

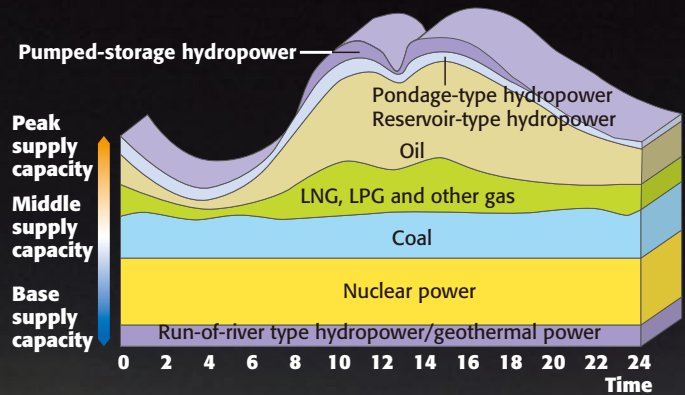
Special Feature 2

# Fulfilling Our Commitment to Stable Supply

Electricity demand varies throughout the day, with different amounts used during daytime and at night. Over the course of the year, as well, demand in summer and winter, when use of electrical cooling and heating tends to be heavy, differs from spring and fall when the use is lighter. Since we cannot store electricity, power must be supplied optimally to meet these constant fluctuations in demand. The supply capacity for the average amount of electrical power required throughout the day and night is adjusted based on the "base supply capacity," while the supply capacity for times of peak power consumption is adjusted based on the "peak supply capacity".

In order to provide a stable supply of electricity without interruption, an electric power company like the J-POWER Group offers electrical power from a variety of sources, including hydroelectric, thermal, and nuclear power, seeking the optimal balance based on such considerations as their operation characteristics, economy, and environmental issues.

■ Drawing on Different Power Sources to Match Electricity Demand



## Fuel procurement – Transport – Power generation (coal-fired thermal power)

### Coal Procurement

The main fuel used in the eight thermal power stations of the J-POWER Group in Japan is coal. These facilities consume more than 20 million tons of coals per year. Because of its economic efficiency and other characteristics, coal serves as base and middle supply capacity.

As a means of ensuring stable procurement of coal, we are participating in a mining project in Australia, one of the main sources of coal used in power generation. At the same time we are diversifying procurement sources, taking into consideration not only coal-producing nations but production areas and loading ports as well. We are also actively test-burning new types of coal, striving for flexibility in procurement.



Unloading coal



### Fuel Procurement and Transport

**Katsuya Toda**

Fuel Group, Energy Business Department

The J-POWER Group uses dozens of types of coal at all times. To transport all this coal to power stations, ships ply the seas more than 200 times annually.

As a basic means of assuring stable transport, the J-POWER Group over the years has invested in our own coal carriers for transporting the coal we procure. Since the amount of coal transported varies each year and each month, in addition to dedicated ships we have contracts with shipping companies for transporting certain quantities, aimed at achieving stable transport of procured coal.

We also need to gather and share information about weather and other unavoidable factors in each country and region, along with factors such as changes in ship layover at ports due to supply and demand, and to take preventive measures.

Lately we have been procuring also from traders other than coal producers. It's a daily struggle to keep track of the amount of coal produced at each mine, the quality, loading ports, the people in charge and other such matters. Besides the challenge of knowing what kind of coal is going to be available from whom, at what time, and in what quantities, the most nerve-racking part of this job is maintaining outside relationships for enabling smooth communication.

## Maintaining a Thermal Power Station

**Michiaki Kawabe** (Maintenance Group) and **Noboru Kaneda** (Operating Group)  
JPec Isogo Company

An Operating Group member inspecting a coal conveyor noticed a problem. Immediately stopping the conveyor, upon further inspection he confirmed that the conveyor was damaged. Without taking action, it would be impossible to continue generating electricity. A call went out right away to the Maintenance Group. The conveyor was found to be torn down the center along its entire length. As the staff discussed what action to take, it was clear that a complete fix could not be implemented soon, but something would have to be done to allow operation to continue. After covering over the tear with tape, they loosened the scraper\*1 to reduce the load on the conveyor. While they worked, the coal bunker\*2 level continued to drop. It was a race against time. Then the maintenance staff announced that the emergency fix was complete. Thanks to the speedy work, the bunker level was still sufficiently high. They had succeeded in keeping the supply of electricity flowing.

A power station may seem quiet on the outside, but on the inside, daily efforts like these are what keeps things running.

\*1: A device for scraping off the coal stuck to the conveyor.  
\*2: A silo for temporary holding of coal to be burned.



Isogo Thermal Power Station



## Operating a Thermal Power Station

**Hiroyuki Kawame**, Operating Group, Isogo Thermal Power Station

During operation, a power station can be hit by sudden equipment trouble or trouble caused by nature. Besides staying on the alert day and night, with patrols and constant monitoring in the operations center to ensure early detection, we work to restore operations quickly in case trouble occurs, doing our utmost each day to meet customer needs.

Seawater is used for cooling in the surface condenser. For the sake of the environment, the facility is operated within strict limits to make sure the intake water and discharge water temperature never differs by more than 7°C from the seawater temperature. If this condition cannot be met, we have to lower the generator output.

As an example of trouble caused by nature, sometimes in summer there will be an abnormally large number of jellyfish in the nearby waters. If they get into the facility in large numbers via the intake pipes, the operators monitoring instruments have to make a quick decision and take adequate action such as adjusting the inflow of seawater. To enable them to react quickly to such changes in the natural environment, our operators are put through accident training and other education to raise their skills, giving them the necessary knowledge, decision-making ability, and notification ability.



## Maritime Transport

A coal-fired thermal power station depends on the stable procurement of coal used as its source of energy. It is a matter of constantly arranging for shipping and acquiring stable suppliers of quality coal. To these ends, procurement is made from a variety of suppliers in Australia, Indonesia, China, Russia, South Africa, and elsewhere, and shipped from diverse ports in each country.



## Coal-Fired Thermal Power Stations

Coal imported from overseas is unloaded and stored in a coal storage yard. From there it is transported to coal-fired thermal power stations in various parts of the country for use as fuel to produce electricity.

The J-POWER Group employs the latest technologies for producing electricity from coal, aimed at generating power efficiently and minimizing the environmental load.



## Timely Treatment and Effective Use of Coal Ash

**Osamu Arakawa**, Operating Group, Takehara Thermal Power Station  
**Takashi Ohtawa**, Management Group, JPec Takehara Company

J-POWER operates three plants at Takehara Thermal Power Station. Stable operations require not only maintenance of reliable equipment but also management of the entire chain from procurement and transport of coal to disposal of coal ash. Coal ash is an inevitable byproduct of combustion in thermal power generation, so its dependable disposal is essential.

Since there is no ash disposal site in Takehara, coal ash is removed from the site, primarily by ocean transport. The shipping schedule is greatly affected by the weather, so it is always important to monitor the weather at Hiroshima prefecture and at seaports where the ash is unloaded. Dense fog in spring, summer typhoons, and winter storms demand special attention. We carefully manage our coal ash storage levels and secure proper shipment through arrangements with receivers.

Coal ash is reused in various ways, such as an ingredient in cement and as concrete admixture. Each of the three Takehara Plants uses a different type of coal, and consequently produces coal ash with different properties, for which we need to secure suitable recipients.

Dependable disposal of coal ash cannot be accomplished by thermal power stations alone. It requires close coordination and cooperation among all parties related to shipping, loading, and receiving, including our affiliate JPec.



Transporting coal ash by ship



## Special Feature 2 Fulfilling Our Commitment to Stable Supply

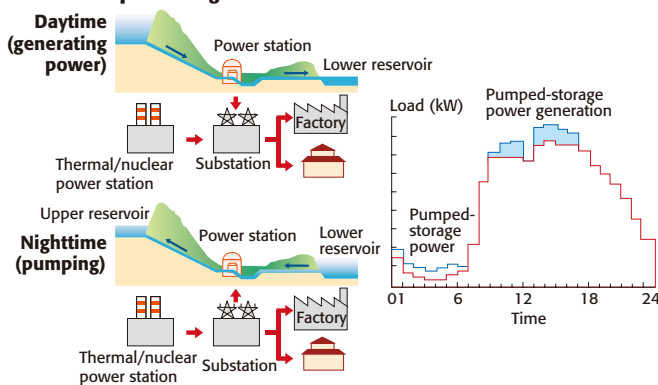
### Operating a Pumped Storage Hydropower Station

**Fujiharu Kishita**  
Electrical Engineering Group,  
Hydropower & Transmission System Department

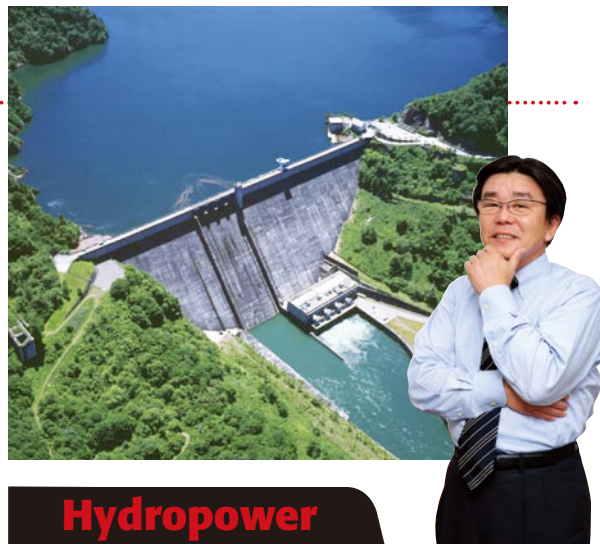
Providing a stable supply of electricity to consumers requires balancing demand and supply, by adjusting the amount of power generated in keeping with constantly fluctuating power demands. Pumped-storage power is a kind of hydropower generation that can be turned on and stopped in short intervals as needed. It also lends itself readily to adjustments in power output, system frequency, and system voltage, contributing to electric system stability and helping to meet emergency supply needs.

As the figure below illustrates, during off-peak demand periods such as late night and weekends, a pumped-storage power station reverses the pump turbines, pumping water up to a dam (upper reservoir) for storing, then releases this water to generate power when needed.

#### How Pumped-Storage Power Generation Works



Tagokura Hydropower Station



## Hydropower

The composition of electric power generation in Japan has gradually shifted from the large-scale hydroelectric power development of the prewar and early postwar eras to the system we have at present, based on thermal and nuclear power. Hydropower utilizes the potential energy of water moving from a high location to a lower one to generate electricity.

Pumped-storage hydropower also has an important role to play in countering global warming, and is a major renewable energy source.

J-POWER owns and operates transmission lines totaling approximately 2,400 km in length, along with eight substations and power conversion stations.

High-voltage transmission lines connect the four main islands of Hokkaido, Honshu, Shikoku, and Kyushu, while frequency conversion stations make it possible to serve both the eastern and western areas with their different currency frequencies. Operating these and other facilities, J-POWER is a major provider of electrical power for all of Japan.

### Transmission Line Network

The J-POWER Group has electric power facilities throughout Japan. The role of transmission lines is to gather electricity generated at each of these power stations and carry it efficiently. Hokkaido, Honshu, Shikoku, and Kyushu are each connected by ultra high-voltage transmission lines, which are key facilities for wide-area distribution of Japan's electrical power.



### Transmission Line Network – Power Conversion Station – Substations



500,000-volt transmission cable installed on Seto Ohashi Bridge

### Operating and Maintaining Transmission Line Equipment

**Masaki Naitoh**, West Transmission Line Maintenance Center

Transmission line facilities are subjected to harsh natural conditions including wind, snow, lightning, and salt from the sea. Even under these conditions, the facilities have to be maintained so that a stable supply of electrical power can be delivered. Maintenance includes also replacing facilities that have deteriorated with age, and dealing with changes in the surrounding area, while maintaining harmony with the environment. It must be carried out in such a way that facility reliability is always assured.

To these ends, maintenance crews make patrol and inspection rounds so that the condition of facilities is always known, making repairs as needed to keep the facilities functioning and ensuring a stable supply of electricity.

Some of the transmission equipment is located in extremely harsh environments, notably the undersea DC cable linking Hokkaido with Honshu, and the large-capacity cable installed on the Honshu-Shikoku Bridge (Seto Ohashi). Besides performing maintenance by means of inspections under the sea and on the bridge, monitoring systems and other means are employed to enable immediate response to emergencies.

### Seawater Pumped-Storage Power Generation

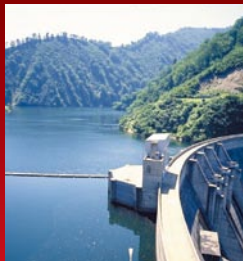
Seawater pumped-storage power generation pumps water from the sea and uses it to generate electricity. Using seawater, there is no need to form a lower reservoir, and the supply of seawater is virtually endless, making possible the construction of large power stations. The main issues that need to be considered when using seawater are the corrosive effects of salt on equipment, the impact on marine organisms, and the environmental impact of seawater released from upper reservoirs. Having carried out verification testing, J-POWER is currently operating and maintaining the world's first seawater pumped-storage power station, in Kunigami, Okinawa.

Okinawa Yanbaru Seawater Pumped Storage Power Station



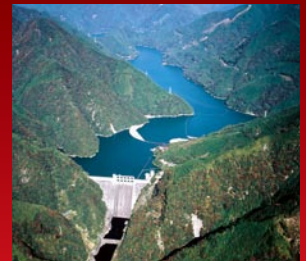
### Dam-Created Lakes

Hydropower produces electricity by using the force of descending water to power hydraulic turbine generators. Generally a dam is built upstream and water is stored in the lake created by the dam, so that electricity can be generated from the energy potential of the stored water. When electricity is not needed, the turbines are stopped and water is stored in the lake. In this way, the stored water can be converted into electricity as the need arises, without wasting it.



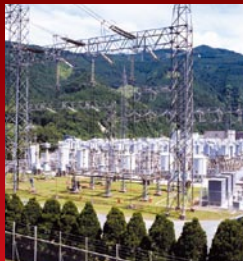
### Hydropower Stations

The J-POWER Group operates approximately 20 percent of the hydropower facilities in Japan. Many of these were built to meet the shortage of electricity after World War II. Today the effective use, operation, and maintenance of these existing facilities are increasingly important. The J-POWER Group draws on technology and skills acquired over many years in carrying out efficient maintenance and operation.



### Converter Stations

The Sakuma Frequency Converter Station performs frequency conversion between 50Hz and 60Hz, and the Hakodate and Kamikita AC/DC converter stations provide two-way conversion between alternating and direct current. They provide the necessary interconnection between the 50Hz and 60Hz systems in Japan and, using DC cable, interconnection between Honshu and Hokkaido systems.



### Substations

Substations distribute electricity from each of the power stations to different destinations, and adjust the voltage. Power is sent from power stations at high voltage to minimize transmission loss, and is then dropped to a lower voltage at substations near the point of use, for efficient delivery of electricity.



### Substation Operation and Maintenance

**Atsuhiko Furuta**, Kawagoe Office, JPHYTEC Co., Ltd.

The substations of the J-POWER Group were built so that power generated at large hydropower stations constructed and put into operation starting in the mid-1950s, including Sakuma Power Station, Okutadami Power Station, Tagokura Power Station, and Miboro Power Station, could be delivered to large power consumption areas such as Tokyo and Nagoya.

Because these hydropower stations are located in mountainous areas, high-voltage transmission lines of 275,000 volts (the highest available at that time) were adopted to ensure efficient power delivery. This required a full-scale effort to develop and manufacture high-voltage, large-capacity equipment in Japan for installation in substations. Starting in the late 1970s, the main transmission line system was gradually upgraded to 500,000 volts.

As the electrical power grid developed over time, the J-POWER Group coordinated efforts with the system upgrade plans of related power companies, adjusting the role of substations accordingly such as by increasing their output. Building a stronger power grid involves not simply increasing its scale; more than that, the equipment has to be made reliable and kept that way. In the past, reliability expected of the highest-voltage-class substations was required. The emphasis today is on equipment, where lack of reliability can have a direct and extremely serious impact such as a widespread power outage.

Substations even today contain equipment that has been in use for more than half a century, since the time of initial construction, as well as old models of equipment. While every effort is made to keep the equipment in top condition, during heavy load periods such as summer the maintenance job tends to be a constantly hectic one.



Minami Kawagoe Substation

