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Development of an Automatic Generation Scheduling System Aimed at Efficient Operation of Power Plant

Operators Perspective

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ABSTRACT

In Japan, where the labor force is decreasing due to a declining birthrate and aging population, automation and efficiency in power plant operations in the retail electricity business are considered to be important technologies in the future. This study aims to automate such power plant operations, initially focusing on reducing manpower, systematizing know-how, and automating operation evaluations in the indispensable task of formulating power generation plans.

In the retail electricity business in Japan, the task of formulating power generation plans involves various processes, such as devising an optimal power generation plan considering various fluctuating elements, sending the power generation plan to the power company by email before the power generation day, and setting the power generation plan in the control system. Elements considered in the planning process include fuel prices, market prices due to supply and demand conditions in the power market, and constraints of power generation facilities. In particular, supply and demand conditions directly affect profits, but can only be roughly predicted from past performance, and differences can easily appear depending on the skill level of the operator. Therefore, creating a plan every day while considering these elements has been a significant burden for operators.

To address these issues, this study attempted to automate the task of formulating power generation plans using the price prediction service provided by the Japan Weather Association (JWA). This method involves obtaining price prediction data for the power market, predicted from seasons, weather, days of the week, and time, provided by JWA's price prediction service via a Web API, and calculating the power generation amount considering profits by comparing it with the fuel gas usage norm. At this time, a unique calculation algorithm was devised to reflect constraints of power generation facilities such as rated power generation, startup time, and number of startups, and corrections were made to make it a realistic power generation plan. This made it possible to quickly create a power generation plan that reflects changes in the power market price and meets actual operating conditions. In addition to planning, the sending of power generation plans to power companies by email and the setting of operation schedules in the power control system were also automated.

As a future initiative, it is planned to take into account medium- to long-term supply and demand forecasts when formulating plans. Using the data for two weeks ahead provided by JWA's price prediction service, automation of plan formulation during this period was achieved. Analysis of past purchase price data revealed seasonal biases, and there were situations where generating more (or less) power seasonally or monthly resulted in better profits. Therefore, by further reflecting the medium- to long-term seasonal fluctuations in purchase prices in the power generation plan, further profit improvement effects can be expected.

1 INTRODUCTION

In Japan's electricity trading market, the sale of electricity to households and small-scale businesses, which had previously been monopolized by regional general electric utilities, was liberalized in 2016. As shown in Figure1, this change allowed private companies, known as new power companies, to enter the retail electricity business as intermediaries. As a result, the introduction of renewable energy sources, particularly solar and wind power, is anticipated. However, alongside these GHG reduction measures, there is a concern that the operating rate of thermal power plants will decrease. Coupled with delays in the restart of nuclear power plants, this is expected to lead to a decline in power supply capacity. Consequently, the integrated operation of demand forecasting and securing supply capacity, including fuel procurement, has become a critical issue.

Renewable energy sources are characterized by their output variability due to weather conditions, making it essential to have power supply mechanisms that play an adjustment role to maintain the supply-demand balance. However, existing storage batteries and similar technologies are insufficient. Therefore, retail electricity providers are required to forecast daily electricity demand accurately and secure the necessary power supply to ensure stable distribution.

On the other hand, due to the chronic decline in the working population and the aging society, there is a growing need for efforts to streamline power plant operations through labor-saving measures. In response to this, we have worked on supporting the creation of efficient power generation operation plans using electricity price forecast data and on reducing labor and improving efficiency in the processes from planning to operation of power generation by utilizing the infrastructure of existing remote monitoring systems.

2 JAPAN'S WHOLESALE ELECTRICITY MARKET

The Japan Electric Power Exchange (JEPX) is the only wholesale electricity market in Japan. In the day-ahead market (spot market), where electricity for delivery on the following day is traded, the transaction price for the electricity to be delivered the next day is determined based on bids for planned generation volumes provided by power producers and planned demand volumes submitted by retail electricity providers under the simultaneous planned value system as shown in Figure2.

Electricity for a day is divided into measurement units of 0-30 minutes and 30-60 minutes each hour, resulting in 48 trading segments per day. Consequently, power producers are responsible for preparing generation volumes for each of these 48 segments and submitting them to retail electricity providers by two days before the operation day. This task is part of their daily operations.

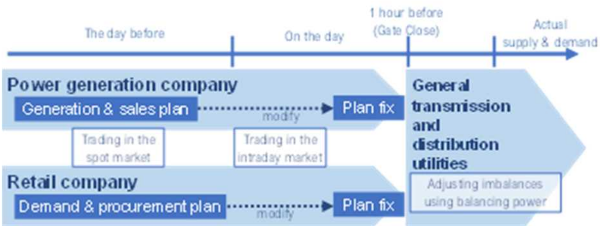


Figure 2. Simultaneous planned value system

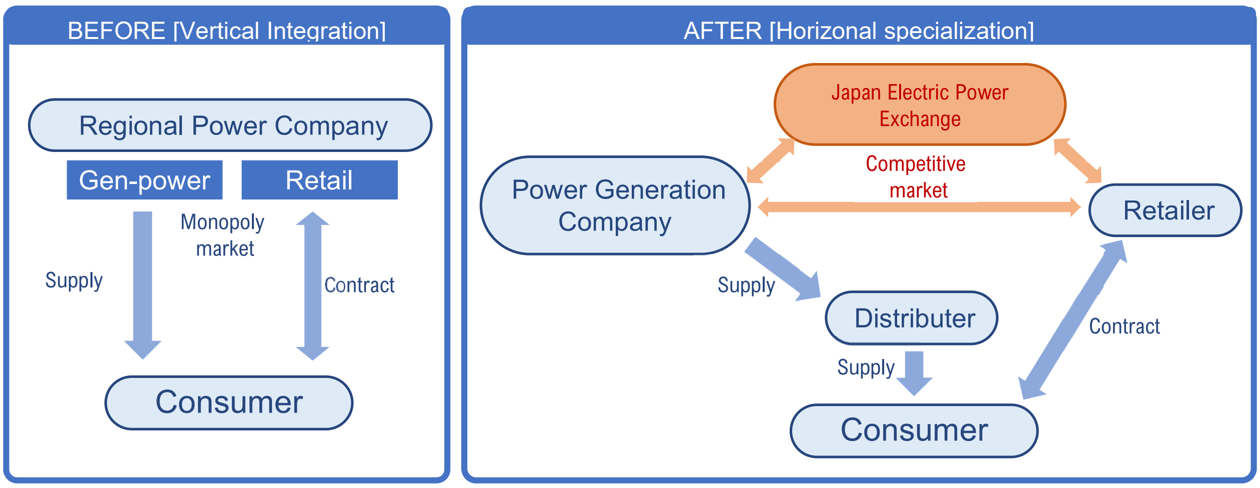


Figure 1. Comparison of Japan Electricity Market BEFORE and AFTER Liberalization

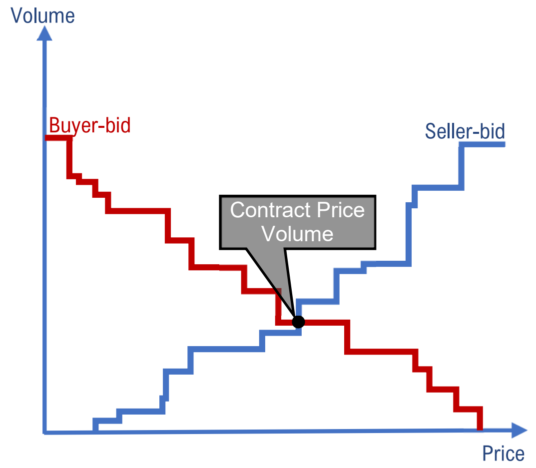


Figure 3. Illustration of price determination in a blind single price auction

3 CURRENT ISSUES

As mentioned earlier, the transaction price in the spot market is determined by the balance of electricity supply and demand. However, electricity supply and demand are susceptible to influences such as temperature, sunlight, and calendar events, which cause the transaction price to fluctuate. Therefore, power producers can operate a more profitable power generation business by considering these influencing factors and planning their generation schedules during times when transaction prices are high.

Additionally, when the power generation equipment is a gas engine, the gas used as fuel is supplied through a pre-agreed usage amount for a certain period, and it is mandatory to use the minimum supply of fuel within that period. If the minimum value is not met, compensation must be paid. Thus, power producers must also consider using gas fuel above the minimum value during the contract period when planning operations, in addition to targeting high transaction price periods.

Until now, power plant operators have relied on their experience and expertise, considering past operational records, weather forecasts, and potential events affecting transaction prices, to create power generation plans for two days ahead. These plans are submitted to retail electricity providers, and based on them, the power generation equipment is operated to supply electricity. However, the profitability of power generation has been heavily dependent on the operator's abilities, and the daily tasks of creating generation plans, communicating with retail electricity providers, and setting operation schedules in the power plant control system have placed a significant burden on operators. With the declining workforce and aging population leading to a shortage of successors, there is an urgent need to streamline and reduce labor in power plant operations.

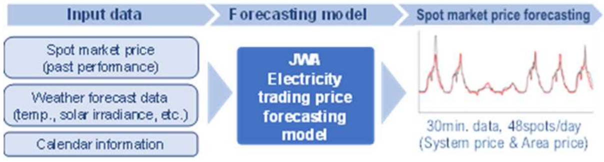


Figure 4. Overview of the Electricity Trading Price Forecast by the Japan Weather Association

4 SOLUTIONS TO ISSUE

In the previous section, two main challenges were identified in the power generation business, where electricity market prices fluctuate daily. First, the profitability relies heavily on the knowledge and experience of power plant operators. Second, the operational workload, including the creation, dispatch, and input of daily power generation plans, is substantial.

This section introduces an initiative aimed at addressing these two challenges by utilizing commercially available electricity price forecast data services. The goal is to automate the process from creating profitable power generation plans to inputting the generator operation schedules by using the power generation planning support system "e-NESTY" developed by IHI Power Systems.

4.1 Power generation planning using electricity price forecast data

As shown in Figure 4, the Japan Weather Association (JWA) offers a service that predicts JEPX spot market transaction prices and delivers this information online. The service provides forecast data for electricity trading prices from the next day up to one month ahead. These forecasts are based on big data analysis of past spot market prices, weather forecast data, and calendar information, as well as analysis techniques utilizing artificial intelligence (AI).

For the forecast data, predictions for the next two weeks are provided with the following specifications:

- Forecast Period: From the next day's delivery to 14 days ahead.
- Announcement Frequency and Time: Once a day, announced daily at 11:00 AM.
- Data Format: XML format.

- Delivery Method: Online distribution.
- Data Content:
  - Spot market trading prices. (30-minute intervals, 48 slots per day)
  - Spot market index.

Develop a generation planning logic based on threshold judgment using forecast data from the past two weeks, where the operation is triggered when the electricity trading price exceeds a predetermined threshold and halted when it falls below the threshold (see Figure 5).

Figure 6(a) illustrates an example of this planning. The green line graph represents the forecasted electricity trading prices, with a threshold set at 35 yen/kWh in this example. The periods during which the forecasted price exceeds 35 yen/kWh and the generator is in operation are highlighted with a light blue band. The cumulative value of the generated power during these light blue periods constitutes the total power output.

However, relying solely on this condition can lead to frequent short-term start-stop cycles of the generator, reducing operational efficiency. To address this, minimum operating and stopping times are set for the generator. Additionally, the partial load power generated during the load pickup time after the generator engine starts and during the load shedding time when the generator engine stops is added to the total generated power. The generation operation plan that takes these conditions into account is shown in Figure 6(b).

If the total operating time over two weeks, based on the generator operation schedule created using the generation planning logic described above, falls below the predetermined minimum operating time (as shown in Figure 6(c)), the threshold is lowered by a certain amount. The generation planning logic is then repeatedly processed until the total operating time meets or exceeds the minimum operating time. Figure 7 illustrates an example of a 48-spot generation plan generated using this logic.

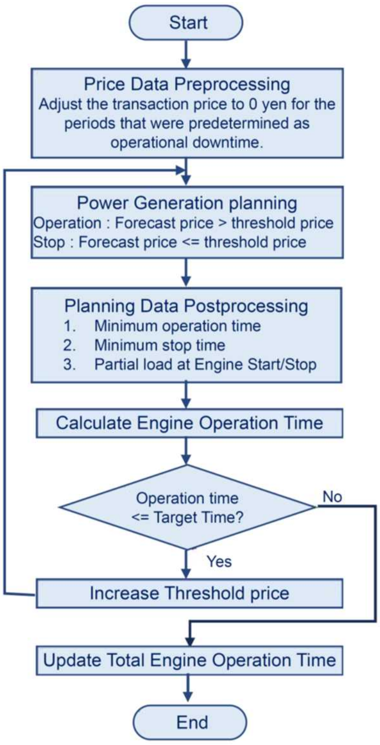


Figure 5. Threshold-Based Power Generation Planning Flow

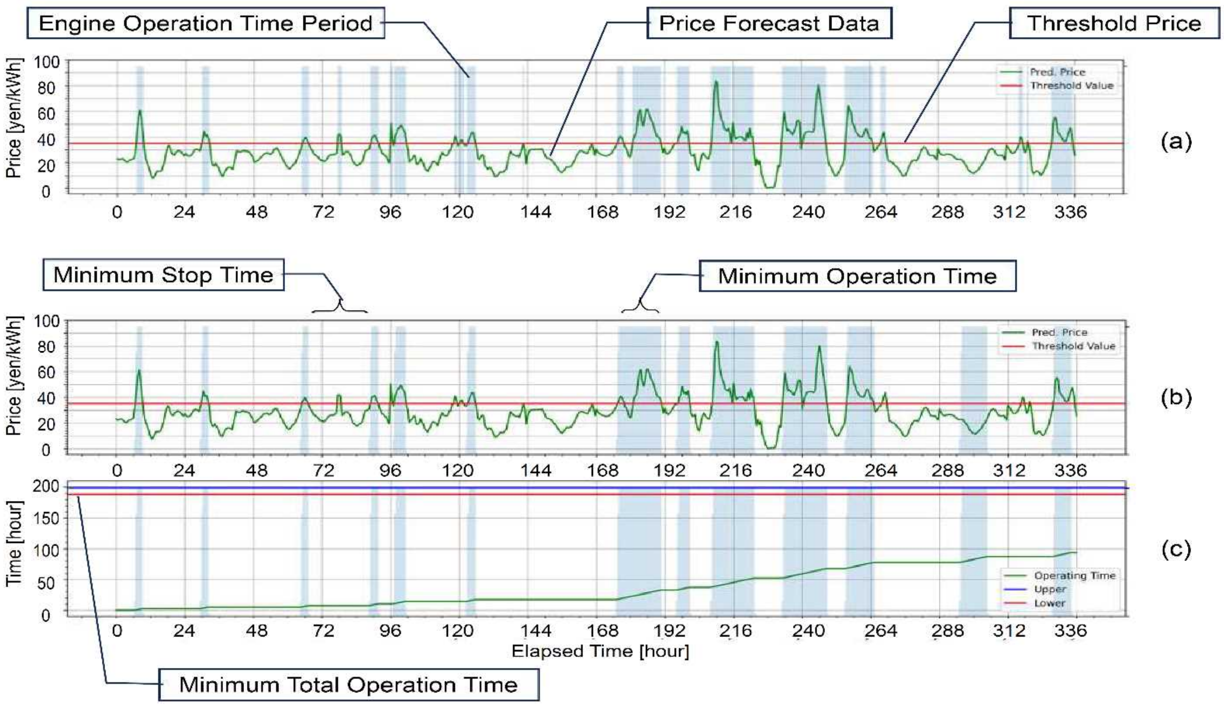


Figure 6. Example of Power Generating Planning

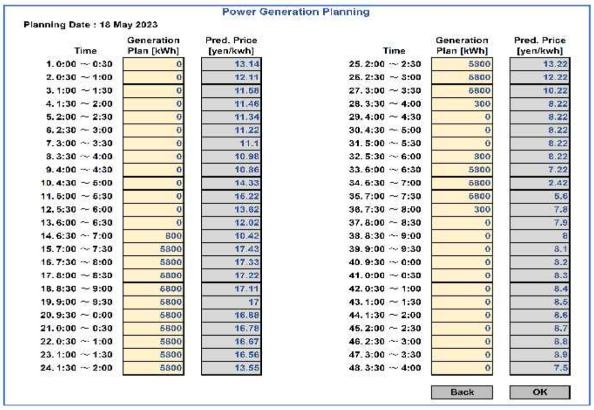
4.2 Verification of Power Generation Planning Logic

In order to evaluate the effectiveness of the generation planning logic presented in the previous section, verification was conducted using the operational performance data of the IPS Niigata Power Plant collected by the IPS remote monitoring system EDEN/NESTY.

4.2.1 IPS Niigata Power Plant and Remote Monitoring System EDEN/NESTY®

In November 2011, our company completed the acquisition of the Niigata Power Plant from Niigata New Energy Co., Ltd., and since October 2022, we have been managing and operating it as a power producer. The IPS Niigata Power Plant features two power generation engines, the 18V28AGS and 18V28AG, which primarily use city gas as fuel and have a total generation capacity of 11,600 kW as shown in Figure 8, Table 1 and Table 2.

Additionally, the IPS remote centralized monitoring system EDEN/NESTY has been installed at this power plant. EDEN/NESTY is a self-developed remote centralized monitoring system for land-based power plants, which began operation in 1996. As shown in Figure 9., it collects and monitors operational data via the on-site monitoring system EDEN-PLIII and transmits this data through public telephone lines or internet networks to the NESTY server at IPS headquarters for centralized monitoring. As of 2024, this system monitors 48 power plant sites across Japan, where IPS's flagship gas engines are installed.


Power Generation Planning

Planning Date : 18 May 2023

Time	Generation Plan [kWh]	Pred. Price [yen/kwh]	Time	Generation Plan [kWh]	Pred. Price [yen/kwh]
1. 0:00 ~ 0:30	0	13.14	25. 2:00 ~ 2:30	5800	13.22
2. 0:30 ~ 1:00	0	12.11	26. 2:30 ~ 3:00	5800	12.22
3. 1:00 ~ 1:30	0	11.58	27. 3:00 ~ 3:30	5800	10.22
4. 1:30 ~ 2:00	0	11.46	28. 3:30 ~ 4:00	300	8.22
5. 2:00 ~ 2:30	0	11.34	29. 4:00 ~ 4:30	0	8.22
6. 2:30 ~ 3:00	0	11.22	30. 4:30 ~ 5:00	0	8.22
7. 3:00 ~ 3:30	0	11.1	31. 5:00 ~ 5:30	0	8.22
8. 3:30 ~ 4:00	0	10.98	32. 5:30 ~ 6:00	800	8.22
9. 4:00 ~ 4:30	0	10.86	33. 6:00 ~ 6:30	5800	7.22
10. 4:30 ~ 5:00	0	14.33	34. 6:30 ~ 7:00	5800	2.42
11. 5:00 ~ 5:30	0	16.22	35. 7:00 ~ 7:30	5800	5.6
12. 5:30 ~ 6:00	0	13.82	36. 7:30 ~ 8:00	300	7.8
13. 6:00 ~ 6:30	0	12.02	37. 8:00 ~ 8:30	0	7.9
14. 6:30 ~ 7:00	800	10.42	38. 8:30 ~ 9:00	0	8
15. 7:00 ~ 7:30	5800	17.43	39. 9:00 ~ 9:30	0	8.1
16. 7:30 ~ 8:00	5800	17.33	40. 9:30 ~ 0:00	0	8.2
17. 8:00 ~ 8:30	5800	17.22	41. 0:00 ~ 0:30	0	8.3
18. 8:30 ~ 9:00	5800	17.11	42. 0:30 ~ 1:00	0	8.4
19. 9:00 ~ 9:30	5800	17	43. 1:00 ~ 1:30	0	8.5
20. 9:30 ~ 0:00	5800	16.88	44. 1:30 ~ 2:00	0	8.6
21. 0:00 ~ 0:30	5800	16.78	45. 2:00 ~ 2:30	0	8.7
22. 0:30 ~ 1:00	5800	16.67	46. 2:30 ~ 3:00	0	8.8
23. 1:00 ~ 1:30	5800	16.56	47. 3:00 ~ 3:30	0	8.9
24. 1:30 ~ 2:00	5800	13.55	48. 3:30 ~ 4:00	0	7.5

Back OK

Figure 7. 48-spot Power Generation Plan Example

Figure 8. Exterior of IPS Niigata Power Plant

Table 1. Specifications of IPS Niigata Power Plant

Specifications of Power Plant	
Site Area	$2200m^2$
Building Area	$750m^2$
Power Generator	18V28AG 18V28AGS
Total Power Output	11,800kW

Table 2. Detailed Specifications of the Power Generation Facility at IPS Niigata Power Plant

	No.1 Engine	No.2 Engine
Engine Type	18V28AGS	18V28AG
Ignition system	Pre-combustion Chamber Spark Ignition System	Micro-pilot Ignition System
Power generating output	6,000 kWe	5,800 kWe
Engine appearance		

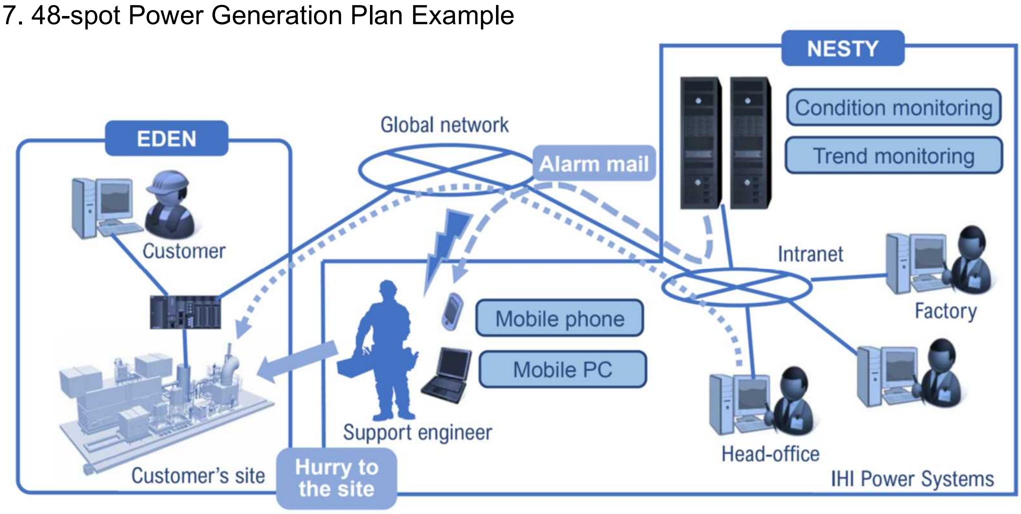


Figure 9. NIIGATA Remote monitoring System “EDEN/NESTY®”

Table3. Data and Evaluation Conditions

	Generation Planning	Actual Operation
Verification Period		
Start Date	October 1, 2021, 0:00	
End Date	February 28, 2022, 23:30	
Power Generation		
Rated Output	5800kWe	
In-house Consumption	100kW	
Power Generation per 30 min.	Automatic Generation	(Power Generation per 1hr.)/2 – in-house Consumption
At Startup.	350 + (80% of next spot)	N/A
At Shutdown.	70	N/A
Gas Fuel		
Consumption	0.2 Nm^3/kWh	
Prices	Updated Monthly	
Contract Period	7 months	
Usage	4,000,000Nm^3	
Transaction Volume	2,800,000Nm^3	
Engine Operation		
Minimum operation time	2 hours	N/A
Minimum stop interval	4hours	N/A

Table 4. Estimated Revenue Results Under Three Conditions

Estimation Condition		Revenue	Total Power Generation	
		Ratio [%]	Volume [x1000kWh]	Rate [%]
Actual Operation	from NESTY Data	100.0	9,400	100
Generation Planning	from JWA Forecast Prices	60.3	12,146	129
	from JEPX Actual Prices	101.6		

4.2.2 Verification

Table 3 shows the data and evaluation conditions used for verification. Data from approximately five months, from October 4, 2021, to February 28, 2022, during which Unit 2 (18V28AG) of the IPS Niigata Power Plant was in actual operation, were extracted from NESTY. Meanwhile, JWA price forecast data and actual power trading prices from JEPX for the same period were obtained, and the revenue results were estimated and compared under the following three conditions:

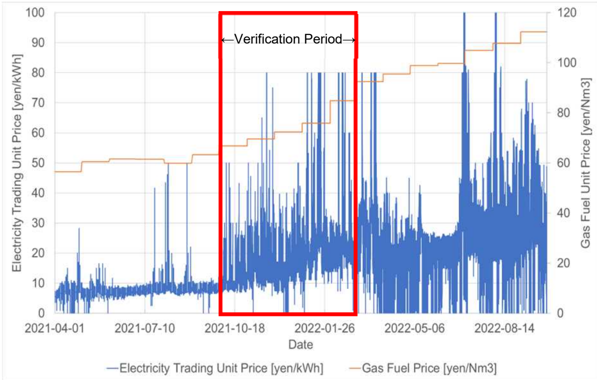


Figure 10. Trends in JEPX Electricity Trading Prices and Gas Trading Prices from April 2021 to July 2022

1. Revenue results calculated from the data actually operated and collected in NESTY at the IPS Niigata Power Plant.
2. Revenue results if power generation operations were conducted according to the operating schedule generated by the aforementioned generation planning logic based on JWA price forecast data, and trading were made at the forecasted power price.
3. Revenue results if power generation operations were conducted according to the operating schedule generated by the aforementioned generation planning logic based on JWA price forecast data, and trading were made at the actual power price from JEPX.

Table 4 shows the evaluation results. Based on the JEPX actual prices, the results showed a slight improvement in revenue compared to the conventional operation. Furthermore, in terms of total power generation, the generation planning logic resulted in approximately 30% more power traded during the same period compared to the traditional method, indicating that it was possible to operate with an increased utilization rate of the power generation equipment while securing the same revenue.

With the JWA forecast prices, the estimated revenue was nearly 40% lower than the conventional operation. However, as shown in Figure 10, the evaluation period had a tendency for higher trading prices compared to the periods before and after, which likely contributed to an environment where securing profits was easier.

Figure 11 shows the trends in generator output and JEPX actual electricity trading prices during real operations. In the upper five-month trend graph of Figure 11, it can be observed that during the first 1.5 months of the evaluation period, electricity trading prices were relatively low, and the generator remained inactive. Subsequently, as

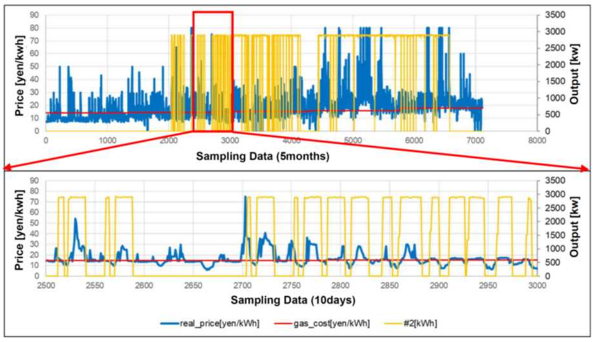


Figure 11. Trends in Generator Operation and JEPX Actual Trading Prices Based on NESTY Real Operation Data

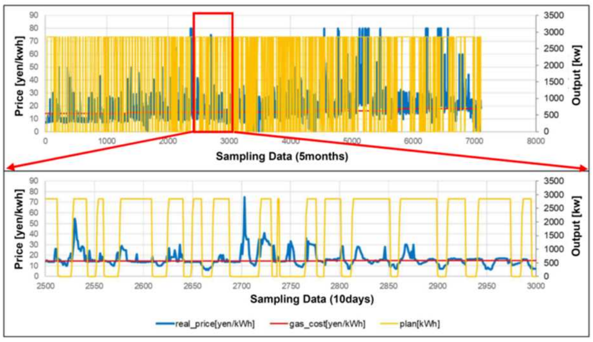


Figure 12. Trends in Generator Operation and JEPX Actual Trading Prices Based on Generation Planning Logic

electricity trading prices began to rise, the generator started operating, and from around the third month, when actual prices increased, continuous operation for about one to two weeks became common.

The trend graph on lower part of Figure 11 is an expanded view of approximately three weeks from the second month, showing an operation strategy that targets periods with high trading prices.

On the other hand, Figure 12 shows the trends in generator output and JEPX actual electricity trading prices based on the generation planning logic. As illustrated in the flowchart in Figure 5, unlike actual operations, this logic sets a trading price threshold to reach a target operating time within a specified period. The generator operates when the threshold is exceeded, resulting in a tendency to operate consistently regardless of price fluctuations. In periods of high trading prices from the third month onward, continuous operation for several days can be observed.

However, the expanded graph on the lower part of Figure 12 reveals that there are instances where the plan does not account for sudden spikes in trading prices, indicating that improvements to the planning logic may be necessary.

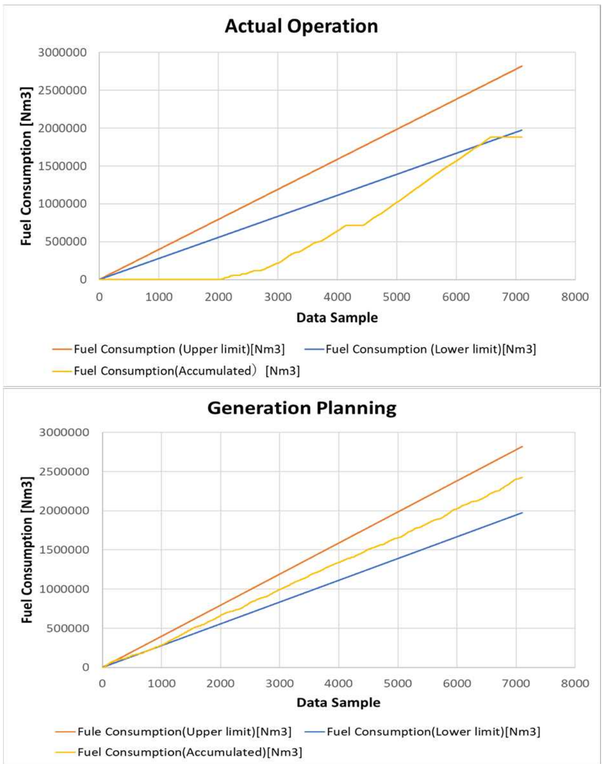


Figure 13. Comparison of Fuel Consumption Trends Between Actual Operation and Generation Planning

Next, Figure 13 compares the trends in gas fuel consumption between actual generator operation and generator operation based on the generation planning logic. In actual operations, operators rely on their experience and past performance to create and execute generation plans. However, it is challenging to plan in a way that systematically consumes the contracted gas fuel supply. During the evaluation period, there was a tendency to prioritize gas fuel consumption over revenue, with intensive generator operation aimed at reaching the lower limit from the middle to the latter part of the period.

In contrast, the generation planning logic creates plans based on the flow shown in Figure 5, aiming to reach the target operating time within a specified period. Consequently, gas fuel consumption consistently remains between the lower and upper limits.

Based on the verification results mentioned above, it was determined that adopting the generation planning logic utilizing the prototype electricity price forecast data is expected to improve revenue and increase the operational rate of the generator. Therefore, it was decided to incorporate this generation planning logic into the EDEN/NESTY system for the IPS Niigata Power Plant and conduct trial operations.

4.3 Power Generation Planning Support System "e-NESTY"

Based on the favorable verification results of the generation planning logic mentioned in the previous section, a system named 'e-NESTY' was developed. Its purpose is to improve the profitability of the power generation business and to reduce the workload associated with creating generation plans, which is typically done by power plant operators. The system automatically or semi-automatically sends high-profitability generation plans, created based on electricity price forecast data, to retail electricity providers via email. It also sends operation schedule data to the generator control system to automate the start-stop control of generators.

Figure 14 shows the system configuration of e-NESTY. e-NESTY extends the EDEN/NESTY system, shown in Figure 5, which has been used for remote monitoring and trend monitoring of local power plant, with the following enhancements.

1 A function to automatically acquire electricity price forecast data from JWA via the internet.

2 A function to automatically acquire actual electricity trading price data from JEPX via the internet.

3 Software to input and edit the generation planning logic shown in Figure 5 and the various conditions necessary for creating plans.

4 A function to review and edit the 48-slot generator operation schedule automatically generated by the generation planning logic.

5 A function to automatically send the finalized 48-slot generator operation schedule to retail electricity providers via email.

6 A function to automatically input the finalized 48-slot generator operation schedule into the generator control system.

7 A function to output daily power plant operation reports.

The operational concept of e-NESTY is described below. Figure 15 shows the flow of data and operations within this concept.

1 If there is a planned operation or shutdown of generators due to maintenance, the operation schedule should be manually input into the operational PC by 11:00 am, three days prior to the operation day.

2 Every day at 11:00 am, acquire the JWA's 48-slot electricity price forecast data for the next two weeks. Based on pre-set condition parameters, determine the electricity price threshold that satisfies the following constraints for the generation plan, and create the plan under these conditions:

A) Each operation duration should be at least the pre-set time.

B) Establish a rest interval of at least the pre-set time between shutdown and startup.

C) Limit the number of start-stop cycles per day to below the upper limit.

D) Consider the period from engine start to rated output and from rated output to engine shutdown as partial load, as pre-set.

E) Ensure the cumulative operating time for the next two weeks meets or exceeds the pre-set target operating time.

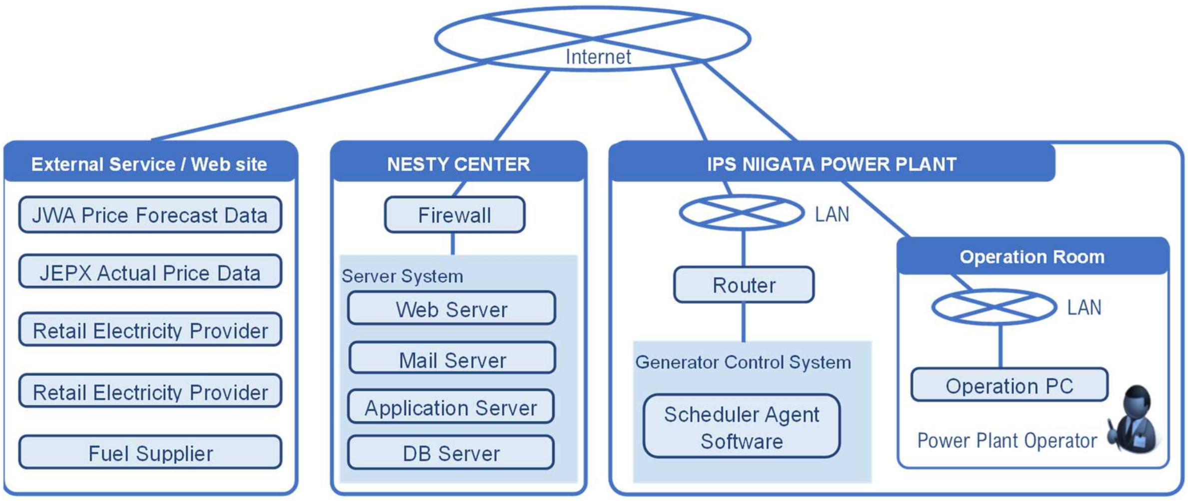


Figure 14. Power Generation Planning Support System "e-NESTY"

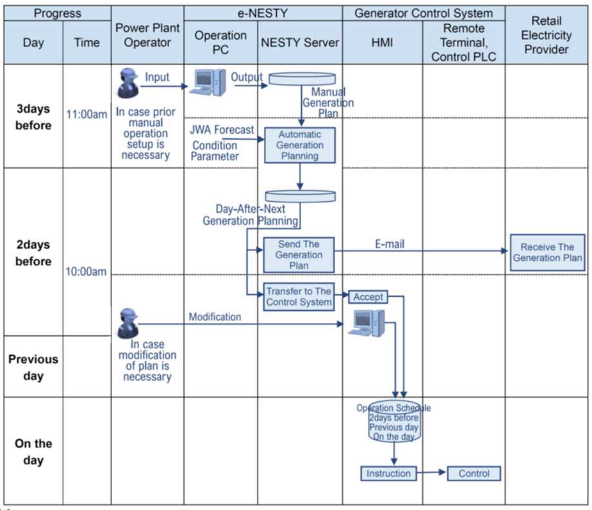


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Figure 15. The flow of Data and Operations within e-NESTY concept.

F) Give priority to any manually input generation plans or shutdown periods.

3 Finalize the generation plan at 10:00 am, two days before the operation day, and automatically send it via email to retail electricity providers. Also, send the operation schedule data to the power plant control system for automatic input of the schedule.

4 On the day of operation, conduct the power generation based on the pre-input generation plan and output the planned electricity.

5 Repeat the processes from 1 to 4 daily.

5 THE IMPACT OF IMPLEMENTING e-NESTY

To evaluate the impact of implementing e-NESTY, we conducted a comparative analysis of the operational results from January to October 2024 using e-NESTY and estimated values assuming operation under conventional power generation planning methods for the same period.

The graph in Figure 16 shows the trend of revenue per kWh from electricity sales, calculated by dividing the cumulative sales revenue by the cumulative power generation over the 10-month period, for both e-NESTY and conventional operations. As of November 2024, the revenue per kWh from operations using e-NESTY was slightly higher than that of the conventional method. However, over the entire 10-month period, there was no clear superiority observed in the operations using e-NESTY.

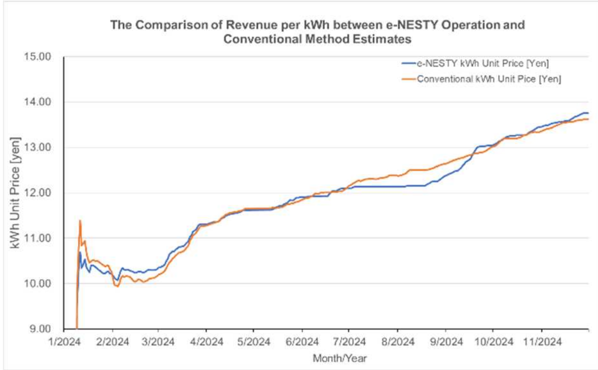

Figure 16. The Comparison of Revenue per kWh between e-NESTY Operation and Conventional Method Estimates.

The decline in revenue per kWh during the summer months of July to September 2024 can be attributed to several factors. One significant factor was the intermittent shutdowns of power generation for 10 to 20 days due to equipment maintenance from July to August. After maintenance, the resumption of operations was marked by a densely packed power generation schedule that prioritized catching up on gas fuel consumption over aligning with electricity market prices. Additionally, in Japan, electricity demand typically decreases in the summer due to seasonal temperature changes, which often leads to lower market prices. This seasonal trend further contributed to the decline in revenue per kWh during this period.

To enhance the operational advantage over conventional methods, it is advisable to improve the current power generation planning logic. This could include features that avoid over-intensive operations following extended shutdowns and take into account the seasonal fluctuations in electricity market prices. Such adjustments could lead to more favorable revenue outcomes.

Additionally, Figures 17 to 19 show screen examples of the newly developed power plant operation reporting features for e-NESTY.

Figure 17 is a forecast report that graphically displays the operational results from the past 30 days and the operational forecasts for the next 14 days. The top graph shows JEPX actual transaction prices and JWA forecast prices, as well as revenue calculated from generator operation data and power generation plans, using bar and line graphs. The bottom graph shows the actual and forecast gas fuel consumption in line graphs. When the mouse cursor is placed over any part of these graphs displayed in a web browser, detailed data for the date corresponding to the cursor is shown numerically.

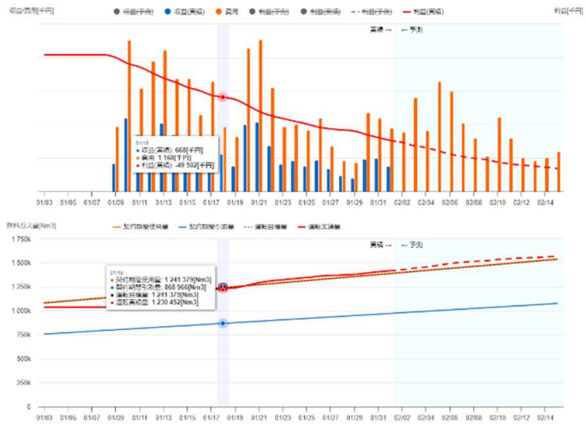

Figure 17. Example Screen Display of the Forecast Report Function (In Japanese only)

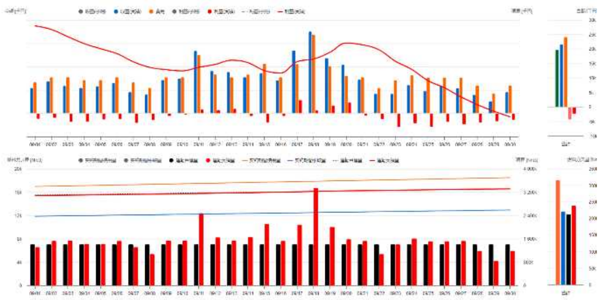

Figure 18. Example Screen Display of the Monthly Report Function (In Japanese only)

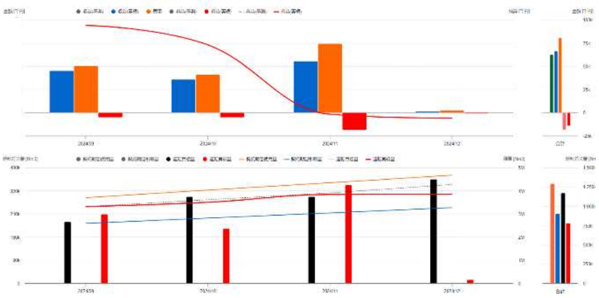

Figure 19. Example Screen Display of the Annual Report Function (In Japanese only)

Figure 18 displays operational results on a monthly basis, and Figure 19 on a yearly basis, both using the same display specifications as Figure 17.

Regarding the impact on the daily operational tasks of operators, the implementation is expected to reduce the time spent on creating, sending, and inputting power generation plans, which previously took 365 hours annually, as shown in Table 5. Beyond the reduction in work hours, operators who have tested e-NESTY have reported several benefits:

Table 5. Reduction in Work Hours Achieved through the Implementation of e-NESTY

Task	Details	Time Required [min.]	Frequency [times]		Annual Time Required [hr.]
			Weekly	Annual	
Plan Creation	Actual Data Collection	10	5	365	60.3
	Operation Plan Creation	30	5	365	182.5
Plan Sending	Preparation of Documents	5	5	365	30.4
	Sending Documents	5	5	365	30.4
Plan Input	Inputting Operation Schedule	10	5	365	60.8
Total		**60**	**-**	**-**	**365.0**

- Relief from the mental burden associated with daily plan creation tasks.
- Easier planning for scheduled operational shutdowns and restarts, such as during long holidays or equipment maintenance.
- Improved management of actual and forecast gas fuel consumption through the report output function.

These comments suggest that the implementation has contributed to a significant reduction in the operators' workload.

6 CONCLUSIONS

In this paper, we introduce the efforts made with e-NESTY, a system that supports the creation and operation of power generation plans by utilizing price forecast data and leveraging the existing remote monitoring infrastructure of EDEN/NESTY, with the aim of enhancing profitability and operational efficiency in the power generation business.

From the trial operation conducted in 2024, it was identified that there is room for improvement in the power generation planning logic. Addressing these improvements is expected to result in more profitable power generation operations compared to conventional methods, and it has also shown a certain level of effectiveness in reducing the workload of operators.

Looking ahead, as the demand for power plants with adjustment functions, like the IPS Niigata Power Plant, is expected to increase with the rise in renewable energy supply, we plan to continue enhancing and improving e-NESTY. We aim to offer it as a new value-added service to our customers.