Island, Republic of Indonesia

analysis was carried out.

3.3. Theme 3: Construction of ICT platform that serves as the foundation for Theme 2

Theme 3 is to construct the infrastructure (common infrastructure) necessary for the actual operation of DSM and cloud-based FEMS among the applications developed in Theme 2, and to verify the effectiveness of this infrastructure.

Specifically, High-quality communication infrastructure that spans a wide area between the data center in Jakarta and the industrial park, as well as cloud infrastructure equipped with various server functions were provided to verify the validity of a common basis for Theme 2. In addition, effective use of these ICT platforms and possible provision of business applications were examined.

3.4. Theme 4: Survey on the establishment of local JVC

Theme 4 is to verify the business structure and other aspects of the technology and business that were demonstrated in Themes 1 to 3.

In order to continue the business and develop export of packaged infrastructure, it was essential to have a local management body.

In order to realize the business model considered at the beginning of the demonstration project, interviews were conducted with related companies in order to clarify the possibility of establishing a Joint Venture Company (JVC) and the conditions for its establishment, and the results were compiled.

Surveys were conducted on local laws and regulations, procedures for establishing local companies, and business licenses in implementing HQPS, DSM, FEMS, and ICT platform businesses.

Figure 3 Scope of survey

4. Construction of demonstration system

In this chapter, the systems constructed for the demonstration are described respectively.

4.1. Theme 1: Power quality stabilization technology

4.1.1. High Quality Power Supply System (HQPS)

The conventional method of installing UPSs at individual factories as a measure to cope with power outages and instantaneous voltage drops requires capital investment on a customer-by-customer basis, but the High Quality Power Supply System (HQPS), which can supply power in a single unit within the high-voltage system, is a shared service model in which each factory receives high-quality power without capital investment. The HQPS was installed in the Suryachipta Industrial Park (Fig. 4), and demonstration operation was conducted for about one year for three factories in the industrial park.

Figure 4 Facilities in the industrial park where HQPS was installed (outer appearance and inside)

The HQPS is equipped with a UPS as a device to maintain a stable power supply against instantaneous power outages and voltage drops. The UPS has a built-in battery of 4 MVA/3.2 MW, and even in the event of a PLN system power failure, it is possible to maintain the power supply to the critical loads of the 3 factories via dedicated line (Figure 5).

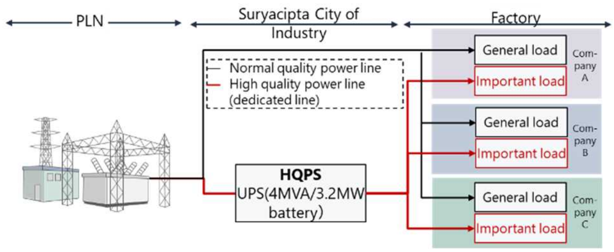


Figure 5 Configuration of HQPS

Prior to the demonstration, power outages and voltage drop due to PLN system occurred frequently, raising a major issue of how to improve the quality of power supply. The factories participating in the demonstration did not have their own backup equipment, so it was then considered as a problem that fluctuations in voltage and frequency affected product quality.

4.1.2. Distribution Automation System (DAS)

The Distribution Automation System (DAS) has been delivered to PLN Karawang office in Karawang province, West Java, with Suryacipta Industrial Park as its service area. In the PLN, monitoring and control systems (SCADA), which remotely and centrally monitor the transmission and distribution systems, are being introduced along with the expansion of the transmission and distribution systems. But the operation of the distribution systems is still in the process of being introduced, and DAS, which has automated fault recovery function and facilitating equipment maintenance, has hardly been introduced.

Figure 6 Outer appearance of PLN Karawang (left) and office installed with DAS (right)

DAS is a system for monitoring and controlling power distribution systems, which incorporates many unique functions such as automated fault recovery, flexible database maintenance and maintenance outage planning in addition to the normal monitoring and control functions of SCADA (Supervisory Control And Data Acquisition) which PLN mainly uses.

For automated fault recovery function, the DAS used in Japan uses time-phased transport system, in which the section causing a system fault is detected by the measured voltage. In Indonesia, however, the system detects a fault section by measured current, taking account the difference in system configuration.

In Indonesia, when a system failure occurs, the cause is searched for by patrol on the site, so restoration to a healthy section takes a long time, but it is expected to be restored in tens of seconds by introducing this function.

Table 2 Differences in functionalities between the demonstration DAS and the competitive system (SCADA)

Main functions	Competing system	DAS for demonstration
Monitoring and control of substation	○	○
Monitoring and control of distribution system	○	○
Topology display of distribution system (charge/discharge, accident point, etc.)		○
Database maintenance (Easily maintained by user)	○	◎
Automated fault recovery (fault detection/ restoration, etc.)		○
Maintenance outage planning		○
Actual data storage	○	○
System error management	○	○

4.2. Theme 2: Energy management of industrial park

4.2.1. Demand Side Management System (DSM)

The Demand Side Management (DSM) system introduced in this demonstration aims to stabilize the balance between power supply and demand, conserve energy, and reduce electricity costs by reducing power demand (shifting/cutting peak demand) at customers (factories in the industrial park) in response to power reduction requests from PLN.

In the demonstration, Mitsubishi Electric Corporation acted as an aggregator and, in cooperation with PLN, have issued bids for power reduction to 21 factories in the Suryacipta Industrial Park, by setting the date, time and unit price of the incentive according to tight supply and demand conditions. The aggregator increased the unit price of the incentive within the upper limit notified by the PLN in accordance with the amount of collected power reduction notified (as a result of bidding) by factories

During the demonstration, a DSM application for factories was developed, and it was verified that the sequence of power reduction requests based on the power supply-demand balance forecast from the PLN, the power reduction call by the aggregator, and the power demand reduction execution at each factory cooperating with the DSM demonstration worked effectively. Then, verification was conducted to see how much the amount of electricity reduction (bid amount) would change by setting incentives (actually deducted from the electricity bill) based on each factory's electricity reduction performance.

In addition, three types of FEMS (factory-mounted FEMS, cloud-based FEMS, and simplified FEMS) were manufactured and installed as a tool for visualizing electricity consumption and promoting energy savings for participating factories in order to make effective use of the DSM, and the efficiency of electricity consumption analysis was verified.

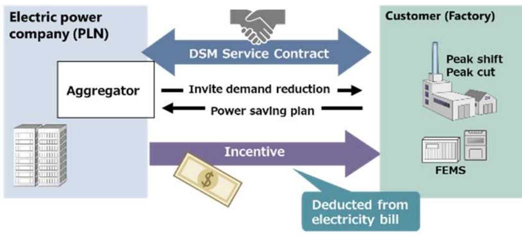


Figure 7 Structure of DSM

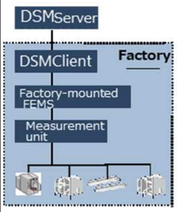
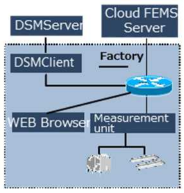
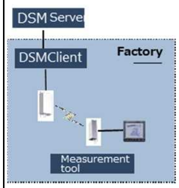
4.2.2. Power Consumption Visualization Tool (FEMS)

When a factory participates in a DMS bid, it is important to manage the amount of electricity used in the factory. In order to use DSM more efficiently, three types of power consumption visualization tools (FEMS) were installed in a total of 17 factories.

Two factories were installed with the "Factory-mounted FEMS" which is designed for large scale factories that require a number of measurement units to be equipped; nine factories with "Cloud-based FEMS" designed for small/medium scale factories that require limited number of measurement units to be equipped; and six factories with low-cost "Simplified FEMS" designed for small/medium scale factories. Both cloud FEMS and simplified FEMS are for small and medium-sized factories. The former measures the amount of use with a dedicated measuring unit, while the latter collects the amount of use of an already installed watt-hour meter and can be installed at a lower cost than the former measures.

With regard to the introduction of FEMS, a business model where factories pay monthly service fee to the manufacturer that provides the FEMS was considered..

Table 3 Types of FEMS and No. of factories that introduced FEMS

Category	Factory-mounted FEMS	Cloud-based FEMS	Simplified FEMS
Manufact-urer	Mitsubishi Electric	Fuji Electric	Mitsubishi Electric
Features	● For large scale factories ● Many measurement units	● Small/mid scale factories ● Limited number of units	● Small/mid scale factories ● Low cost
Structure			
No. of factories introduced	2 factries	9 factries	6 factries

4.3. Theme 3: Construction of ICT platform that serves as the foundation for Theme 2

4.3.1. ICT Platform

In this demonstration, NTT Communications provided a highly reliable cloud platform and communications to support provision of DSM and cloud-based FEMS as the ICT platforms for 20 factories.

The cloud platform was located in the data center in Jakarta City and the communication line (relay line) over 50 km to the factory was made up of communication lines by two communication companies to ensure redundancy. (Figure 8)

Also, the industrial park has ring-shaped redundant optic fiber communication path, enabling factories to use Internet via this platform.

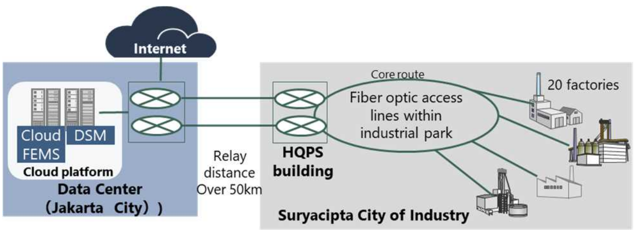


Figure 8 Configuration of ICT Platform

5. Demonstration results

5.1. Theme 1: Demonstration results of power quality stabilization technology

Evaluation results of HQPS and DAS systems are described below.

5.1.1. Evaluation result of HQPS

In the demonstration of high quality power supply by HQPS, the effectiveness of the power quality improvement was verified against the instantaneous voltage drops that occurred multiple times during the demonstration period. During the one-year demonstration period, there were 14 instantaneous voltage drops in the power supply of the PLN system, seven of which were severe enough to affect the factory's critical facilities, but HQPS was able to improve them to a level that did not affect customers. As shown in Figure 9, without HQPS, the power supply voltage drops by 45.2% for 99 milliseconds (about 0.1 second). However, the introduction of HQPS markedly reduces the voltage drop. It is estimated that the direct economic loss in the event of production facilities stopping or failing due to seven serious-level instantaneous voltage drops would be a total of 60.9 million yen at the three factories during the observation period (about one year), which means that the risk could be avoided.

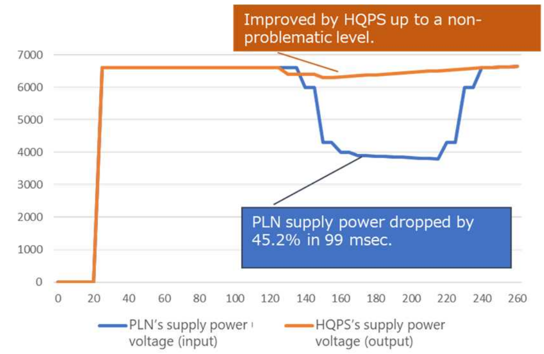


Figure 9 Example of power quality improvement using HQPS

In addition, business demonstration was conducted during this demonstration based on an assumed scheme that a factory using HQPS (customer) pays high-quality power charges to PLN and PLN makes payment to a business operator assuming O&M of the HQPS in exchange for the O&M service.

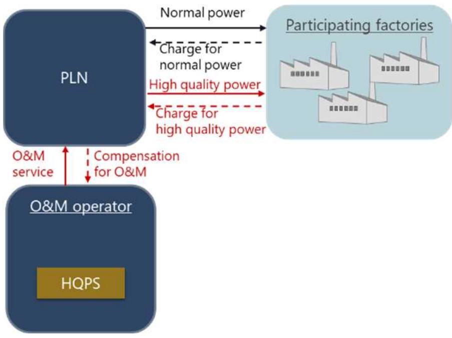


Figure 10 HQPS business demonstration scheme

According to the original estimation, by setting the price equivalent to regulatory ceiling (1,650Rp/kWh) as the price of high-quality electric power, it becomes possible to secure the difference from normal power rate as a profit (650Rp/kWh before the demonstration). However, because the electricity price increased sharply due to changes in business environment during the demonstration period, the difference between normal electricity price and regulatory ceiling price for electricity became smaller (the difference reduced to 250Rp/kWh), making it difficult to secure profit margins

In the demonstration area (Table 4).

Table 4 Changes in profit margins due to rising electricity rates

	2011 (Before the start of demonstration)	2017 (During the verification period)
Regulatory ceiling price for electricity	1,400 Rp/ kWh※	1,650 Rp/kWh
Normal electricity price	750 Rp/kWh	1,400 Rp/kWh
Difference (= Interest in this demonstration)	**650 Rp/kWh**	**250 Rp/kWh**

*1 rupiah is 0.008 yen (As of 2020)

In addition to the aforementioned high electricity tariffs, the power supply quality of the PLN in the industrial park has improved sharply, with the Suryacipta Industrial Park experiencing power outages of less than one hour (once) between 2015 and 2017, compared to 3.2 hours (five times) per year in 2010 (Figure 11). (However, in August 2019, there was a major 12-hour power outage in the area.)

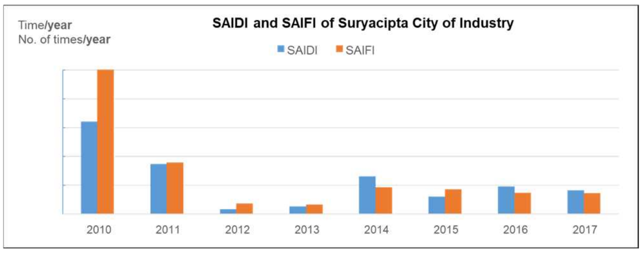


Figure 11 Changes in the duration (SAIDI) and frequency (SAIFI) of power outages at the industrial park

Taking into account the significant changes in the business environment during the demonstration period, such as soaring electricity rates and improvements in electricity quality, the initially envisioned business model, in which HQPS was introduced and O&M services were provided, would not be feasible in the demonstration area, and decided not to continue the business using the demonstration equipment (HQPS).

5.1.2. Evaluation result of DAS

In the demonstration of the power distribution automation system (DAS), the introduction of a system with advanced fault recovery functions and flexible data maintenance functions in accordance with the standard specifications and international standard protocols set by the PLN was verified to contribute to the reduction of power outage time in the event of an accident and to the maintenance of the power distribution system, which is expanding daily.

The DAS server and the monitoring and control console installed at the PLN Karawang office in this demonstration complied with PLN standard specifications for communication with remote terminal units (RTUs) installed at substations by PLN.

In addition, it was confirmed that the DAS can be interconnected with the equipment of multiple vendors such as Siemens and ABB using the international standards protocol (IEC).

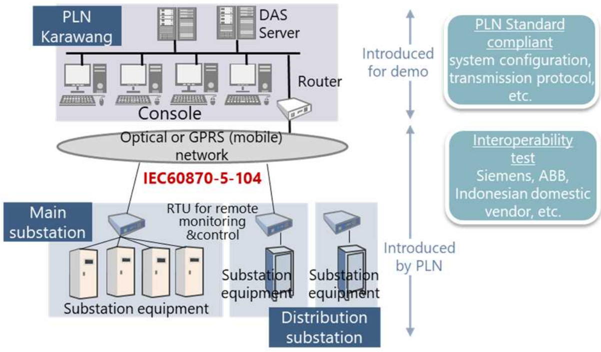


Figure 12 Overall specifications of DAS (Configuration and communication standard)

As for the automated fault recovery function of the DAS, the current supply reliability of the Suryacipta region was analyzed based on the power outage records of Suryacipta Industrial Park from 2011 to 2017, and the outage time with the automated fault recovery function was estimated based on the outage records of Suryachipta Industrial Park. As a result of the trial calculation, it was found that the outage time was significantly improved to less than half before and after the introduction of DAS (estimated) (Table 5).

Table 5 Power outage time improvement by automatic accident recovery function (Estimate)

		2011	2012	2013	2014	2015	2016	2017
SAIDI※ (min.)	Before introduction of DAS	104	10	16	78	36	57	49
	After introducing DAS (estimate)	10	3	7	10	4	8	9

*Power outage duration x total number of customers who lost power

In addition, regarding the database maintenance function, it was possible for user to select equipment from the pallet on the DAS screen, arrange it freely, and draw distribution lines. It was confirmed that the person in charge of PLN could easily update the database at the time of updating distribution lines such as adding more equipment.

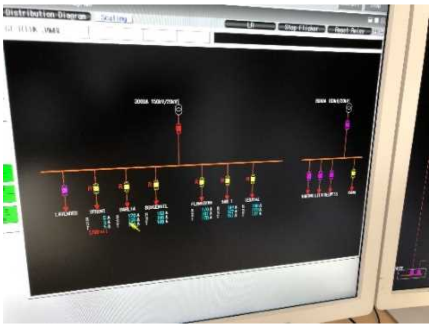


Figure 13 System diagram created by DB maintenance function

5.2. Theme 2: Demonstration result of energy management of industrial park

This section describes the evaluation results of DSM and FEMS.

5.2.1. Evaluation result of DSM

In the DSM demonstration, a new DSM application was developed to solve the challenges of the previous DSM trials by PLN, and the effectiveness of incentive/penalty settlement between PLN and each factory and power visibility through the introduction of three types of FEMS was verified in an industrial park.

PLN demonstrated DSM system on its own in 2011. At that time, a DSM was based on a contract between PLN and the factory and did not have a system for exchanging information with the factory. This means PLN paid incentives to the factory based on the performance of power reductions during times of high power demand (peak hours), with a fixed unit price of incentives and no specified date and time for power reductions.

It was also stated that no penalties would be imposed even if no power cuts were made. Because of this, it was not possible to predict or control the amount of power reduction, and this has not been put to practical use. It was confirmed that the DSM introduced in NEDO demonstration project was able to predict and control the amount of power reduction because the unit price of incentives changes according to the amount of bidding on a bid basis (Figure 14).

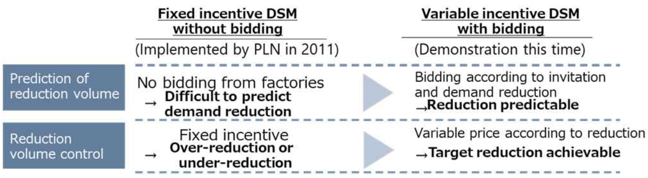


Figure 14 Result-based DSM vs Bid-based DSM

For the DSM demonstration, the participating factories and PLN signed a service agreement on the unit price (up to 1,650 Rp/kWh) of incentive/penalty for the demonstration period. As a result, a total of 13 requests for electricity demand reduction were made during the period, resulting in a total of 829 bids, a total of 4719 kRp for incentives, and a total of 150 kRp for penalties (Table 6).

Table 6 Actual bids submitted by participating factories

Demand reduction was conducted for 13 days during the period between July 2017 and February 2018		
No. of factories participated in bidding		On average 6 factories per day bidding was conducted Total: 75 factories
No. of bids		On average 64 bids per day bidding was conducted **Total: 829 bids**
Incentive price (average)	At the start of bidding	769(Rp/kWh)
	At the end of bidding	1,397(Rp/kWh)
Incentive total		**4,719Rp(kWh)**
Penalties total		**150(Rp/kWh)**

As for the method of setting the unit price of incentives, they set a low unit price of incentives at the start of the electricity reduction bidding, and increased the unit price of incentives during the demonstration period. Then, the impact of the increase in the unit price of the incentive was confirmed by counting the change in the number of bids from participating factories in relation to the number of days elapsed.

The results showed that the amount of bidding (the amount of power reduction) was low when the unit incentive was low, and that the amount of bidding (the amount of power reduction) increased markedly when the unit incentive was increased. When the incentive unit price was set at 500 Rp/kWh, the amount of electricity reduction was about 13 kW to 24 kW, but when the incentive was raised to 1,200 Rp/kWh, the amount of electricity reduction increased to 103 kW. It was found that the amount of electricity demand reduction could be controlled by increasing or decreasing the incentive unit price.

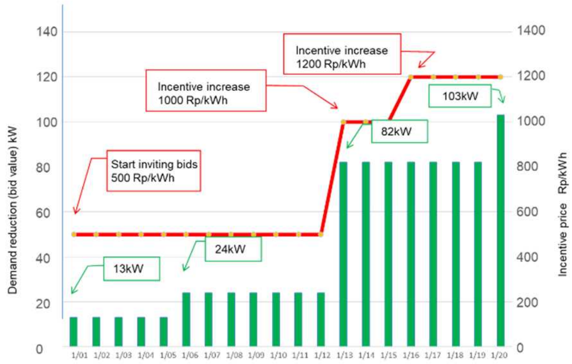


Figure 15 Changes in bidding with changes in incentive price

In this demonstration, possible business model involving license agreement with Japanese operator as aggregator and PLN was examined as Japanese operators dealt with demand reduction bidding as aggregator on behalf of PLN,.

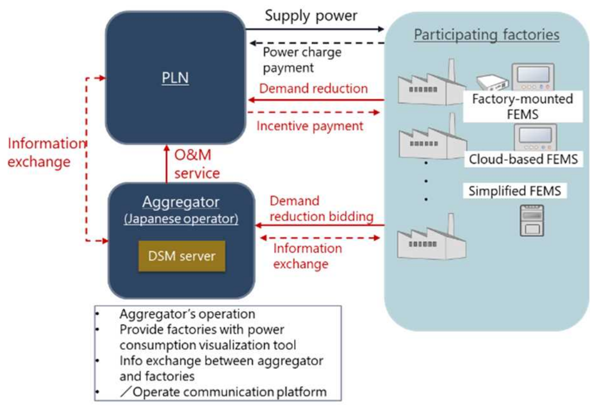


Figure 16 Scheme of DSM business demonstration

However, as described in 5.1., as of 2016, the supply-demand balance of power in the target area of the demonstration project had been largely improved with the increase in PLN's supply capacity, and the need for demand reduction itself has disappeared. Therefore, the above business model that had been assumed at the beginning of the project eventually fell through.

5.2.2. Evaluation result of FEMS

(1) Factory-mounted type FEMS

With a custom-made FEMS that assumes a large-scale factory, based on the usage data (kWh) and production data (units) for each time zone, it became possible to check the power consumption (usage per product) for each line (Fig. 17).

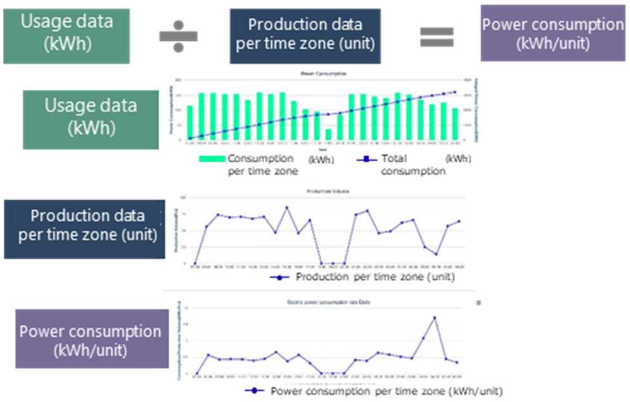


Figure 17 Visualization of power consumption by factory-mounted FEMS

Also, the production status (Stop, Idle, Production) of individual equipment in the factory was made visible. It even became possible, for example, to examine energy saving during non-production hours by limiting idle time and bidding for DSM (Fig. 18).

Figure 18 Visualization of operation status of equipment by time zone

(2) Cloud-based type FEMS

With the cloud-based FEMS intended for medium-sized factories, the operating status of equipment that consumes a lot of energy can be identified, so as to realize energy saving.

For this purpose, a function was developed to display a ranking of devices with high energy consumption based on the amount of electricity used (kWh) (Fig. 19).

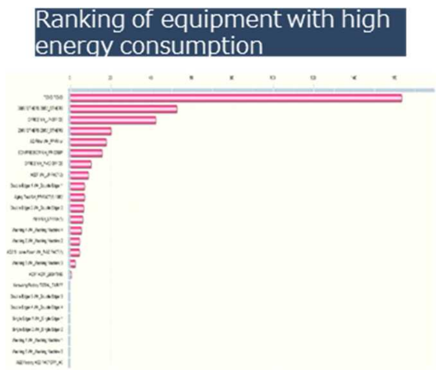


Figure 19 Energy usage ranking by equipment

In addition, a function was developed to visualize the operating status of equipment with high consumption by showing the breakdown of power consumption by equipment in the power consumption graph by time of day (Fig. 20).

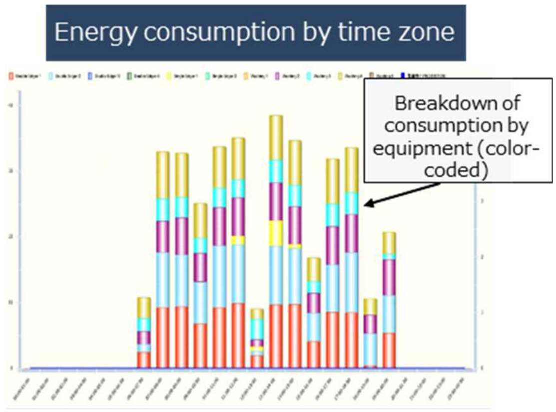


Figure 20 Usage graph by time zone

By utilizing the above functions, energy saving and leveling of energy usage (energy shift) at medium-sized factories, which account for a large proportion of industrial parks, were successfully implemented.

(3) Simplified type FEMS

The simplified FEMS intended for small-sized factories enabled visualization without difficulty by having minimum equipment configuration that connects the slave unit connected with power meter and the base unit connected with DSM via wireless communication (920MHz specified low-power radio communication) (Figure 21).

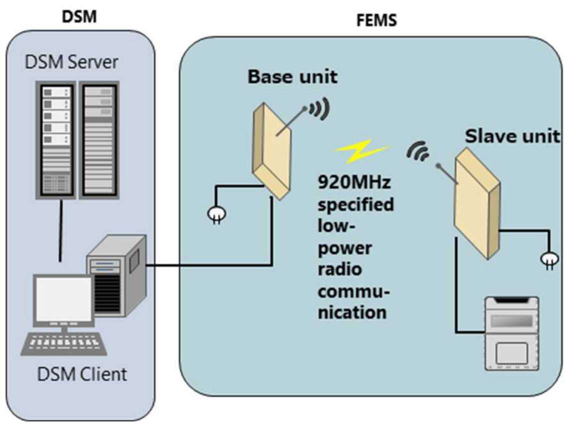


Figure 21 Overall specifications of Simplified FEMS

(4) Association with DSM

Fig. 22 shows the DSM bidding frequency for each factory, which verified the possibility of participating in and guiding DSM by using these visualization technologies.

It was confirmed that, of the 21 factories that participated in DSM, those without FEMS made extreme number of bids, while 17 factories with FEMS (factory-mounted, cloud-based and simplified type) were active in terms of DSM bidding.

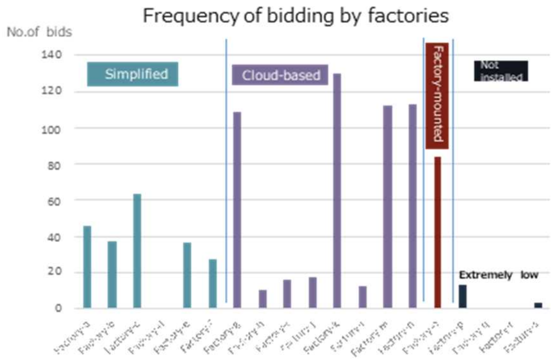


Figure 22 Frequency of DSM bidding by factory (with and without FEMS)

5.3. Theme 3: Demonstration result of construction of ICT Platform

As shown in Table 7, the service was successfully provided to DSM and Cloud-type FEMS by the redundant configuration. No problem was found with the performance and quality during the demonstration period, and the effectiveness was verified.

Based on the observations between May 2017 and February 2018, Table 7 compares the utilization rates with and without redundant configurations. The utilization rate for the redundant configuration is shown in the bottom row, and the utilization rate for the period in which the redundant configuration is not used is shown in the upper row as an estimate.

In the section from data center to service line of the industrial park, if the configuration is not redundant, the annual downtime was more than 7 hours. However, with redundant configuration, the downtime became 0 hour with the utilization rate of 100%, succeeded in ensuring high availability.

Table 7 Comparison of utilization rate of equipment with or without redundant configuration

From Jul. 2017 - Feb.. 2018 Utilization rate/Downtime converted to annual basis	Section 1 From data center to service line of the industrial park	Section 2 From data center to each factory (endpoint)
Non-redundant configuration (estimate)	Utilization rate: 99.92% Downtime converted to annual basis: 7.1 hours	Utilization rate: 99.86% Downtime converted to annual basis: 12 hours
Redundant configuration	Utilization rate: 100% Downtime converted to annual basis: 0 hour	Utilization rate: 99.94% Downtime converted to annual basis: 4.8 hours

5.4. Theme 4: Survey results on establishment of local JVC

In the study of the establishment of the local JVC, the possibility of dissemination of the business results was verified based on the business model of each system.

Through the survey, the business licenses required for projects as well as the procedures for establishing a local company in accordance with Indonesia regulations were confirmed in a comprehensive manner. It was clarified that although required license would be different depending on the solution, the common procedures would be used for establishing a local company, for example when making applications for and registering a company with the government agencies. (Table 8)

Table 8 Requirements by project (summary)

	Local regulation (foreign currency restrictions)	Business license requirement	Local incorporation procedures
HQPS	Up to 95% allowed	Electricity Business License (IUJPTL)	Following procedures to be implemented regardless of business content. ①Register investment with BKPM (The Investment Coordinating Board) ②Reserve company name (trade name) with Ministry of Law and Human Right ③Prepare Certificate of Establishment by notary public ④Obtain Proof of Location at municipal office ⑤Obtain tax number from local tax office ⑥Open an account at local bank ⑦Establishment of a company is registered with Ministry of Law and Human Right by notary public ⑧Obtain investment permit from BKPN ⑨Register the company with Ministry of Trade ⑩Acquire business licenses from MEMR, etc.
DSM	Up to 95% allowed	Electricity Business License (IUJPTL)	
FEMS (Cloud-based)	Up to 67% allowed	Registration of business entity with MCIT	
ICT Platform	Up to 67% allowed	Registration of ICT business license	

5.5. Demonstration results - Summary

The results of the demonstrations on the four themes are summarized in Table 9.

Table 9： Results of demonstration (Summary)

Theme	Results/Achievement
Power quality stabilization technology	✓ It was confirmed that communication between DAS system and RTU was PLN Standard compliant and that the system can be interconnected with equipment of multiple vendors. ✓ Power outage duration was improved by the automated recovery function and operator of PLN became able to easily update/ maintain the system diagram. ✓ It was confirmed that the instantaneous voltage drop occurred in the PLN system during the demonstration period could be improved to a non-problematic level by the HQPS.
Energy management of industrial park	✓ It was confirmed that bidding was activated with the increase in the incentive price, revealing that power demand could be controlled by increasing or decreasing the incentive unit price. ✓ Visualization of power consumption using FEMS was realized and successfully linked with DSM. It was found that the DSM bidding was activated with the introduction of visualization of power consumption.
Construction of ICT Platform	✓ ICT platform that uses DSM and cloud-based FEMS via communication network was built. ✓ There was no problem with the performance and quality during the demonstration period, and the effectiveness was verified. In particular, the adoption of redundant configuration has reduced the downtime to 0 hour, succeeded in ensuring high availability with 100% utilization rate.
Survey on establishment of local JVC	✓ The business licenses required for each business and the procedures for establishing local company in accordance with Indonesian regulations were confirmed exhaustively.

Energy saving and CO_2 reduction effects through introduction of DSM were also estimated as the results of this demonstration.

Based on the energy saving effect estimated from the contracted power and the average power reduction rate of the industrial park, the estimate was also made for PLN's Java Bali system.

＜Energy saving effect by introducing DSM＞

Energy saving of industrial park: 800MWh / year

Energy saving of Java Bali system: 67.1 GWh / year, 844 GWh (10 years)

＜CO_2 reduction effect by introducing DSM＞

CO_2 reduction of Java Bali system: 752kt-CO_2 (10 years)

6. Key Findings

Important achievements and implications obtained through this demonstration project have been organized from the following three perspectives:

① Importance of flexibility with changes in business environment
② Balancing of international standardization and usability
③ Change of perspective from technology to business

Point(1): Importance of flexibility with changes in business environment

At the start of the demonstration (2011), Indonesia was in short supply of power, and there was a strong need for power companies to reduce demand and consumers to stabilize power quality (to avoid power outages).

Considering this, the demonstration was positioned as a business demonstration. However, the electric power company PLN sharply expanded the generation facilities, which significantly improved the supply-demand balance during the demonstration period. As a result, initially assumed business models for HQPS and DSM fell through in the short term.

Regarding the DAS introduced in PLN's office, Mr. Adi of PLN commented that the Suryacipta City of Industry had already been relatively reliable areas in terms of power supply so that it could be further utilized in areas with lower reliability.

On the other hand, Mr. Walla of Suryacipta City Of Industry (SCI) pointed out that if factories of robots and semiconductors are located in an industrial park to be developed in the future, the need for high-quality electricity would increase and that if industrial park has its own power source, the need for demand reduction would increase, suggesting possible future utilization of Japanese technology.

As described above, the fluctuations in supply-demand balance and differences in power quality required in the target area have a great impact on energy business. It is therefore necessary to assume trends of the business environment as much as possible in advance and establish a system that allows the provider to flexibly change the plan.

This is the first smart community demonstration by NEDO in Southeast Asia. Based on the demonstration results, risk management guidelines including actually formulated to appropriately review the business system through the PDCA cycle, and have been utilized in planning and management of subsequent demonstrations. This is considered one of the achievements of the project.

Hardware-based solutions pose an issue of increase in fixed costs associated with handling and maintaining things, but cloud-based solutions involve only the usage fee which therefore have an operational advantage because the users can take flexible contract arrangements and plan expansion and abolition of servers according to customer needs.

Point(2): Balancing of international standardization and usability

Through construction of DAS (Distribuion Automation System) in this demonstration project, Fuji Electric complied with the IEC communication standards, carried out testing for interoperability with equipment of multiple vendors and successfully built a highly versatile package system.

The SCADA and DAS made by Japanese vendors that have been introduced by general transmission and distribution operators in Japan have limited compliance with IEC in terms of communication standards and databases. They have not reached the level to be used in general.

On the other hand, systems from major European and American vendors, including remote control units (RTUs), have been developed based on the IEC communication standards. Even in Southeast Asia where many of them have already been introduced, the application of IEC has become a standard in terms of coordination between systems, etc.

In fact, the PLN standard that stipulates the standard specifications for the products which PLN adopts has been developed based on the IEC communication standard, i.e. PLN does not introduce own standard unlike Japan.

It is therefore important to establish a system that can easily coordinate with other existing systems and equipment based on the compliance with international standards, even when deploying Japanese solutions overseas.

In addition, in terms of the strengths compared with the competitors, DAS-specific functions support PLN's operation, and its unique usability-conscious function would continue to add value to the system.

According to Mr. Hendra of PLN Karawang, where DAS was installed, DAS is used about once a week, and the main functions being used are remote control for switching the system, changing system diagram and monitoring of equipment status. It was a great achievement to have the ability to monitor the status of equipment on the distribution system online using DAS, which allows to take measures in advance if something goes wrong.

Although being multifunctional and excellent in usability, DAS has a certain level of restrictions on user customization compared with the competitive system in Europe and the United States (SCADA), and it is an issue that it is designed with less flexibility.

Based on the above, it is believed that improving the versatility and interoperability by complying with the standard and achieving usability according to customer needs will be advantage of Japanese solutions.

Point: ③ Change of perspective from technology to business

In this project, DAS, HQPS, DSM, FEMS and ICT platform each achieved the goal in terms of technical demonstration, being able to show Japan's high technical capabilities in this field.

In fact, stakeholders like Mr. Purnomo of PLN and Mr. Edi of MEMR praised the high quality of Japanese solutions.

On the other hand, such comments were obtained that they were not yet feasible as business when comparing the benefits from introduction of system with the system maintenance costs.

In particular, as described above, one of the reasons this time was that because the supply-demand balance of power improved during the demonstration period, it became difficult for company to secure profits. Given that the supply-demand balance would improve sooner or later, it is important to aim for creating universal value that does not depend on changes in the business environment to make good business sense.

For specific needs, Mr. Walla of SCI and Mr. Edi of MEMR mentioned that they wanted technology transfer from Japan. This reflects the idea that not just having Japanese vendors bring in Japanese solution but the cooperation with local vendors would contribute to improving technical capabilities of the relevant country.

In addition, as a result of the survey on the establishment of local JVC, it was pointed out by Mr. Tachi of Sumitomo Corporation that in order to develop the business it is necessary to register license which however is difficult to carry out by Japanese operator alone.

In order to be successful as a business, it is believed important for a company to increase the presence abroad through expansion of local technical resources including associating with foreign partners (operators) and export of technical knowhow as well as solutions.

7. Summary

The implementation content, results achieved and key findings for each of the themes conducted in this demonstration have been summarized.

It was a great achievement that the power quality improvement technology, which is one of Japan's strengths, was proven to be effective in the Indonesian power grid, and that each solution achieved its quality goal.

Further, the establishment of relationships with local stakeholders including the power company PLN is considered to help Japanese companies deploy technology in Indonesia in the future.

On the other hand, Indonesia, where demand was growing remarkably, securing supply capacity was a top priority issue, therefore it was premature to seek the solutions for reducing social and labor costs at that time.

However, it is expected that the solutions such as DSM and HQPS will increase the value not only in electric power companies but also among customers if self-consumption of energy makes progress in the future, driven by lower-cost batteries and other distributed energy resources.

In such efforts, it is hoped that the solutions will be developed into successful business with reference to the knowledge and learning obtained from this demonstration.

Finally, comments by stakeholders of Japan and overseas who deeply engaged in this demonstration are introduced.

Comment by Mr. Purnomo, PLN

PLN's basic monitoring and control system is SCADA, but Suryacipta's DAS is still being used. If more advanced functions are added, it will be needed in various places. I suspect that DAS will become more popular in 5 or 10 years.

Japanese engineers are open, friendly and easy to work with. If you have a problem, they will deal with it immediately. I was able to work with them without any worries. If the project with Japan is feasible for the customer, I would like to be involved again.

Comment by Mr. Nakamura, Fuji Electric

I think it is one of the achievements that PLN engineers got interested in DAS. I feel that they were particularly interested in the functions of detecting and recovering from accident points and the system diagram maintenance. In the case of SCADA of European and American vendors, they have to code by themselves for the maintenance of system diagram, and it does not support charging and power failure indications. In this regard, the system diagram function is useful. However, a problem is that users cannot freely increase the types of equipment.

Comment by Mr. Walla, SURYACIPTA CITY OF INDUSTRY

The ability to react to small voltage and frequency deviations was better than what is stated in the operating standard of PLN. It did not result in continued use with additional charge on normal electricity rate after the demonstration, but because there occurred blackouts three times in the area in 2019, some factories may have regrets over removing HQPS. If factories of robots and semiconductors enter the industrial park in the future, the required quality will be higher and the need for HQPS will emerge.

Also, because Suryacipta City of Industry has set up a power contract with PLN at a flat price regardless of the time zone, the benefits of DSM could not be found. However, for example, from the standpoint of procuring supply capacity by ourselves (i.e. having own power generation facility), it would be useful if DSM could reduce the originally prepared power of 100 to 60. This is what we are thinking at the moment for the new industrial park we are planning. We believe that there are areas where Japanese technology can be used.

Comment by Mr. Jaya, MEMR

Many factories participated in the demonstration and their reaction was that the systems were easy to use but not so necessary at present.
MEMR is responsible for the promotion of energy saving which should be addressed anyway even if power is oversupplied.
It is said that the customers of C & I (Commercial and Industrial) such as factories have the energy saving potential of 10%, so we are intending to work on technical aspects (e.g. establishment of standards to be applied by energy-saving functions, etc.).

Comment by Mr. Makino, Mitsubishi Electric Company

Prior to the start of the demonstration, PLN had tried DSM with fixed incentives to reduce demand during peak hours, lamenting that it was uncontrollable. The purpose of this demonstration was to make the system controllable. As a result, we could get an idea that with how much incentive price would be required to get a certain amount of bids. It was also found that factories with FEMS are clearly more energy conscious and submit more bids than those without FEMS. It was not only a simple simulation, but it resulted in a major achievement that we incorporated it into the power contract between PLN and the factory, and could go as far as to actually issue a power reduction directive.
There was an issue that factory operators stopped looking at the screen when they were busy, so there was a need for automation. This time it was for demonstration purposes, so we did not do that much, but we found that usability-conscious design is important in actual business.

Comment by Mr. Tachi, Sumitomo Corporation

This demonstration was originally aimed at the establishment of JVC, but due to changes in the business environment, etc., the results were limited to the investigation of requirements. A major factor in the business change was that Indonesia's supply capacity improved during the demonstration period.
In order to develop business locally, license registration is necessary, and it was proven that it was difficult to do it alone in Japan. Therefore, we recognized the importance of collaborating with local stakeholders.

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