

June 10, 2015

The Kansai Electric Power Co., Inc.

Implementation of Emergency Repair Work for Steam Turbine at Himeji No. 2 Power Station,
Kansai Electric Power Co., Inc.

The Kansai Electric Power Co., Inc. (Code: 9503)

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Unit 3 of Himeji No. 2 Power Station (rated power: 486,500 kW), which had been operating normally, shut down automatically at 11:30 a.m. on May 9 due to excessive vibration of its steam turbine during normal operation. In addition, Unit 5 of the same station (rated power: 486,500 kW) shut down automatically at 1:04 p.m. on June 1 during normal operation due to the occurrence of the same event.

Subsequently, the relevant equipment of Units 3 and 5 was investigated. In the investigation it was confirmed that a final-stage rotating blade of the steam turbine¹ was partially bent and broken in both units. It was also confirmed that the broken pieces hit and damaged other components. However, there were no other anomalies. On the basis of these observations, the cause was determined to result from the aforementioned rotating blades. It was finally judged that the partial bend and breakage of the rotating blade caused a loss of balance and therefore the excessive vibration, resulting in automatic shutdown. For this reason, in order to prevent the same trouble in the future, we decided to implement emergency repair work for all units of 1 to 6 of the same type in the same station. A written notification of the work plan was submitted to the national government. Today, the notification was approved.

Specifically, the relevant rotating blade, a contributor to the trouble, will be removed, and emergency work to install a pressure plate² will be performed sequentially from June 11 to the beginning of August. Because the installation of the pressure plate reduces generation efficiency, we are planning to operate each unit at a rated power of about 412,000 kW³ in July and August.

Due to this work, the supply capacity of Himeji No. 2 Power Station will decrease by some 940,000 kW in July, 580,000 kW in August, and 390,000 kW in September, but it is expected that a reserve margin of 3%, the lowest margin required to supply power, will be ensured by receiving additional electricity from electric power companies in central and western Japan. In light of this situation, we implore customers in our service area to cooperate in saving electricity.

At times when a tight power supply and demand is predicted due to previously unforeseen situations such as power station problems, we also ask customers to conserve electricity wherever possible, as long as such efforts do not affect customer’s health, and to the extent that the efforts do not hamper maintenance of lifeline functions or production activities.

We will immediately perform our emergency repair work with a focus on safety, and having investigated why the relevant rotating blade was partially bent and broken, take permanent measures to prevent a recurrence. Furthermore, we will take all possible measures to balance supply and demand, such as making efforts to detect any abnormal indication of the equipments at an early stage or promptly restoring the equipments, and will continue to advance efforts in demand-side control, including demand response.

- 1 This is a rotating blade that drives (rotates) a turbine by steam from a boiler. It was confirmed that the final-stage rotating blade, the 28th blade from the high-pressure side, was partially bent and broken in both Units 3 and 5.
- 2 This is a steel plate that is installed in place of the removed final-stage rotating blade, causes the same pressure drop in steam as a turbine rotating blade, and has many holes to restore airflow to its original state. Because the pressure plate does not generate force to rotate the turbine even if it receives steam, it provides lower generation efficiency than the turbine blade.
- 3 Due to high temperatures in July and August, the generation efficiency will be reduced. Consequently, an output of 428,000 kW is anticipated. However, because the pressure plate reduces power by 16,000 kW, the output will be about 412,000 kW.

<Outline of Himeji No. 2 Power Station>

	Existing Unit 5	Existing Unit 6	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
Startup	October 1973	November 1973	August 2013	November 2013	March 2014	July 2014	September 2014	March 2015
Rated power	600,000 kW	600,000 kW	486,500 kW (460,000 kW)	486,500 kW (460,000 kW)	486,500 kW (460,000 kW)	486,500 kW (460,000 kW)	486,500 kW (460,000 kW)	486,500 kW (460,000 kW)

* The values in parentheses indicate the rated power after the emergency repair work.

Location; Megatokiwa-cho, Shikama-ku, Himeji City, Hyogo

Fuel: Natural gas

Attachment 1: Results of Inspection of Units 3 and 5, Himeji No. 2 Power Station

Attachment 2: Outline of Emergency Repair Work, Himeji No. 2 Power Station

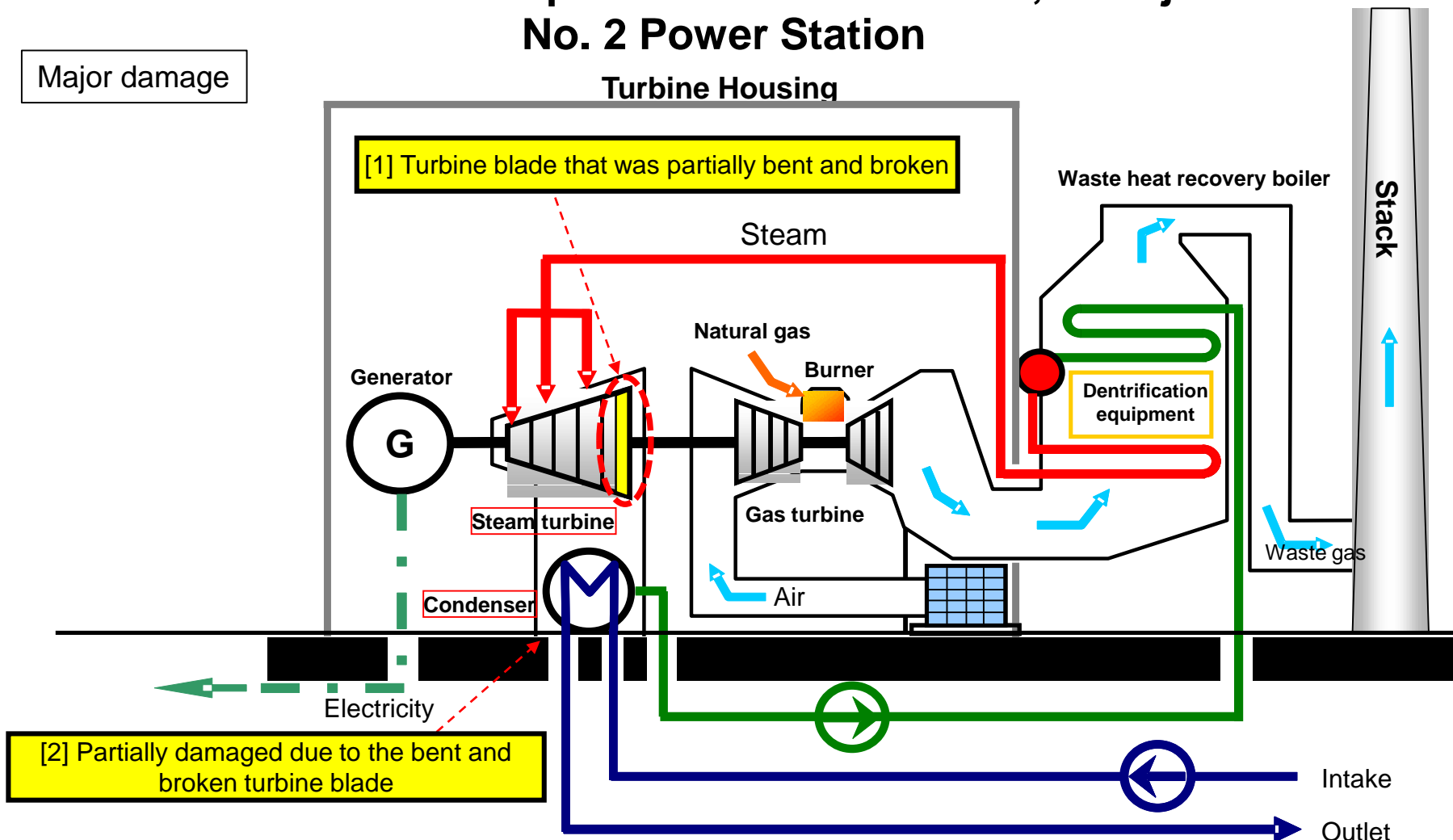
Attachment 3: Process of Emergency Repair Work, Himeji No. 2 Power Station

Attachment 4: Prospect for Supply and Demand this Summer

Results of Inspection of Units 3 and 5, Himeji No. 2 Power Station

Major damage

Turbine Housing



[1] Turbine blade that was partially bent and broken

[2] Partially damaged due to the bent and broken turbine blade

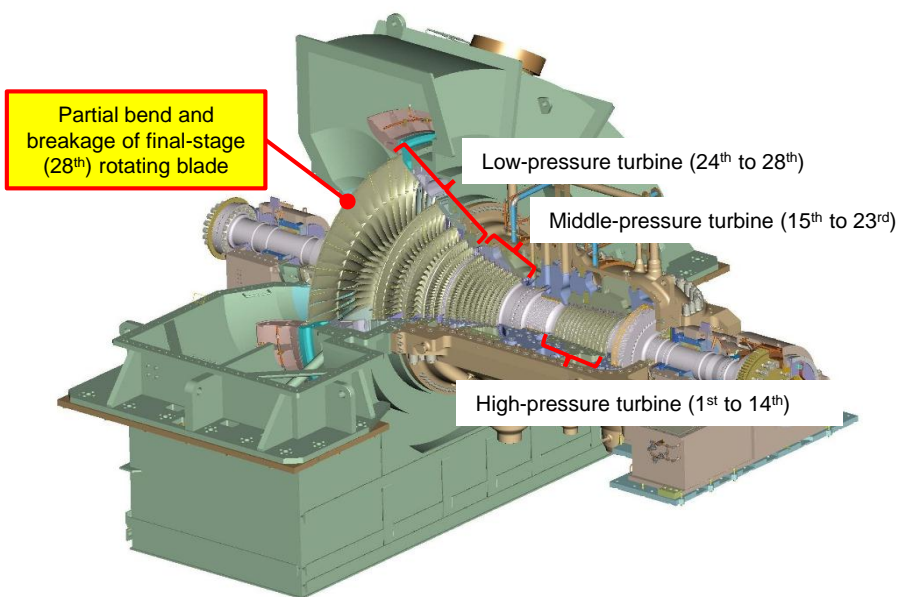
[1] Steam turbine

[Bend and damage of final-stage rotating blades]

<Inspection results>

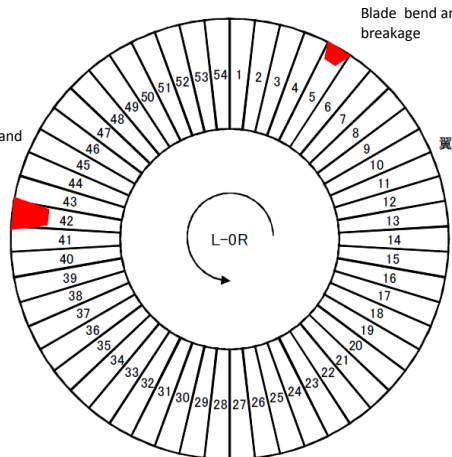
- It was confirmed that a final-stage (28th) steam turbine blade was partially bent and broken. (A trace generated when broken pieces of the rotating blade hit the final-stage rotating blade and stator blade, was confirmed.)
- Other rotating and stator blades showed no anomalies.

[Outline of steam turbines in Units 3 and 5]



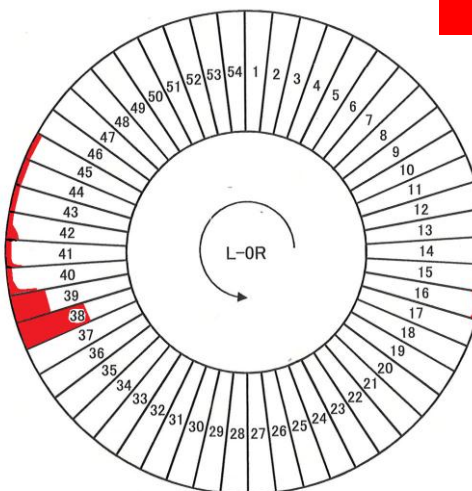
Unit 3

Blade bend and breakage



Unit 5

Red square: Point where rotating blades were bent and broken



[2] Condenser

- Types of damage, such as breakage (9 tubes), perforation (50 tubes) and hollowing (40 tubes) were confirmed in tubes. Cause: Secondary damage, caused by broken pieces of the partially bent and broken steam turbine blade, was likely cause.

Break



Perforation



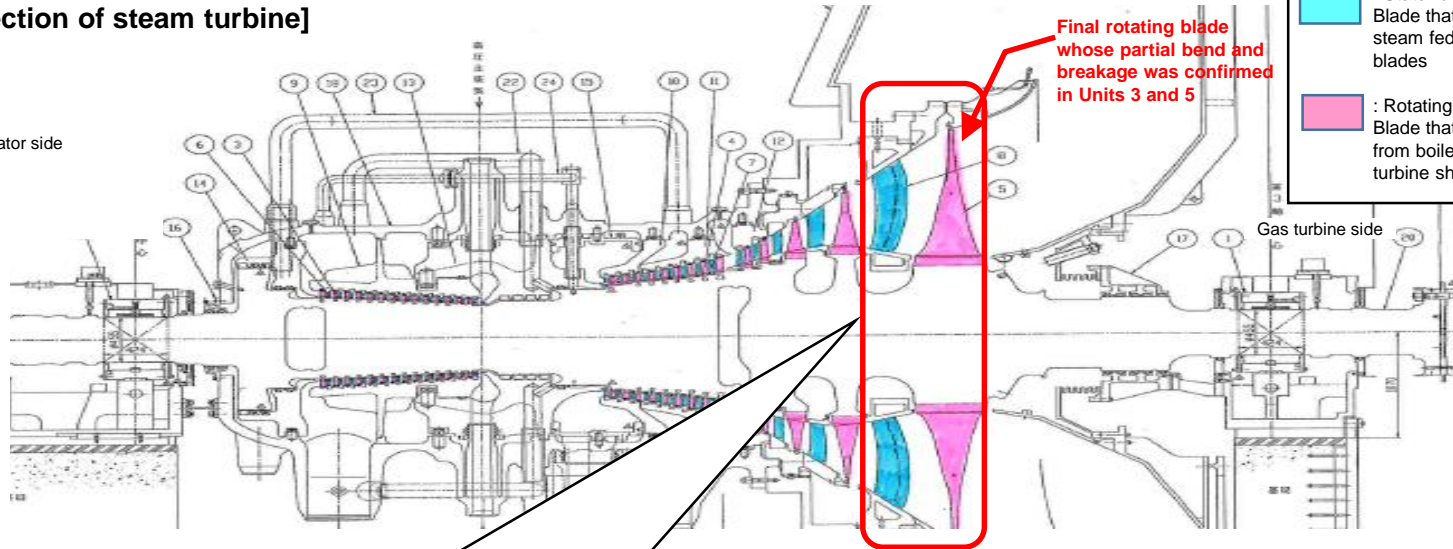
Total no. of damaged tubes confirmed visually in Unit 3: 99
(Reference) Total no. of condenser tubes: 8,136

- * The photo shows the number of damaged points in Unit 3.
- * The same damage was confirmed also in Unit 5. The number of damaged points in the same unit was investigated.

Outline of Emergency Repair Work, Himeji No. 2 Power Station

[Section of steam turbine]

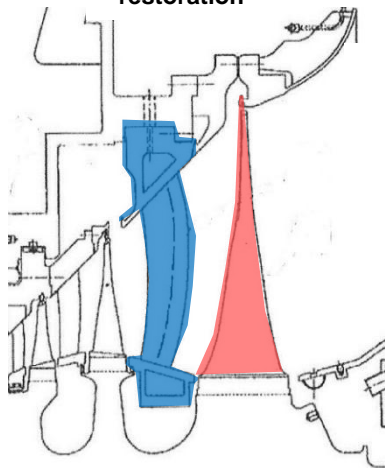
Generator side



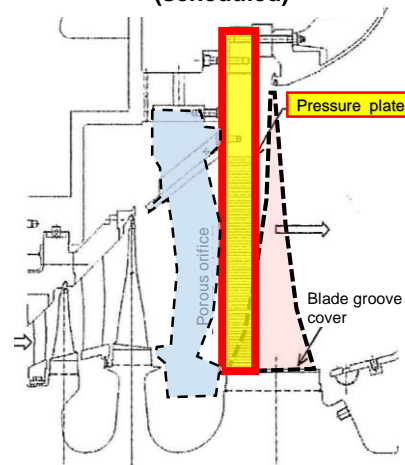
Final rotating blade whose partial bend and breakage was confirmed in Units 3 and 5

- : Stator blade
Blade that corrects flow of steam fed to rotating blades
- : Rotating blade
Blade that receives steam from boiler and rotates turbine shaft

Before restoration



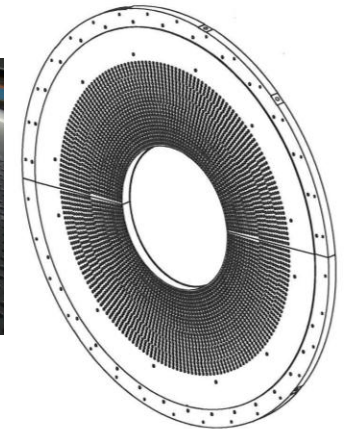
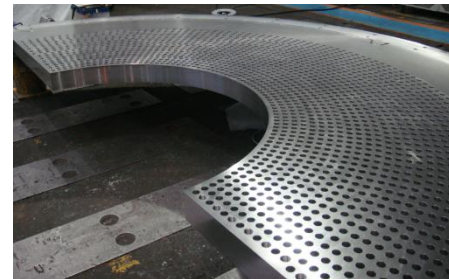
After restoration (scheduled)



Remove the rotating blade with confirmed partial bend and breakage. Because the pressure plate was designed to drop the pressure of rotating and stator blades, it is also necessary to remove adjacent stator blades.

- : Removal
- : Pressure plate

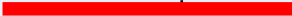

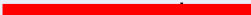



Photo and graphical overview of pressure plate



◆ Pressure plate

In the case of removal of final-stage rotating and stator blades, the difference in pressure increases between the inlet and outlet of the turbine rotating blade before the final blade, thereby imposing a considerable load on the front blade. In order to prevent the relevant turbine blade from being overloaded, a steel plate, installed in place of the final-stage blade, has many holes to provide the same pressure drop as the final turbine blade and restore airflow to its original state.

Process of Emergency Repair Work, Himeji No. 2 Power Station

Unit	2015					
	April	May	June	July	August	September
1 (Periodic inspection)			6/11 	Planned restoration in the middle of July		
2 (Shutdown)			6/11 	Planned restoration in the middle of July		
3 (Shutdown due to accident)			6/11 	Planned restoration at the beginning of July		
4 (Shutdown)			6/11 	Planned restoration in the middle of July		
5 (Shutdown due to accident)			6/11 	Undetermined restoration for secondary damage to be inspected		
6 (Shutdown)			6/11 		Planned restoration at the beginning of August	

Prospect for Supply and Demand this Summer (July: if no nuclear restart)

	[1] As of May 22	[2] As of June 10	Difference ([2] - [1])	Remarks
Supply capacity—Demand (Reserve margin)	84 (3.0%)	84 (3.0%)		
Demand	2,791	2,791	0	
Supply capacity (Total)	2,875	2,875	0	
Nuclear power	0	0	0	
Hydropower	232	232	0	
Thermal power	1,687	1,592	▲94	○ Reduction associated with steam turbine trouble, Himeji No. 2 Power Station (▲94)
Pumped hydropower	375	383	+9	○ Increase of supply capacity using pumped hydropower, associated with increase of received electricity through power interchange during nighttime (+9)
Renewable energy	0.3	0.3	0	
Other companies and power interchange	581	667	+86	<div style="border: 1px solid black; border-radius: 15px; padding: 10px; margin-bottom: 10px;"> <p>* Power interchanges as of May 22 (19 in total) Chubu Electric Power Company: 10 in total Chugoku Electric Power Company: 9 in total</p> <p>* After taking into account the following increments (90 in total) Chubu Electric Power Company: 35 in total Chugoku Electric Power Company: 9 in total (no change) Hokuriku Electric Power Company: 16 in total Shikoku Electric Power Company: 30 in total</p> </div> <p>○ Increase of procured self-generation (+9)</p> <p>○ Increase of received electricity through power interchange etc. (+77) (Increments of received electricity through power interchange: 71 in total (+25 from Chubu Electric Power Company, +16 from Hokuriku Electric Power Company, +30 from Shikoku Electric Power Company))</p>
Other companies	567	576	+9	
Hydropower and pumped	68	68	0	
Thermal power	420	429	+9	
Renewable energy	79	79	0	
Interchange etc.	14	91	+77	

* Totals may not match due to rounding off.

Prospect for Supply and Demand this Summer (August: In the case of no nuclear restart)

(Unit: 10,000 kW)

	[1] As of May 22	[2] As of June 10	Difference ([2] - [1])	Remarks
Supply capacity—Demand (Reserve margin)	84 (3.0%)	84 (3.0%)		
Demand	2,791	2,791	0	
Supply capacity (Total)	2,875	2,875	0	
Nuclear power	0	0	0	
Hydropower	212	212	0	
Thermal power	1,682	1,623	▲58	○ Reduction associated with the trouble of the steam turbine, Himeji No. 2 Power Station (▲58)
Pumped hydropower	368	376	+8	○ Increase of supply capacity by pumped hydropower, associated with the increase of received electricity by power interchange during nighttime (+8)
Renewable energy	0.3	0.3	0	
Other companies and power interchange	613	663	+50	<div style="border: 1px solid black; border-radius: 15px; padding: 10px; margin-bottom: 10px;"> * Power interchanges as of May 22 (48 in total) Chubu Electric Power Company: 20 in total Chugoku Electric Power Company: 28 in total * After taking into account the following increments (82 in total) Chubu Electric Power Company: 29 in total Chugoku Electric Power Company: 38 in total Hokuriku Electric Power Company: 10 in total Shikoku Electric Power Company: 5 in total </div> ○ Increase of procured self-generation (+10) ○ Increase of received electricity by power interchange etc. (+40) (Increments of received electricity by power interchange: +34 in total (+9 from Chubu Electric Power Company, +10 from Hokuriku Electric Power Company, +10 from Chugoku Electric Power Company, +5 from Shikoku Electric Power Company))
Other companies	570	580	+10	
Hydropower and pumped	68	68	0	
Thermal power	420	430	+10	
Renewable energy	82	82	0	
Interchange etc.	43	83	+40	

* Totals may not match due to rounding off.

Prospect for Supply and Demand this Summer (September: If no nuclear restart)

(Unit: 10,000 kW)

	[1] As of May 22	[2] As of June 10	Difference ([2] - [1])	Remarks
Supply capacity—Demand (Reserve margin)	82 (3.0%)	82 (3.0%)		
Demand	2,712	2,712	0	
Supply capacity (Total)	2,794	2,794	0	
Nuclear power	0	0	0	
Hydropower	193	193	0	
Thermal power	1,663	1,624	▲39	○ Reduction associated with steam turbine trouble, Himeji No. 2 Power Station (▲39)
Pumped hydropower	382	386	+4	○ Increase of supply capacity using pumped hydropower, associated with the increase of received electricity through power interchange during nighttime (+4)
Renewable energy	0.1	0.1	0	
Other companies and power interchange	556	592	+36	<div style="border: 1px solid black; border-radius: 15px; padding: 5px; width: fit-content; margin-bottom: 10px;"> * Power interchanges as of May 22 (41 in total) Chubu Electric Power Company: 23 in total Chugoku Electric Power Company: 18 in total * After taking into account the following increments (62 in total) Chubu Electric Power Company: 23 in total (no change) Chugoku Electric Power Company: 39 in total </div> ○ Increase of procured self-generation (+9) ○ Increase of received electricity through power interchange etc. (+27) (Increments of received electricity through power interchange: +21 in total) (+21 from Chugoku Electric Power Company)
Other companies	521	530	+9	
Hydropower and pumped	68	68	0	
Thermal power	420	429	+9	
Renewable energy	33	33	0	
Interchange etc.	35	62	+27	

* Totals may not match due to rounding off.

Prospect for Supply and Demand this Summer (If no nuclear restart)

(Unit: 10,000 kW)

	July	August	September
Demand	2,791	2,791	2,712
Supply capacity	2,875	2,875	2,794
Reserve supply capacity	84	84	82
Reserve margin	3.0%	3.0%	3.0%

Breakdown of supply capacities	Nuclear power	0	0	0
	Thermal power	1,592 (▲94)	1,623 (▲58)	1,624 (▲39)
	Hydropower	232	212	193
	Pumped hydropower	383 (+9)	376 (+8)	386 (+4)
	Renewable energy	0.3	0.3	0.1
	Other companies and interchange	667 (+86)	663 (+50)	592 (+36)

* Totals may not match due to rounding off.

* The values in parentheses indicate increase/decrease from estimations as of May 22.