



Introduction to Genkai Nuclear Power Station

Introduction

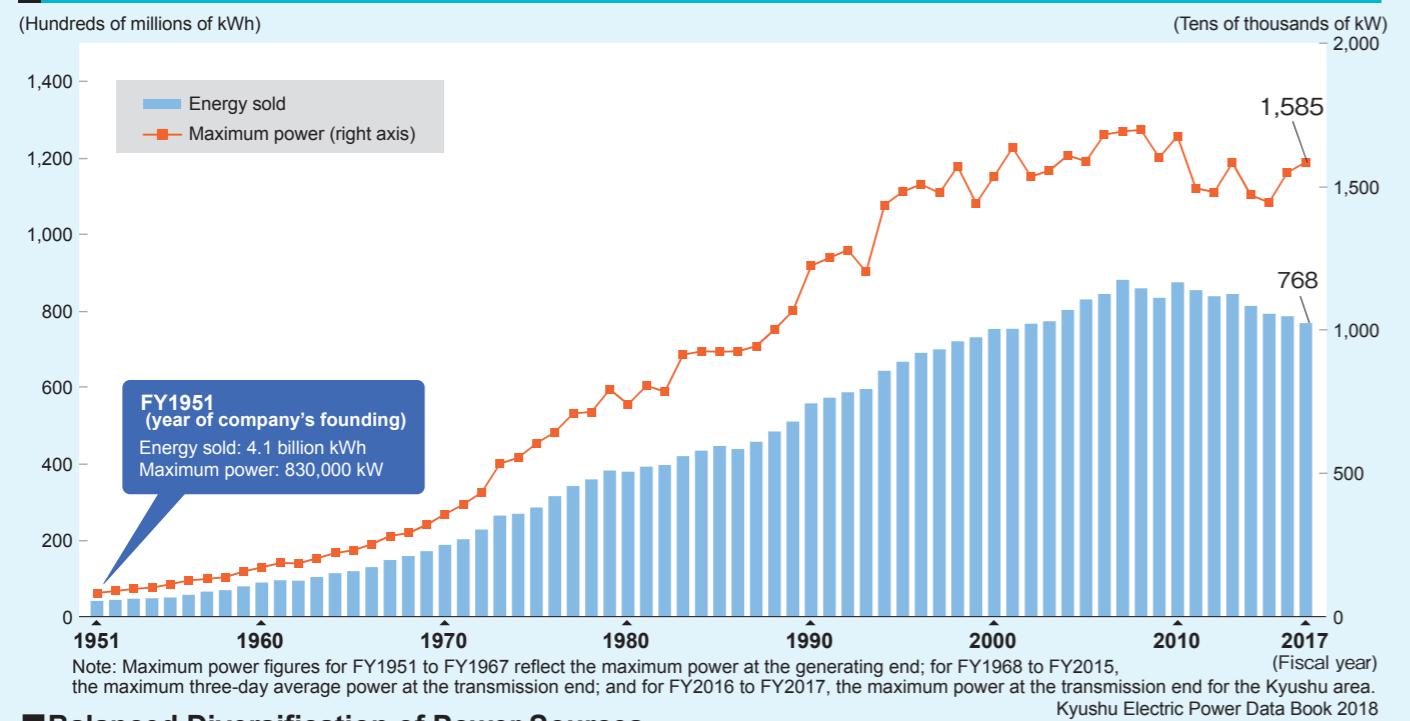
Compared with oil and other energy sources, nuclear power offers numerous advantages, including a stable supply of resources, harmony with the environment, and superior economy.

Genkai Nuclear Power Station began commercial operation in October 1975 with the startup of the No. 1 Unit. Since then, we have constructed three additional units to meet the growing demand for electric energy. As a result of those expansions, Genkai's output rose to 3,478 megawatts.

The No. 1 and No. 2 units subsequently ceased operation on April 27, 2015, and April 9, 2019, respectively, bringing the current total output to 2,360 megawatts.

All of Genkai's employees will continue to work together to accomplish the planned decommissioning of the No. 1 and No. 2 Units as well as the safe, stable operation of the No. 3 and No. 4 Units while ensuring that safety remains the top priority.

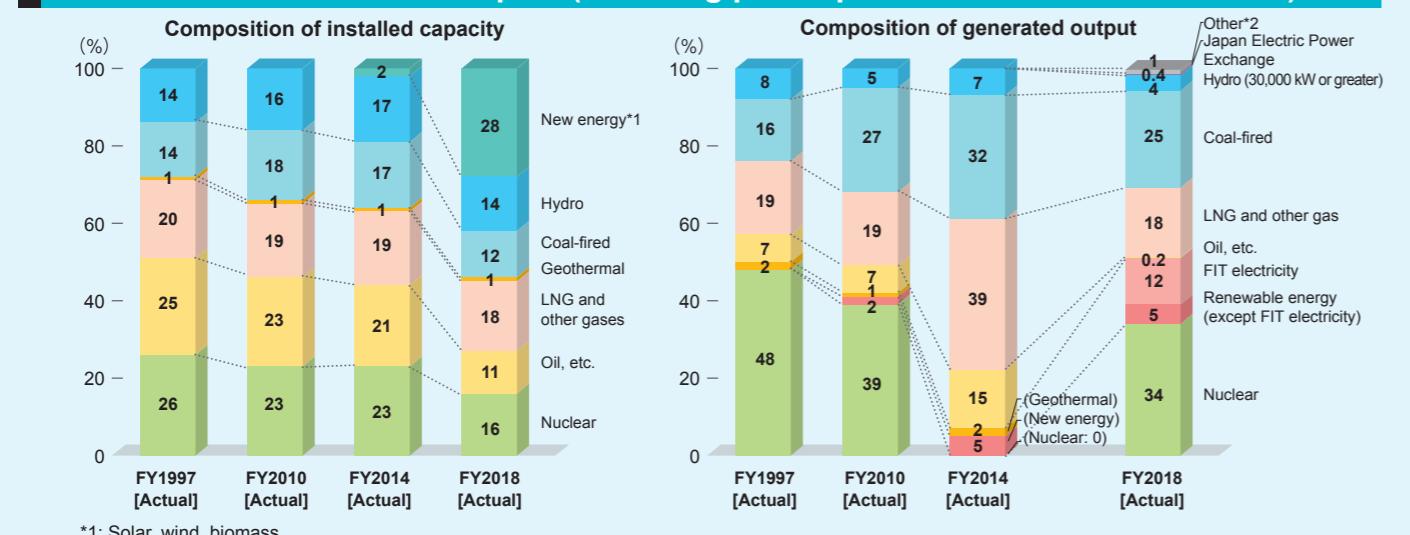
Electric power sales and peak power



Balanced Diversification of Power Sources

Kyushu Electric Power strives to combine a variety of power sources in order to deliver an optimal mix based on considerations including stability of fuel procurement, generating cost, and environmental impact. A typical mix during peak power demand in the summer would be nuclear and coal-fired generation for baseload, LNG-fired generation for middle load, and oil-fired generation for peak load. We're also maximizing use of solar and wind as we accommodate power demand.

Power source diversification plan (including power purchased from other utilities)



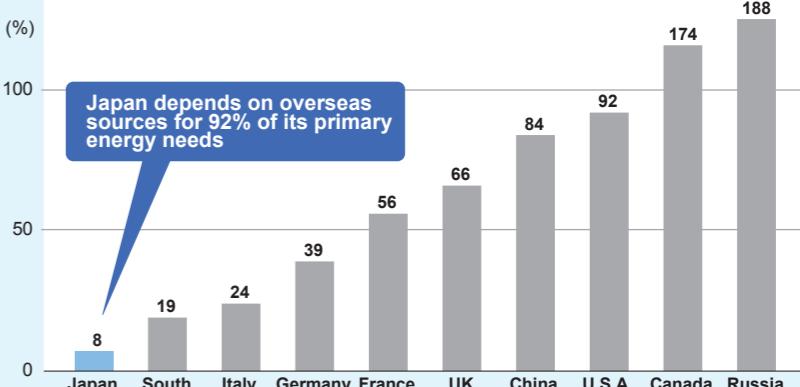
Japan's energy supply

Ensuring a stable supply of electricity

Japan is a resource-poor country with an energy self-sufficiency rate of just 8%. Because we depend on imports for most energy resources in a process that is highly susceptible to global conditions, ensuring energy security is a top priority. Additionally, the need to reduce emissions of greenhouse gases such as carbon dioxide in order to deal with global warming remains a pressing and enduring issue.

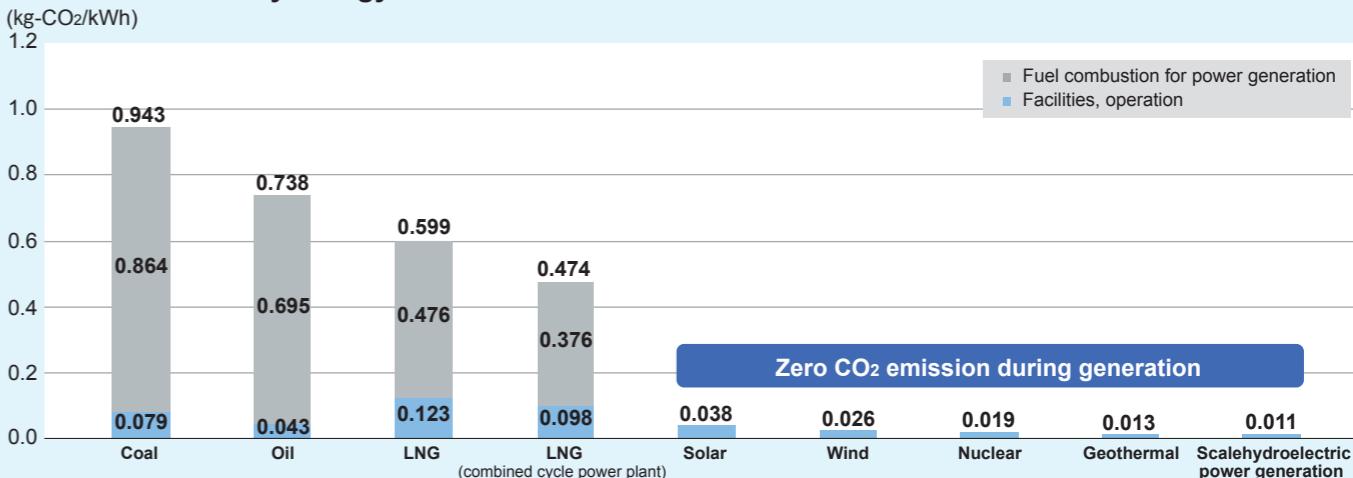
Consequently, it is necessary to combine nuclear, thermal, and renewable energy with an overriding focus on safety based on factors such as the need to ensure a stable of energy over the long term while addressing global environmental problems.

■Energy self-sufficiency



Notes 1: The IEA includes nuclear power when calculating the energy self-sufficiency rate since uranium, which nuclear power plants use as fuel, can be used for several years after being imported.
Note 2: Energy self-sufficiency rate (%) = Domestic production / Primary energy supply × 100
Note 3: Countries except Japan, FY2015; Japan, FY2016 (estimated)
Sources: "World Energy Balances 2017" (IEA), "Graphical Flip-chart of Nuclear & Energy Related Topics" (Japan Atomic Energy Relations Organization)

■CO2 emissions by energy source



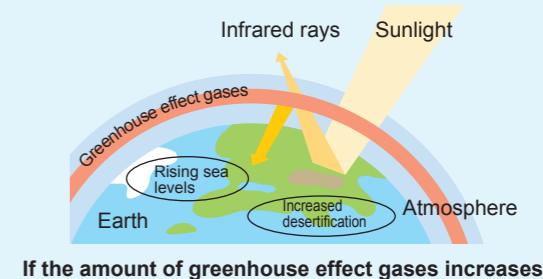
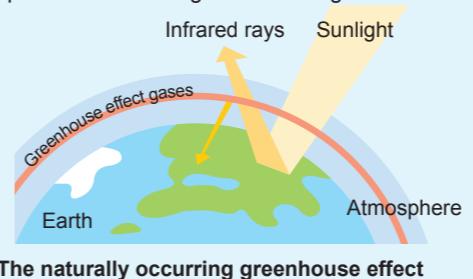
Source: Central Research Institute of Electric Power Industry (CRIEPI) Report (July 2016)

* The calculation of CO2 discharge includes all energy consumed in burning fuel for generation electricity as well as in mining raw materials, construction of facilities, transportation of fuel, refining, operation, and maintenance, etc.

*As for nuclear power generation, CO2 emissions are calculated by averaging the energy consumed by Japan's proposed domestic reprocessing of spent nuclear fuel, known as plu-thermal use (assuming one recycling), disposal of high-level radioactive waste, and other uses. Figures are tallied for boiling water reactors (BWR; 0.019 kg-CO2) and pressurized water reactors (PWR; 0.020 kg-CO2) and adjusted based on the total installed capacity for each type of facility.

The mechanism for global warming

A characteristic of carbon dioxide and other greenhouse effect gases is that they absorb infrared rays and other sources of heat while letting visible light through. If the amount of greenhouse gases rises, it is believed that heat will be trapped inside the atmosphere and lead to global warming.

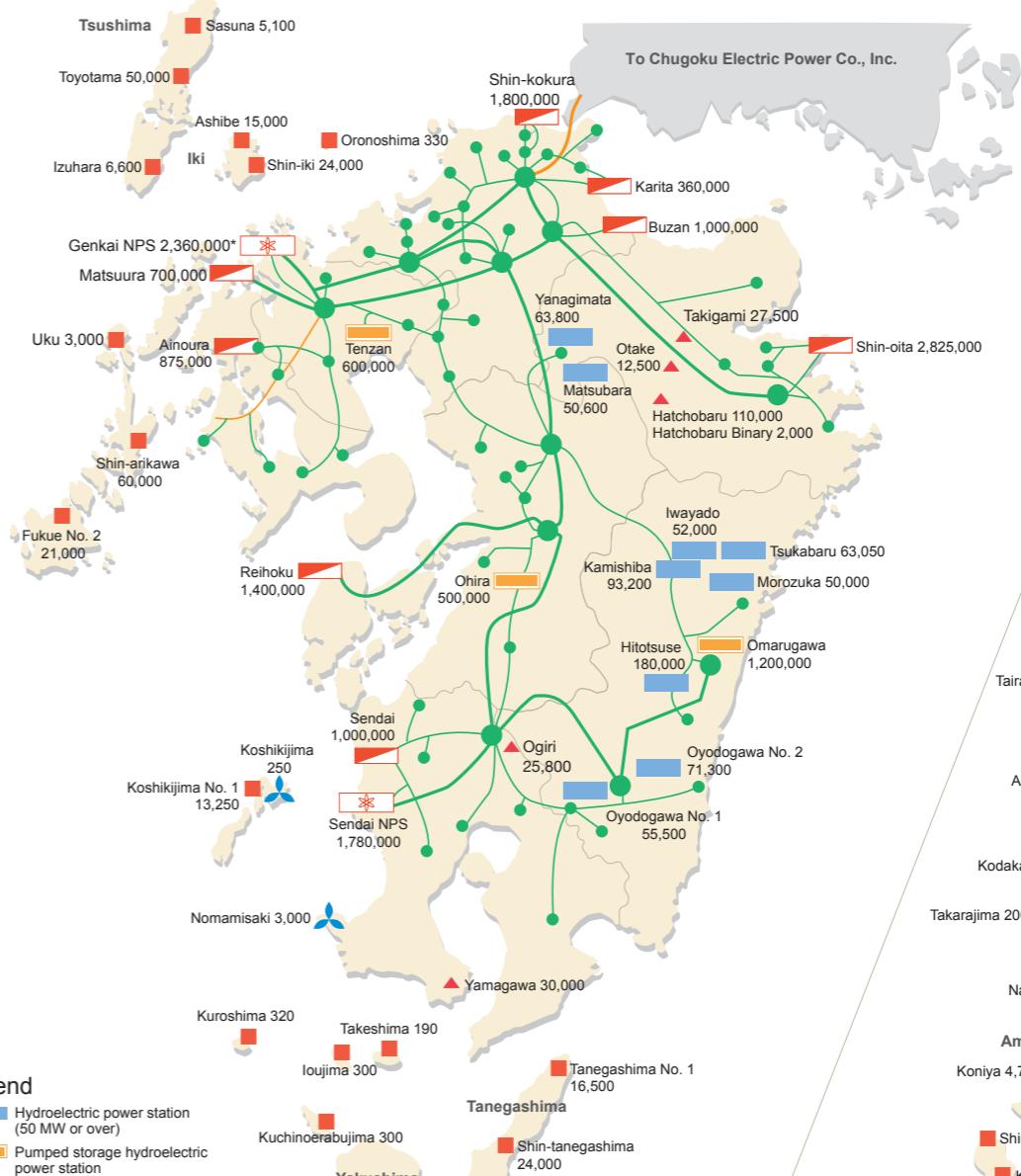


Outline of Genkai Nuclear Power Station



Outline

	Unit 1	Unit 2	Unit 3	Unit 4
Site	Imamura, Genkai-cho, Higashi Matsuura-gun, Saga Pref.			
Site area	870,000 m ² (approx.)			
Generated output	559 MW	559 MW	1180 MW	1180 MW
Reactor Type	Pressurized water reactor (PWR)			
Thermal output	1650 MW	1650 MW	3423 MW	3423 MW
Fuel type	—	—	Low-enriched uranium dioxide (approximately 4%), mixed uranium-plutonium oxides	Low-enriched uranium dioxide (approximately 4%)
Fuel capacity	—	—	89 tons (approx.)	89 tons (approx.)
Start of operation	October 1975	March 1981	March 1994	July 1997
End of operation	April 2015	March 2019	—	



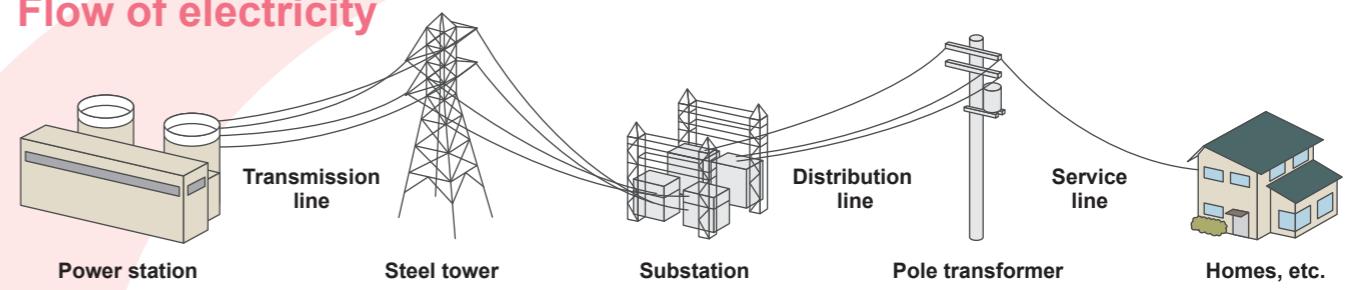
Legend

- Hydroelectric power station (50 MW or over)
- Pumped storage hydroelectric power station
- Thermal power station
- Nuclear power station
- ▲ Geothermal power station
- Internal combustion power stations
- Wind power station
- Main substation
- Transmission line (500 kV)
- Transmission line (220 kV)
- Other company's transmission line

*Output for the No. 3 and No. 4 Units is shown as the Genkai No. 2 Unit ceased operation in April 2019.
Figures for power plants indicate output (kW).

(As of March 31, 2019)

Flow of electricity



System of Nuclear Power Station

System

The type of reactor used at Genkai Nuclear Power Station is called a pressurized water reactor (PWR). One feature of the pressurized water type, shown in the figure below, is the complete separation, through the use of steam generator heat exchanger tubes, of the system that circulates water through the reactor (primary system) from the system that supplies steam to the turbine (secondary system), ensuring that no radioactive substances are transmitted over to the turbine side.

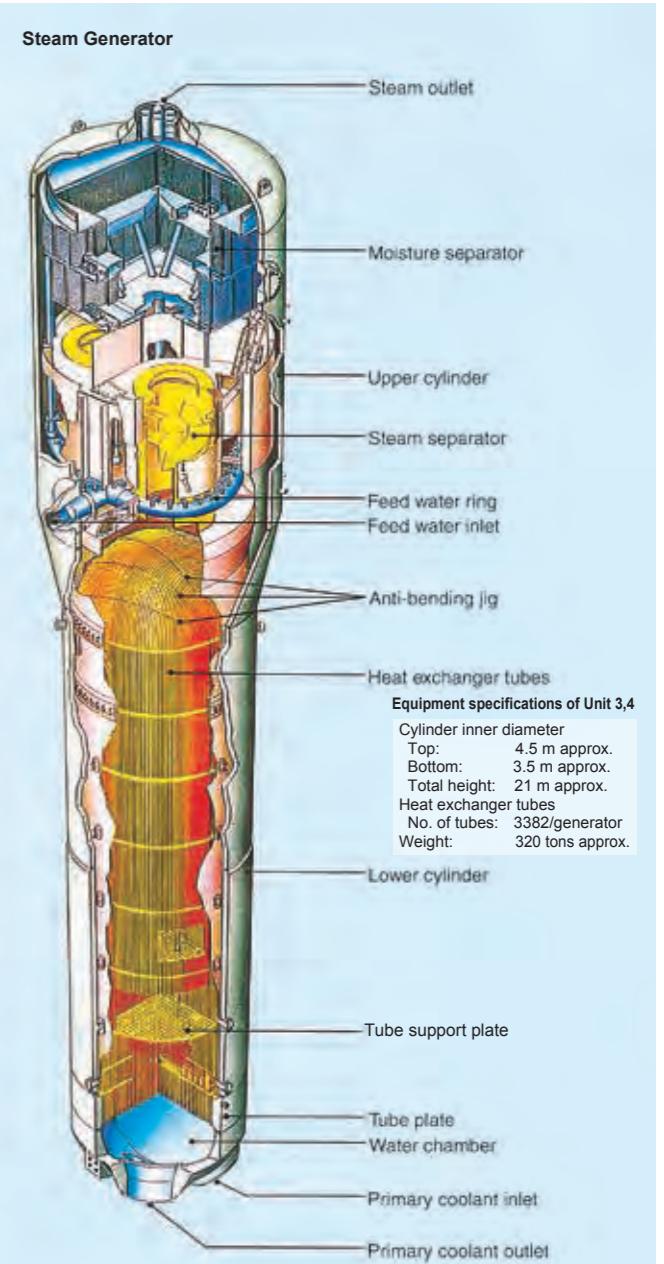
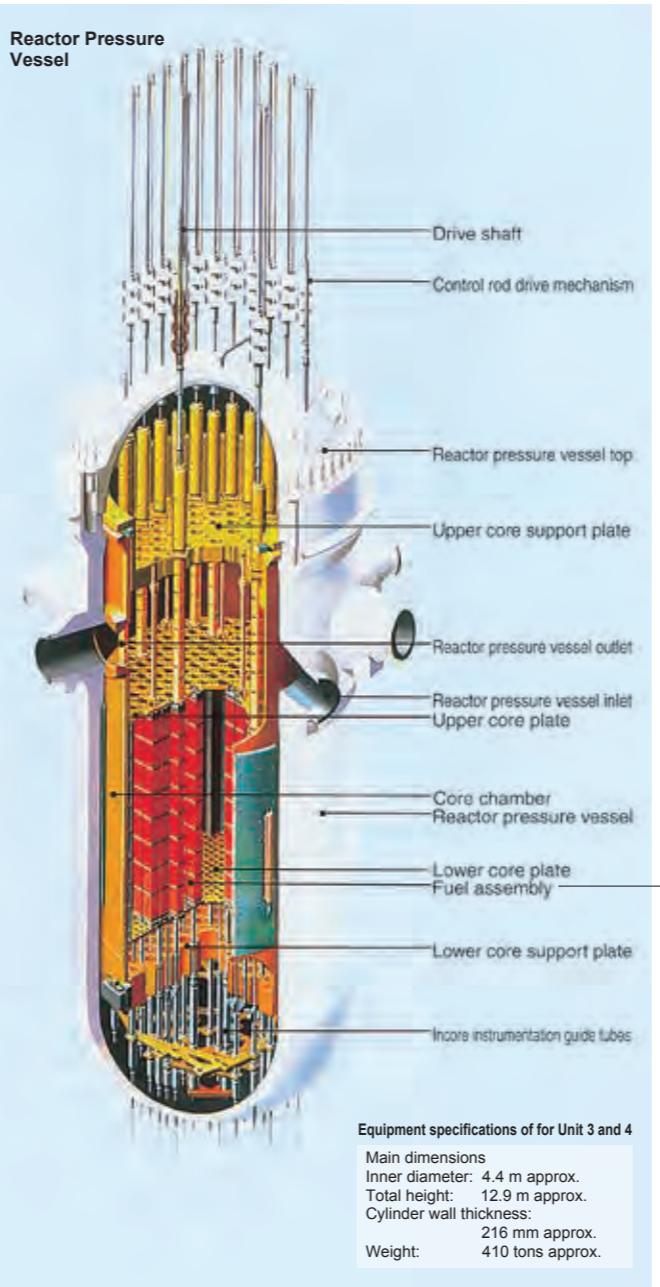
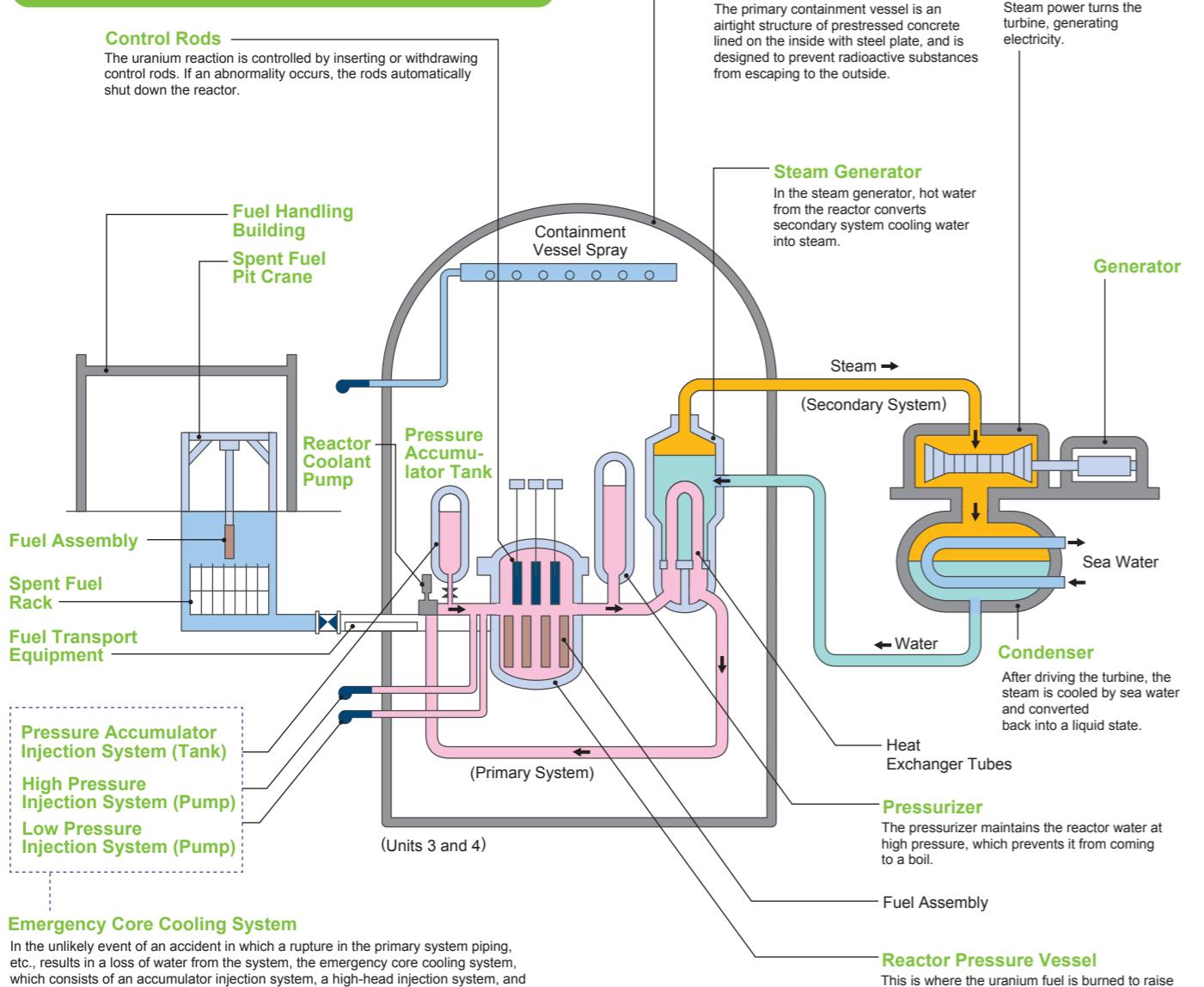
In the reactor, the uranium fuel undergoes nuclear fission, generating large quantities of heat. This heat is transferred to the water of the primary system, which is then transported to the steam generator by the primary reactor coolant pump.

The primary system water is transported into the steam generator, where it flows through the inner side of the heat exchanger tubes, transmitting heat through the tube walls to the surrounding secondary system water. The primary system water is then returned to the reactor.

Meanwhile, the secondary system water is transformed into steam within the steam generator, travels to the turbine, and drives the turbine-generator to produce electricity.

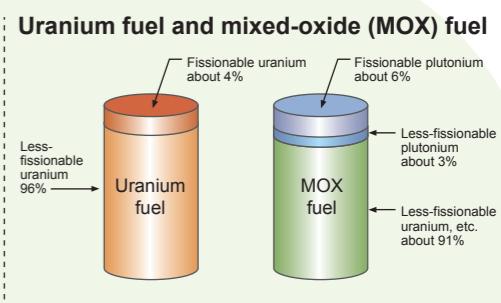
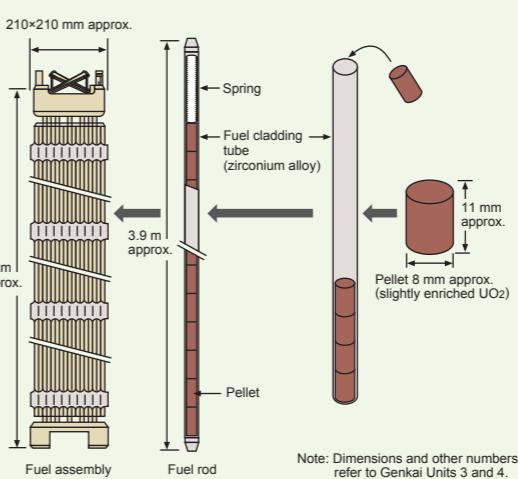
Once the steam has finished its work at the turbine-generator, it is cooled in the condenser by tubes filled with seawater, returned to a liquid state, and transported back to the steam generator.

**The only difference between nuclear power and thermal power is the fuel used.
From the turbine onward, all the equipment is the same.**



Fuel Assembly Structure

Uranium powder is baked into hard pellets, which are loaded into cladded tubes to form fuel rods. These fuel rods are assembled into a lattice grid shape to form the fuel assembly.



MOX fuel can, in principle, be used as-is in existing generating facilities.

Inside Genkai Nuclear Power Station



Turbine-Generator

The steam produced by the steam generator turns the turbine. Electricity is produced by the generator which is linked directly to the turbine.



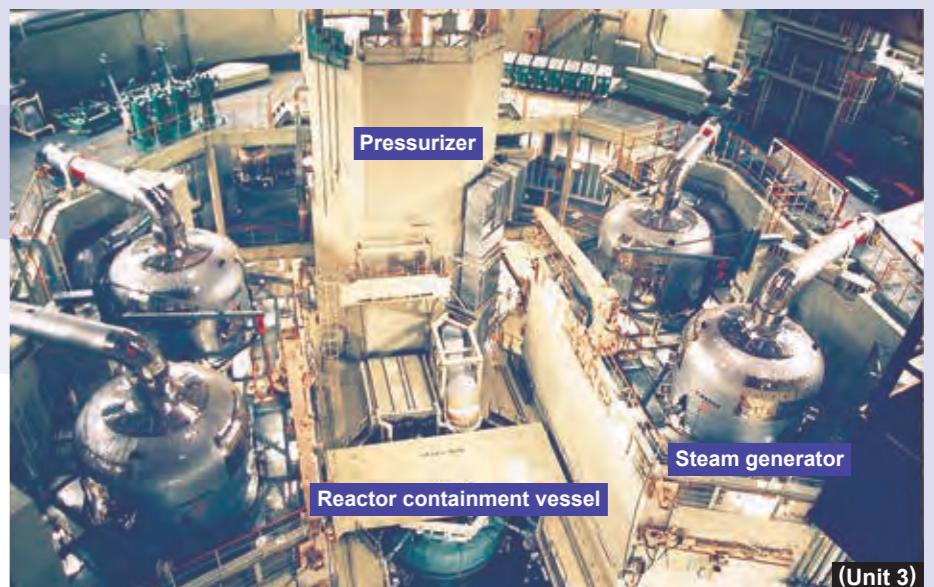
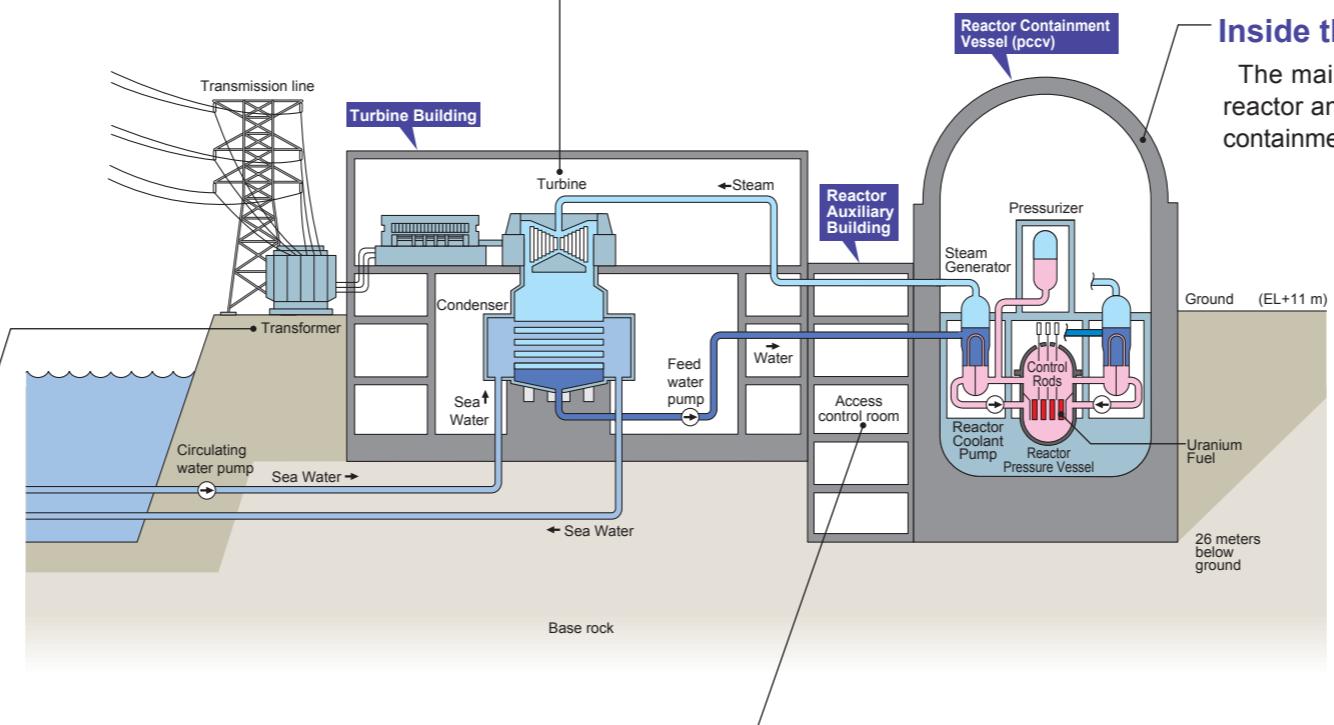
Transformers/Switch Yard

The electricity produced by the generator is stepped up to a higher voltage by transformers and sent out over the transmission lines.

The Switch Yard plays the role of switch between the power station and transmission lines.

Radiation Controlled Area Access Control Room

Monitoring devices such as a registration system for entry and a body surface contamination monitor are installed to control access to the radiation-controlled area.



Inside the Containment Vessel

The main equipment of the primary system, such as the reactor and steam generator, is installed inside the reactor containment vessel.



Central Control Room

The Central Control Room, with its wide variety of meters, warning and monitoring devices, operating switches and other equipment is the brain of the power station. Members of the Operation Section monitor the reactor, turbine-generator, and other equipment under a 24-hour-a-day system.

Safety of Nuclear Power Station

Multiple Layers of Safety Protect Against Expanding Harm

The major premise of safety measures for nuclear power stations is to ensure the safety of persons in the surrounding area from danger due to radioactive materials.

As a result, we use multiple layers of safety measures based on acceptance of the idea that machinery will break down, and people will make mistakes.

We have a full range of systems for ensuring safety.

Safety Assurance

1. Prevent abnormalities before they occur

We implement designs that ensure ample safety margins, and use equipment and materials of the highest performance and quality. In addition, we utilize systems that are capable of automatically evading dangerous situations even should the machinery break down, and that can prevent the equipment from receiving operating commands issued in error.

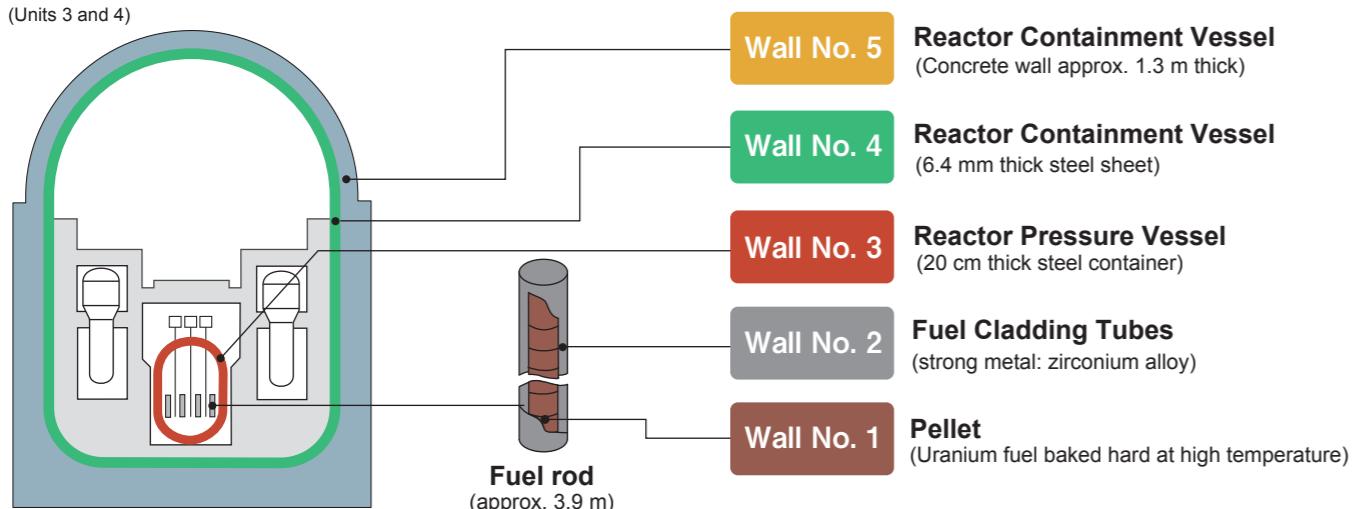
2. Prevent abnormalities that do occur from burgeoning into accidents

We have established a monitoring system for instant notification of abnormalities, to ensure that the abnormalities do not lead to accidents. Moreover, the system can automatically shut down the reactor should the need arise.

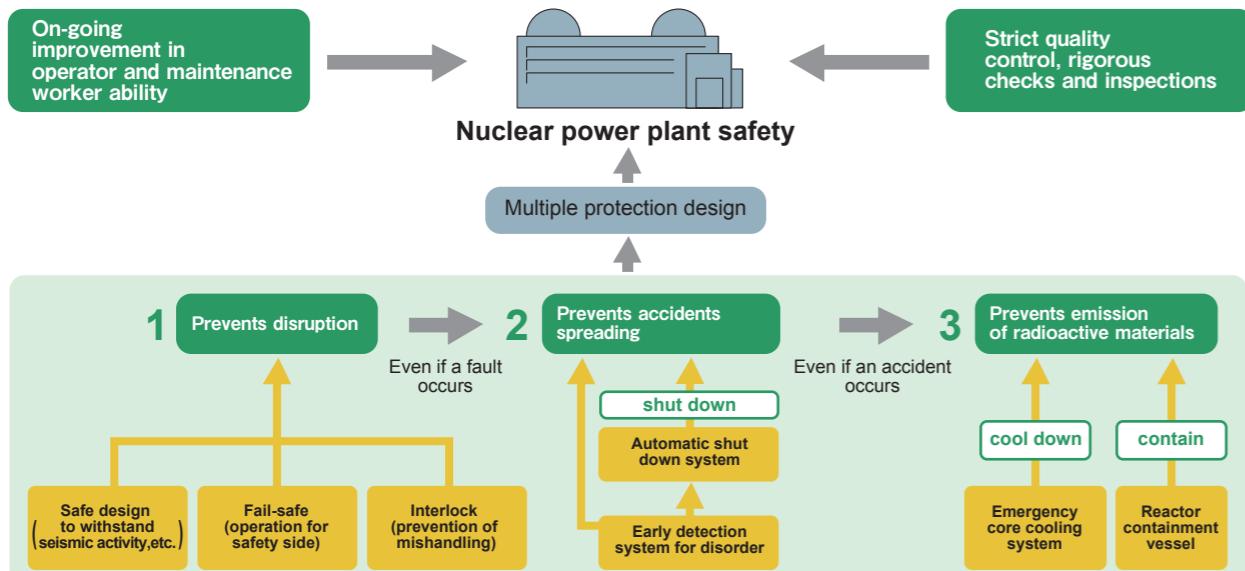
3. Prevent the release of radioactive materials in the unlikely occurrence of an accident

To prevent the abnormal release of radioactive materials in the unlikely occurrence of an accident, the reactor shall immediately be cooled down and all radioactive materials be sealed in.

Five Walls of Protection



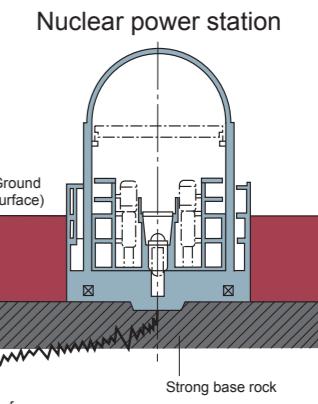
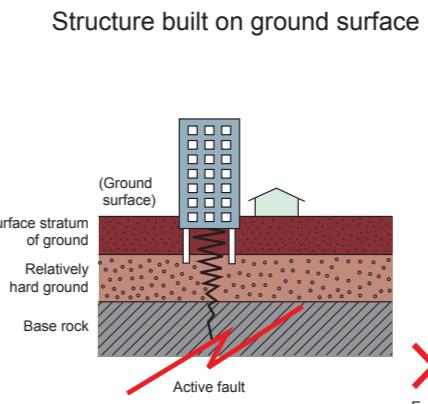
Safety Features of Nuclear Plant Design



Earthquake countermeasures at nuclear power station

When an earthquake occurs, the seismic waves are amplified as they travel from the epicenter to the ground surface. This causes violent shaking in structures which are built on the ground surface.

In contrast, earthquakes have far less effect on structures such as nuclear power station which are built directly on strong base rock, because the base rock does not amplify the motion of the quake.



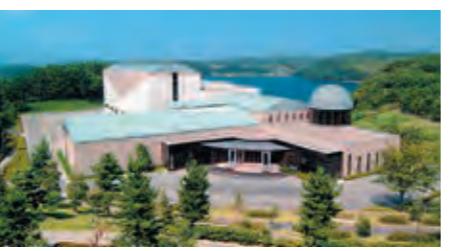
Daily Inspection

In order to confirm the operating condition of the equipment, patrol personnel make inspections every day.



Periodic Inspection

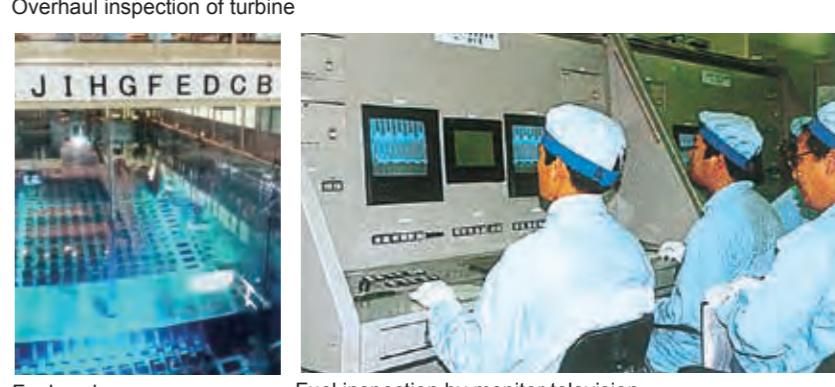
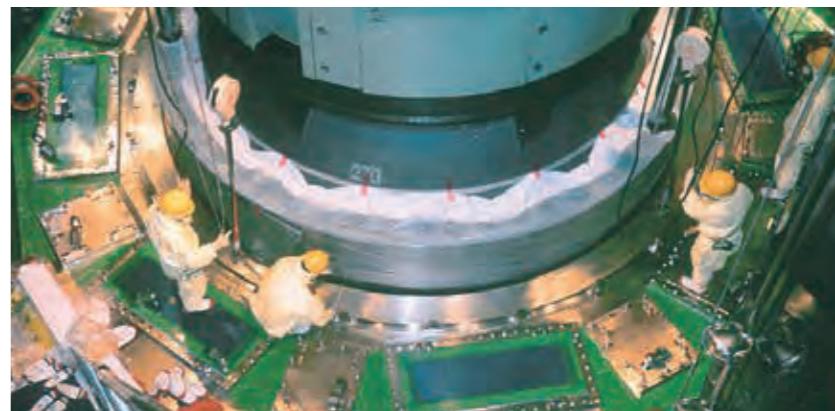
In addition to thorough implementation of multiple safety measures for the equipment, every effort is made to ensure safety by rigorous training of operators and maintenance personnel, which is conducted periodically at the site and the Training Center.



Exterior view of the Nuclear Power Training Center

Periodic Inspection

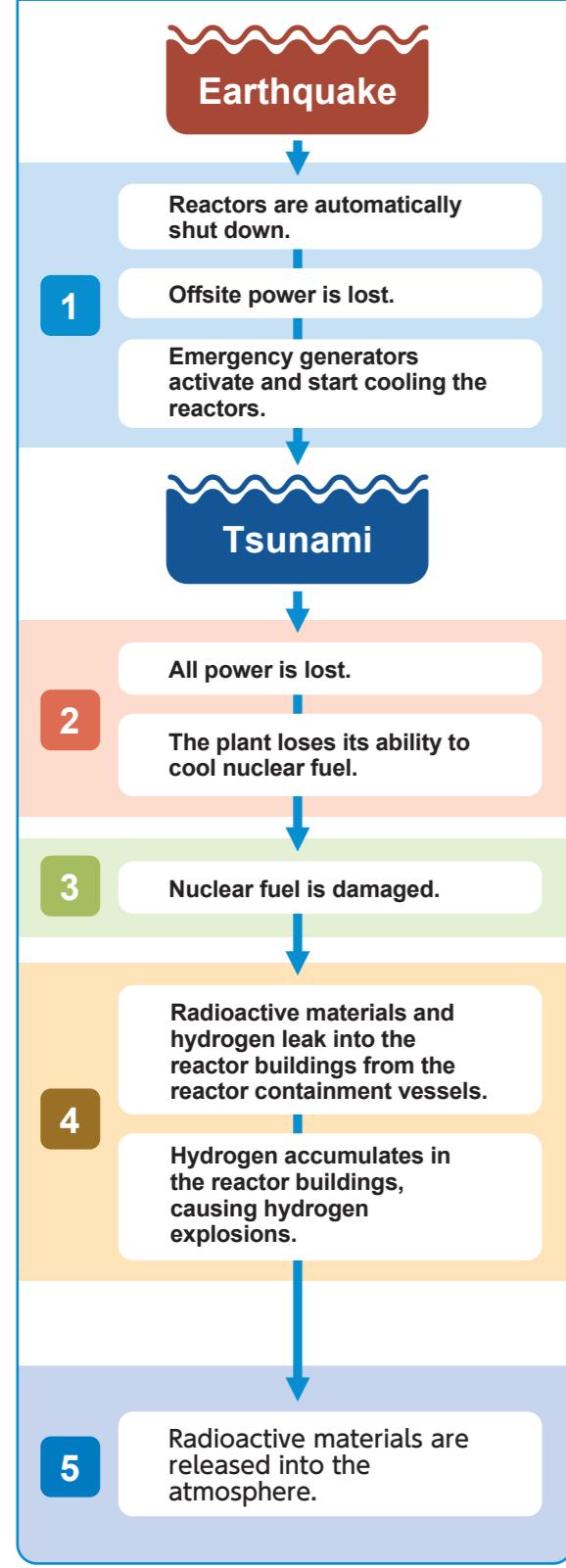
As required by law, equipment is periodically disassembled, inspected, and tested.



Measures to ensure safety in the event of a serious accident

Genkai Nuclear Power Station has learned from the lessons of the Fukushima Daiichi Nuclear Power Plant and implemented a facility equipment and operational management in the immediate aftermath of an accident. Going forward, we will strive to pursue a voluntary and ongoing program of initiatives to boost safety and reliability.

Progress of events during the accident at the Fukushima Daiichi Nuclear Power Plant



Overview of new regulatory standards

Basic approach

Japan's new regulatory standards for preventing serious accidents strengthen legacy standards that were in place prior to the adoption of the new regime, add new standards, and incorporate new requirements designed to deal with serious accidents in the event they occur.

Previous regulatory standards

Operators are responsible for determining how to deal with serious accidents.



- Consideration of risks posed by natural phenomena
- Consideration of risks posed by fire
- Reliability of the power supply
- Performance of other equipment
- Earthquake and tsunami resilience

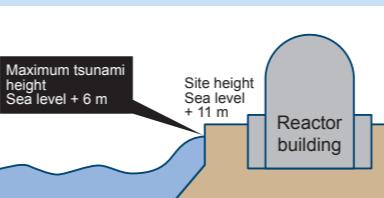
New regulatory standards

- Ability to withstand an intentional impact by an aircraft*
- Measures to limit dispersion of radioactive materials
- Measures to prevent damage to reactor containment vessel
- Measures to prevent core damage
- Consideration of risks posed by internal flooding (new)
- Consideration of risks posed by natural phenomena (with volcanic eruptions, tornadoes, and forest fires added as new risk factors)
- Consideration of risks posed by fire
- Reliability of the power supply
- Performance of other equipment
- Earthquake and tsunami resilience

Principal safety measures in place at the Genkai Nuclear Power Station (example initiatives)

1 Preventing anomalies

Strengthening the plant to prepare for the largest-scale natural disasters that are scientifically possible



We've taken steps to boost seismic resistance based on the maximum anticipated standard earthquake ground movement.



The site is situated 11 meters above sea level, and we have verified that even the maximum anticipated tsunami would not have an adverse effect on the safety of the reactor facility.



2 Preventing an anomaly from expanding



We've prepositioned an array of generators* at the site in order to ensure we can secure the power needed to prevent a serious accident.

*Equipment has been dispersed throughout the site at elevations of about 11 to 28 m above sea level.

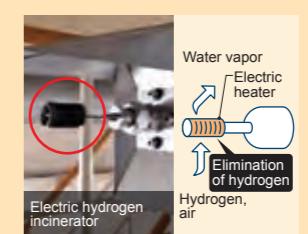
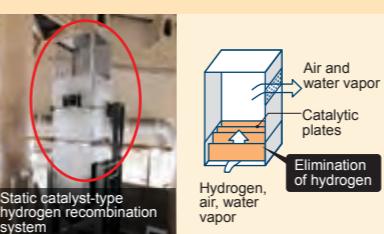
3 Preventing damage to nuclear fuel



We've prepositioned an array of pumps* at the site in order to ensure the nuclear fuel can be cooled. (Also used in Measure 4.)

*Equipment has been dispersed throughout the site at elevations of about 11 to 28 m above sea level.

4 Preventing damage to reactor containment vessels



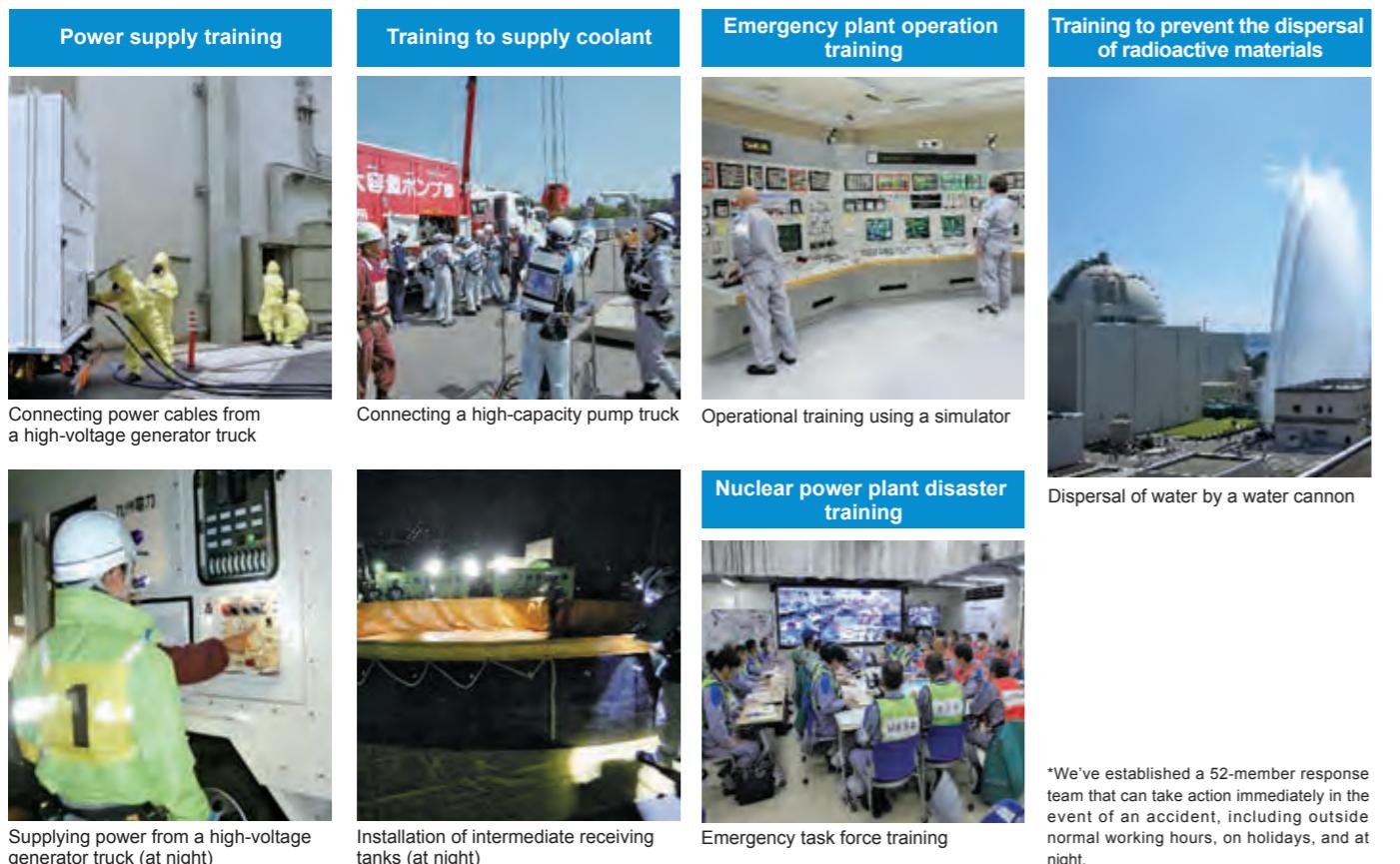
In addition to adopting more varied means of cooling reactor containment vessels, we've installed hydrogen elimination systems as a way to lower hydrogen concentrations.

5 Preventing the release and dispersal of radioactive materials

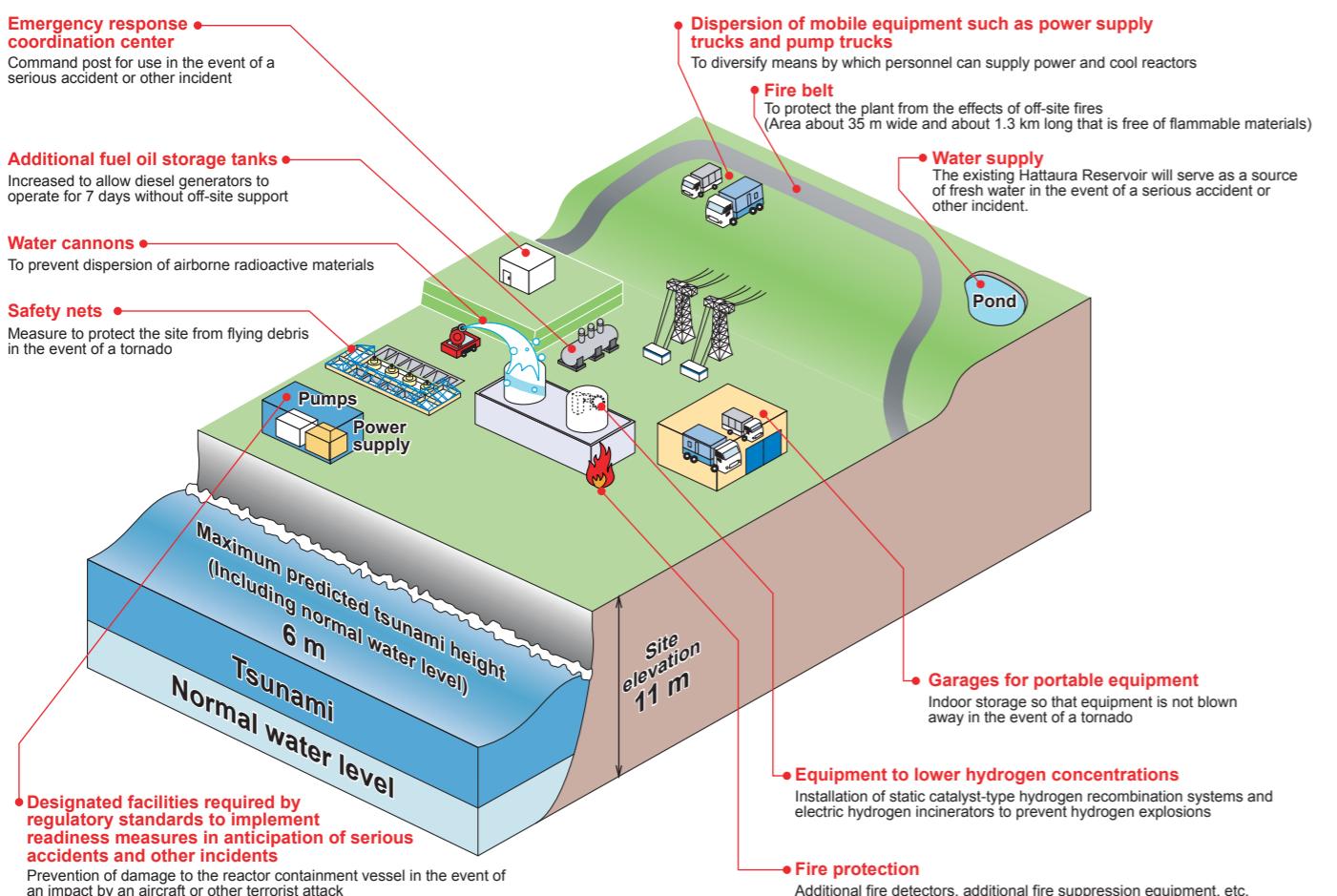


To prepare for the unlikely event that a reactor containment vessel were to sustain damage, we've prepositioned water cannons and underwater curtains at the site.

Training to prepare for a serious accident



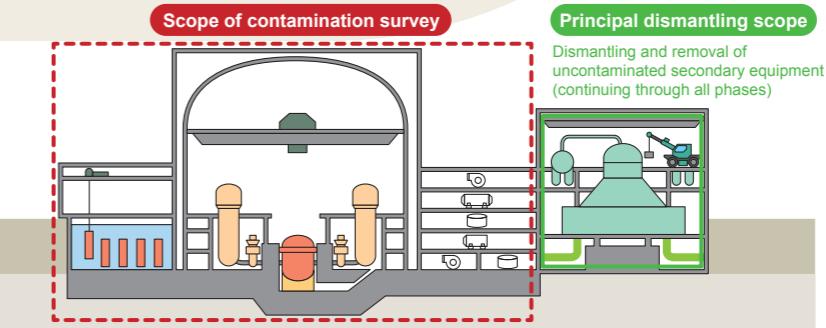
Major equipment installed under Japan's new regulatory standards (illustration)



Overview of the decommissioning plan

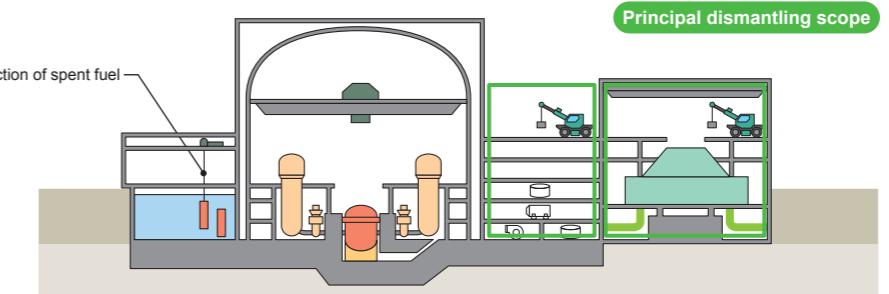
Broadly speaking, the decommissioning process consists of four stages.

I Preparing for dismantling (starting July 2017)



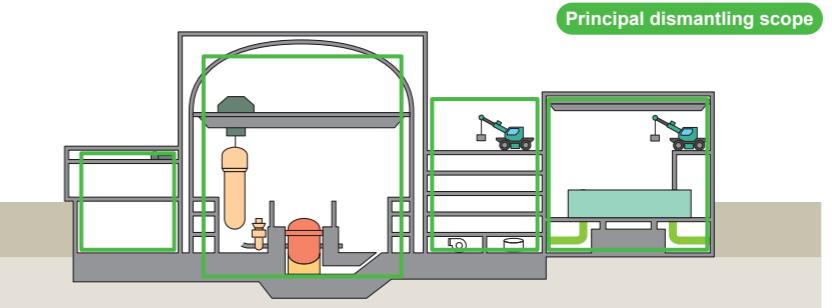
- Equipment is surveyed to assess the extent of contamination.
- Any radioactive material that has adhered to pipes and other equipment is removed using chemicals (as part of a cleaning process).

II Dismantling and removing equipment around the reactor



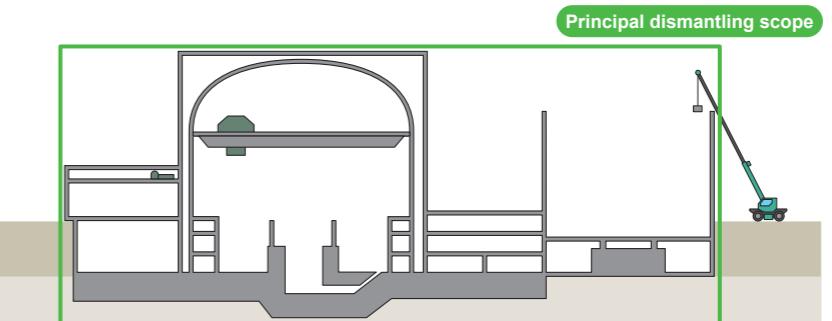
- Equipment with a comparatively low level of radioactivity is dismantled and removed.
- The fuel extraction process is completed.

III Dismantling and removal of the reactor and related equipment



- Once radioactivity levels have fallen, equipment such as the reactor pressure vessel and steam generator is dismantled and removed.

IV Dismantling and removal of buildings



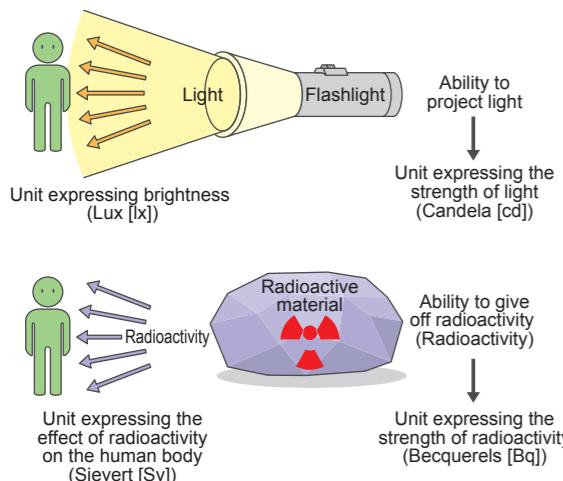
- Once contaminants inside buildings have been removed, buildings* are dismantled and removed.

*Except underground buildings, underground structures, and foundations that have not been contaminated with radioactive materials.

Everyday Life and Radiation

Radiation and Radioactivity

The capacity to emit radiation is called radioactivity. Materials which have this capability are called radioactive materials. In other words, using a lamp as an example, it could be said that the light bulb is like the radioactive material, the light emitted by the bulb is radiation, and the capacity to emit light is radioactivity.



Natural Radiation and Artificial Radiation

Radiation includes natural radiation, which exists in nature, and artificial radiation, which includes X-rays used in medical procedures, and emissions from nuclear power stations and other devices. However, the effect on the human body is the same regardless of the source, as long as the radioactive values are the same.

Radiation in the Vicinity of Nuclear Power Station

The target value of the radiation dose received by persons in the vicinity of a nuclear power station as a result of station operation is set at 0.05 millisieverts per year. However, the radiation dose emitted by power stations in actual operation is held under 0.001 millisieverts. This is far lower than the radiation we receive from natural sources, and has no effect whatsoever on the human body.

Radiation Management for Personnel Working at the Genkai Nuclear Power Station

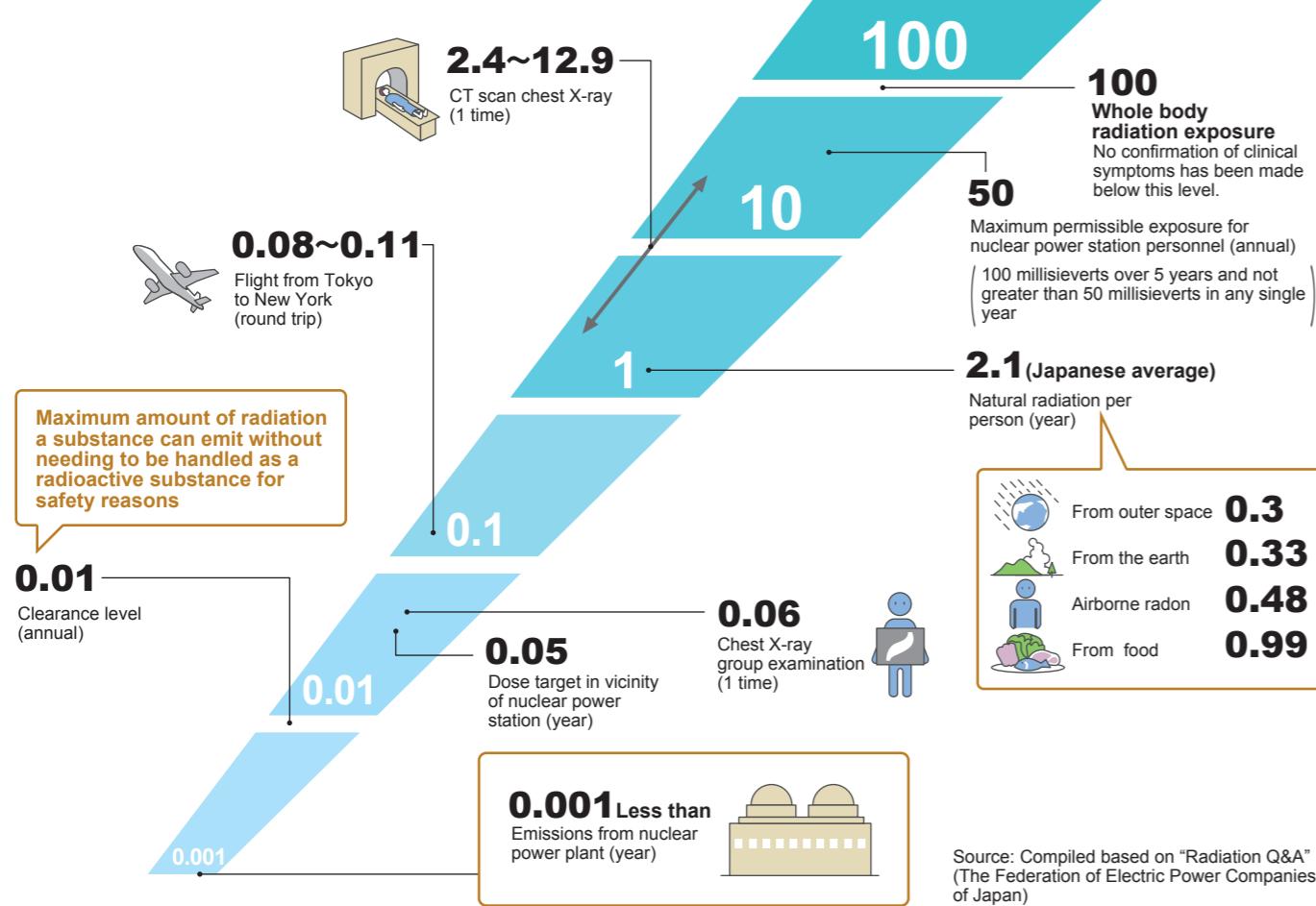
The radiation doses actually received by personnel who work at nuclear power stations average 0.1 millisieverts per year (data from FY2017), far less than the legal limit of 50 millisieverts per year. Moreover, various considerations are being taken in terms of both planning and management to reduce this amount even further.

Note: The maximum exposure under law is 50 millisieverts per year, and 100 millisieverts over a 5-year period.

Radiation in every day life

[Radiation exposure during everyday life]

Unit: Millisieverts



Environmental Monitoring

In order to confirm that there is no change in environmental radiation due to operation of the Genkai Nuclear Power Station, monitoring stations and monitoring posts* have been installed in the vicinity of the plant to continuously measure and monitor radioactivity and other parameters. Additionally, crops, soil, drinking water, fish, seaweed, seawater, and other materials in the area surrounding the facility are sampled periodically and measured for radioactivity and radioactivity concentration. Further, monitoring vehicles are used to periodically measure radioactivity in the area surrounding the power station. These activities are termed environmental monitoring. Measurement results are published by Saga Prefecture, and the plant publishes environmental radioactivity results.

*Monitoring stations: Continuously measure and monitor radioactivity and airborne radioactive concentrations using gamma ray monitors and dust monitors.

Monitoring posts: Continuously measure and monitor radioactivity using gamma ray monitors.



Monitoring station



Environmental sample collection (soil)



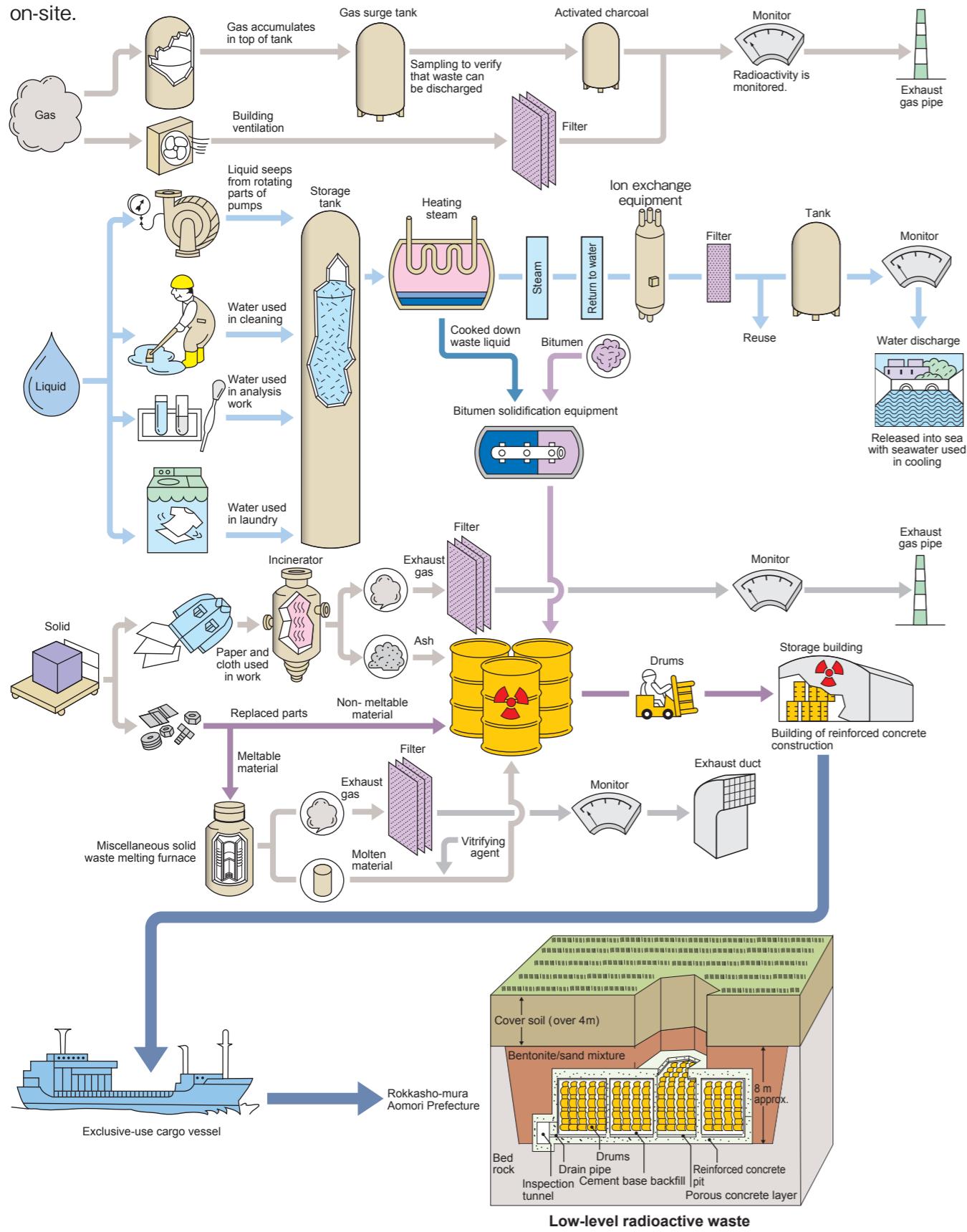
Monitoring vehicle



Environmental sample collection (Matsuba)

Treatment of Radioactive Waste

Radioactive waste generated in nuclear power stations includes low-level radioactive gaseous, liquid, and solid waste. Gaseous and some liquid wastes are treated appropriately, and then discharged into the air or the sea after their safety has been confirmed. Moreover, the remainder of the liquid wastes, and the solid wastes, are treated, sealed into drums, and then stored under strict conditions in a storage building on-site.



Management of Wastes

The liquid and solid wastes which are generated by the power station are first compacted to reduce their volume and then packed in drums, which are held (mid-term storage) under strict conditions in the solid waste storage facility at the power station.

These drums will eventually be transported to the Low- Level Radioactive Waste Disposal Center at Rokkasho-mura in Aomori Prefecture for burial (final disposal).

Wastes from power stations are controlled safely to the very last.

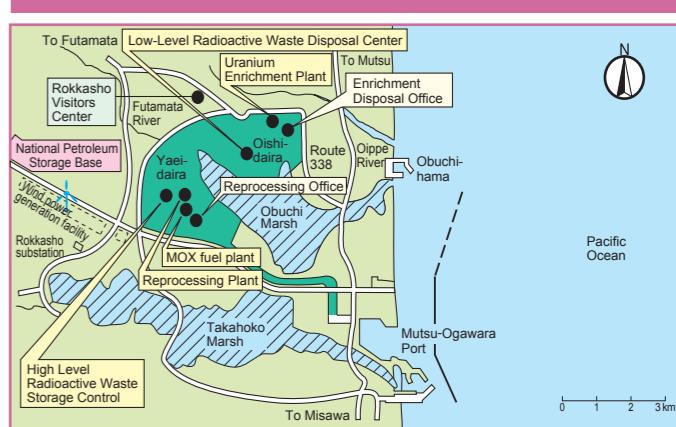


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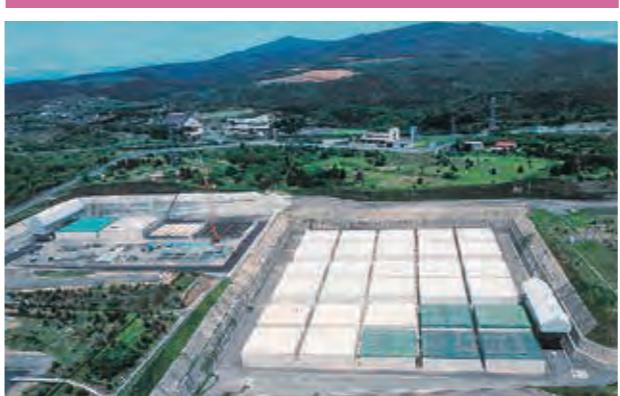
Low-Level Radioactive Waste Disposal Center

Operator	JAPAN NUCLEAR FUEL LIMITED (JNFL)
Scale of site	200,000 m ³ (Equivalent to 1 million drums) To be expanded to 600,000 m ³ (Equivalent to 3 million drums) *1drum=200 liters
Start of operation and storage	December 1992

Layout of Rokkasho-mura



Low-Level Radioactive Waste Disposal Center



Welcome to Genkai Energy Park

At Genkai Energy Park, which opened in March 2000, visitors are introduced to nuclear energy as they walk around and see its facilities. It is both a learning and playing experience.

The park's main attraction, the PR Center, consists of two facilities, the Science Pavilion and Kyushu Furusato Pavilion. The former exhibits, for the first time in Japan, a full-view reactor mock-up, while the latter introduces traditional crafts and folklore from all over Kyushu. Other facilities include the Taiyo-no-Hiroba with outdoor play equipment and Jabu-Jabu Pond, and the "Visitor's conservatory."

In March 2006, Yuchuntei Awatsuki, built in traditional Japanese style with a Japanese garden, was completed in the Camellia Park to mark Genkai Energy Power Station's 30th anniversary. Calming and wood-scented, Awatsuki can be used for various events such as tea ceremonies, haiku meetings, and flower arrangement (free of charge; reservations required).

It is operating in conjunction with the adjoining Genkaicho Next Generation Energy Park Asupia, offering an expanded variety of outdoor facilities.



Facility Outline

	PR Center	Taiyo-no-Hiroba	Decorative plant greenhouse
Outline	Scale of structure Ferroconcrete structure (a basement and four stories) Building area 5,400 m ² approx. Total floor area 9,700 m ² approx. Maximum height of building 30 m approx.	Grassy plaza Cherry tree Promenade Outdoor play equipment Jabu-Jabu Pond	Scale of structure Ferroconcrete structure (one basement and one above-ground floor) Building area 1,300 m ² approx. Total floor area 1,520 m ² approx. Maximum height of building 18 m approx.
Address:	4112-1 Oaza Imamura, Genkai-cho, Higashi-Matsuura-gun, Saga 847-1441 JAPAN Tel: 0955-52-6409 Fax: 0955-52-3796		
Access:	Take the Showa Bus from Karatsu (Oteguchi Bus Center) and get off at the Genkai Energy Park stop (Genkai Nuclear Power Station Entrance). Takes about 40 minutes.		
Hours:	9:00 to 17:00; admission free		
Closed:	New Year's holidays (Dec. 29 to Jan. 2), third Monday of each month (or next day, if a holiday)		
<ul style="list-style-type: none"> • Tour courses: Genkai Energy Park, Nuclear Power Training Center, Visitor's Conservatory • Please contact Genkai Energy Park to make reservations (required) for the tennis courts or Yuchuntei Awatsuki. These facilities are open to the public free of charge. 			
Tennis courts		From two weeks in advance	
Yuchuntei Awatsuki		From the first day of the month in which the day falling three months before the desired reservation falls	

Genkai Energy Park Expansion Area



Together with the Region

In operating a nuclear power plant, the cooperation of everyone in the area is indispensable. To deepen the understanding and friendly feeling of residents toward Genkai Nuclear Power Plant, we are fully involved in everyday dialogue activities, volunteer activities, sports, and other parts of the life of the community.

Events



Japanese croquet

Volunteer activities



Cleanup at a social welfare facility



Empty can and trash collection



Cleaning road curve mirrors

Building a Better Community

We are also working to improve the social infrastructure of the area. For example, to improve welfare services, we have donated funds for the construction of public facilities under the three main laws for the promotion of power station construction.



Genkai Research Institute of Medicinal Plants

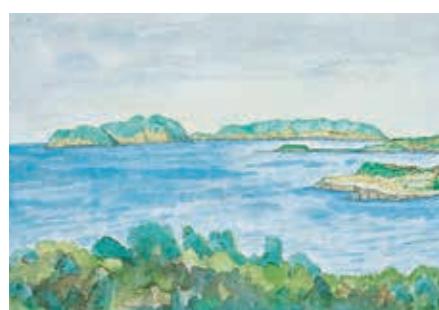


Recreation Plaza

Genkai Nuclear Power Station

Guide to the Surrounding Region

Genkai, a beautiful town blessed with blue sea and a fascinating history



1 Genkai Marine Observation Tower

From the tower built out from the tip of Cape Hato, it is possible to observe to a depth of 7 meters below water level.



2 Ruins of Nagoya Castle

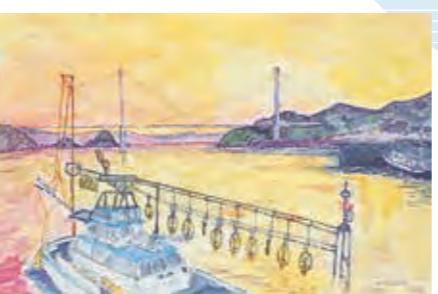


3 Saga Prefectural Nagoya Castle Museum

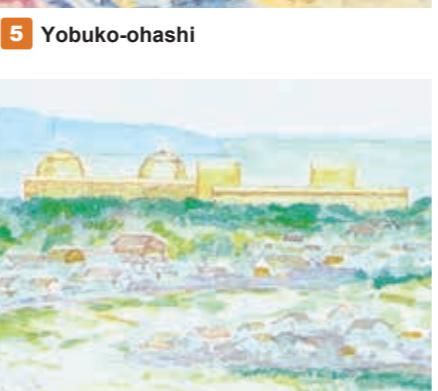
Dates from the 9th year of Tensho (1591). The remains of the castle constructed by Hideyoshi as the main base for an expedition to Korea. Ranks among the largest of Momoyama period castles remaining today in Japan. The Museum houses a collection of documents on the history of the castle and its vicissitudes.



4 Windview Hill Gardens



9 Kariya Bay



10 Tsuruno-iwaya



15 Niji-no-Matsubara

One of Japan's three great pine groves, Niji-no-Matsubara is 5 kilometers long and 1 kilometer wide, forming a rainbow-like arch along the sea and white sand.

Planted by Terasawa Shimanokami Hirotake as a windbreak in the Bunroku era. Seen from Mt. Kagami, this is one of Japan's unsurpassed scenes of natural beauty.



11 Flower Adventure Island

Cross the fairy bridge to Never-Never land in the story of Peter Pan. A place for the whole family to enjoy, with a pirate ship built of logs, Crocodile Island, Fantasy Island, and other special places.

16 Hikiyama Float Exhibition Hall

This exhibition hall houses the 14 Festival Floats, which play the main role in the Karatsu-Kunchi that enlivens the autumn season in Karatsu.

The completion of the floats require years of work and masterly skill. These are truly mobile works of art. The festival itself has also been designated as an important intangible folk cultural property by the government.



13 Kirigo Peonies



12 Irohajima



6 Genkai Nuclear Power Station



8 Mishima Park



14 Ukidake

Ukidake (Hamatama-machi, Karatsu City)
View from Karatsu Castle.



18 Nanatsu-gama

Outline of Genkai Nuclear Power Station
Introduction
Outline of Genkai Power Station System
Inside the Power Station
Securing Safety
Serious incident countermeasures
Decommissioning plan
Monitoring
Waste Treatment
Community Activities
A Guide to the Surrounding Region



Introduction to Genkai Nuclear Power Station

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For more information about the Genkai Nuclear Power Station, visit
<http://www.kyuden.co.jp/genkai-index.html>

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