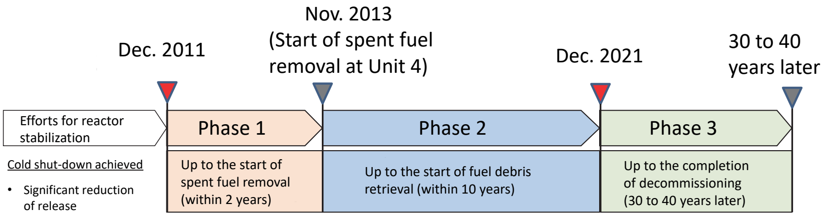
Efforts for Decommissioning and Progress

Procedures for Decommissioning and Contaminated Water Management at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS

Overall framework of decommissioning procedures



- ◯ Decommissioning procedures by roughly dividing the whole process into three phases
- ◯ This overall framework is maintained in the Mid- and Long-term Roadmap revised in September 2017.
- ◯ Fuel debris retrieval is scheduled to be commenced by the end of 2021.

Efforts to stabilize damaged nuclear reactors have been continued at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS. At present, cooling of reactors is continued at all Units and they are all being kept stable and under control.

Procedures for decommissioning and contaminated water management are unprecedentedly challenging and the government of Japan takes the initiative to carry out measures stably and steadily in line with the Mid- and Long-term Roadmap towards the Decommissioning of Tokyo Electric Power Company Holdings' Fukushima Daiichi NPS (Mid- and Long-term Roadmap).

In September 2017, the Mid- and Long-term Roadmap was revised to incorporate the policy on fuel debris retrieval. However, the overall framework for completing the decommissioning in 30 to 40 years is maintained.

Decommissioning procedures will continuously be implemented while collecting wisdom from all over the world.

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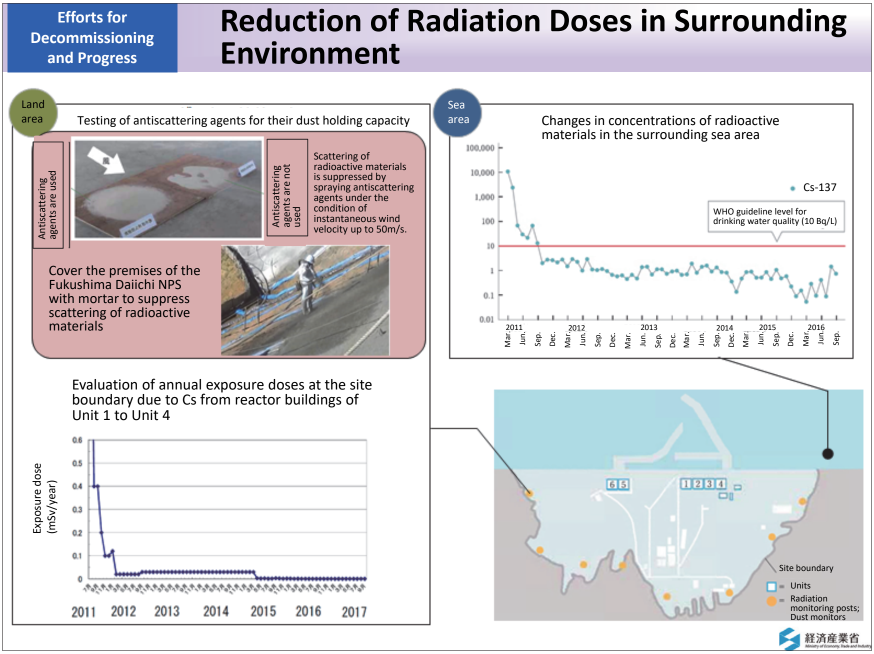

< Sea area monitoring >

By the sea-side impermeable wall consisting of driven steel piles, which was completed in October 2015, and other various measures, concentrations of radioactive materials in the surrounding environment were reduced and have maintained levels far below the World Health Organization (WHO) guideline level for drinking water quality.

< Surrounding area monitoring >

At the Fukushima Daiichi NPS, various measures are taken to prevent scattering of radioactive materials to outside of its premises. Representative measures being taken are spraying of antiscattering agents and facing of the ground with mortar. These measures have worked to stabilize measurement results at radiation monitoring posts within the premises.

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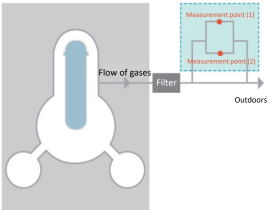
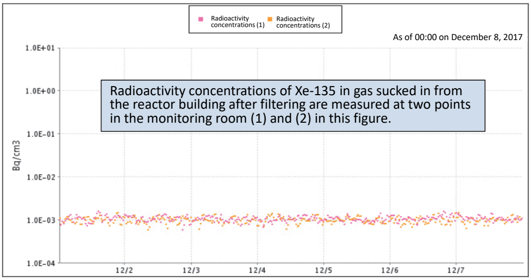
Measures against Recriticality and Future Earthquakes and Tsunamis

■ Amount of noble gases generated





■ **Measures against earthquakes and tsunamis**

Through computer analyses and other means, it has been confirmed that reactor buildings and other major facilities are sound enough to withstand any earthquakes or tsunamis equivalent to or even bigger than the Great East Japan Earthquake.

Securing of power sources in an emergency

In preparation for power loss, ordinary power sources have been multiplexed and emergency power supply vehicles and gas turbine vehicles are put in place. These vehicles are to be used to supply power to water injection facilities in an emergency.

Water injection drill / Emergency power supply vehicle / Fire engines

Backup power sources such as emergency power supply vehicles and water injection means such as fire engines are placed at a higher area where tsunamis are unlikely to reach.

Temporary seawall
(Source: Website of Tokyo Electric Power Company)

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< Recriticality >

When criticality occurs, Xe-135 and other noble gases increase in an unexpected fashion. At the Fukushima Daiichi NPS, generation of noble gases is being monitored at all hours. At present, the amount of noble gases has been stable, which suggests that recriticality has not occurred. However, in preparation for any risks of recriticality, a boric acid water system to suppress nuclear fission in the event of criticality has been installed.

< Measures against earthquakes and tsunamis >

As measures against any earthquakes and tsunamis of the same level as the Great East Japan Earthquake, a temporary seawall has been constructed and the work to block openings of the buildings has been underway to prevent inflow of seawater in the event of a tsunami. Additionally, backup power sources such as emergency power supply vehicles and water injection means such as fire engines are placed at a higher area where tsunamis are unlikely to reach.

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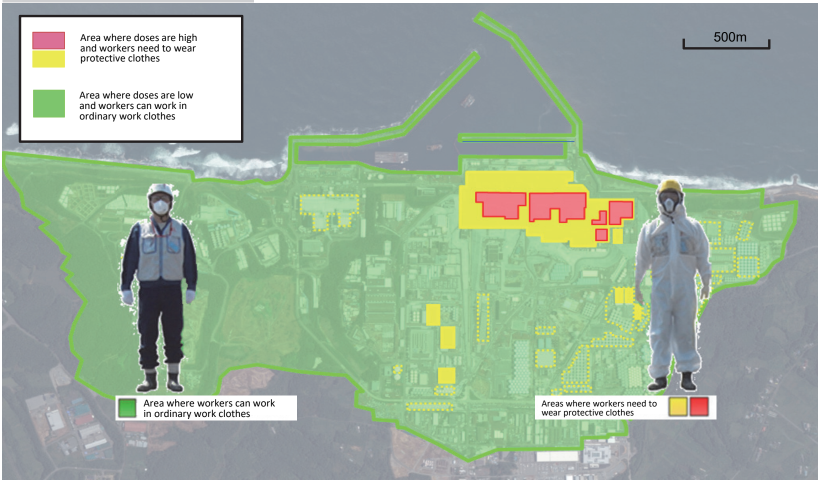
Improvement of Working Environment at the Fukushima Daiichi NPS

Premises of the Fukushima Daiichi NPS



Provided by Japan Space Imaging Corporation and (c) Digital Globe
Prepared by the Ministry of Economy, Trade and Industry based on the materials of Tokyo Electric Power Company

In order to improve safety and workability by reducing workers' load, efforts to improve the working environment, such as debris retrieval and facing, have been made at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS. As a result, areas where workers can work in ordinary work clothes expanded to approx. 95% of the entire premises in March 2017.

In May 2015, a large rest house was opened and workers are served with hot meals prepared at the food service center and can take a shower and buy things at a convenience store. They can thus work under normal working conditions at present.

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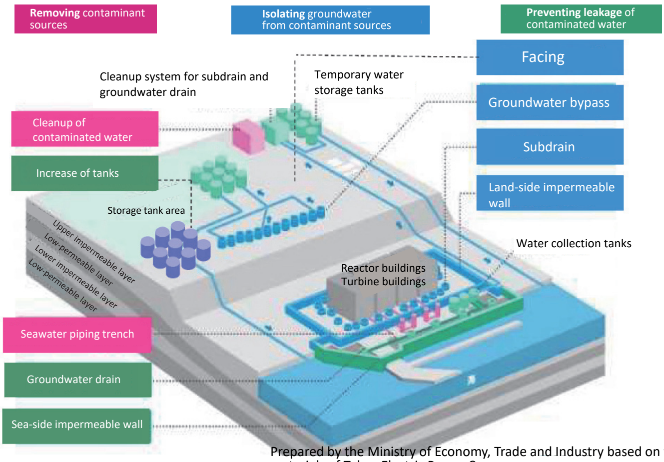
Efforts for Decommissioning and Progress

Measures against Contaminated Water

Preventive and multi-layered measures are being taken against contaminated water based on policies of (i) removing contaminant sources, (ii) isolating groundwater from contaminant sources, and (iii) preventing leakage of contaminated water.



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< Policy 1: Removing contaminant sources >
(i) Clean up contaminated water with regard to 62 types of radionuclides excluding tritium(*) by the use of the Advanced Liquid Processing System (ALPS) and other systems
(ii) Pump up highly contaminated water accumulated in the underground tunnel (trench) on the sea side of the buildings and fill and block the trench at the same time
⇒ Removal of contaminated water from the seawater piping trench and filling thereof was completed at Units 2 to 4 by December 2015.
* Tritium is an isotope of hydrogen and exists in nature, in tap water and even in the human body. Comprehensive deliberations not only from a technological perspective but also from a social perspective are underway concerning the management of the water that has been treated and is stored in tanks.

< Policy 2: Isolating water from contaminant sources >
(i) Pump up groundwater on a hill on the mountain side of the buildings to suppress inflow of groundwater around the buildings (groundwater bypass)
(ii) Pump up groundwater using the subdrain (a well near the buildings) to lower the groundwater level, thereby suppressing inflow of groundwater into the buildings and outflow of groundwater into the area on the sea side of the buildings
(iii) Construct a frozen soil wall closely around the buildings to suppress inflow of groundwater from outside of the frozen soil wall
(iv) Suppress infiltration of rainwater into soil by facing (pavement of the surface) to reduce the amount of groundwater and suppress inflow of groundwater into the buildings
⇒ By these preventive and multi-layered measures, the amount of contaminated water generated in a day decreased from 500m3 in May 2014 to 200m3 in the first half of FY2017.

< Policy 3: Preventing leakage of contaminated water >
(i) Construct a sea-side impermeable wall made of steel pipes to reduce outflow of groundwater containing radioactive materials into the sea
(ii) Pump up groundwater using the groundwater drain in the seawall area to suppress outflow of groundwater into the sea
(iii) Secure tanks to store contaminated water generated every day and accumulated water in the buildings in a planned manner
⇒ The sea-side impermeable wall was completed in October 2015 and radioactivity concentrations in the port decreased significantly.

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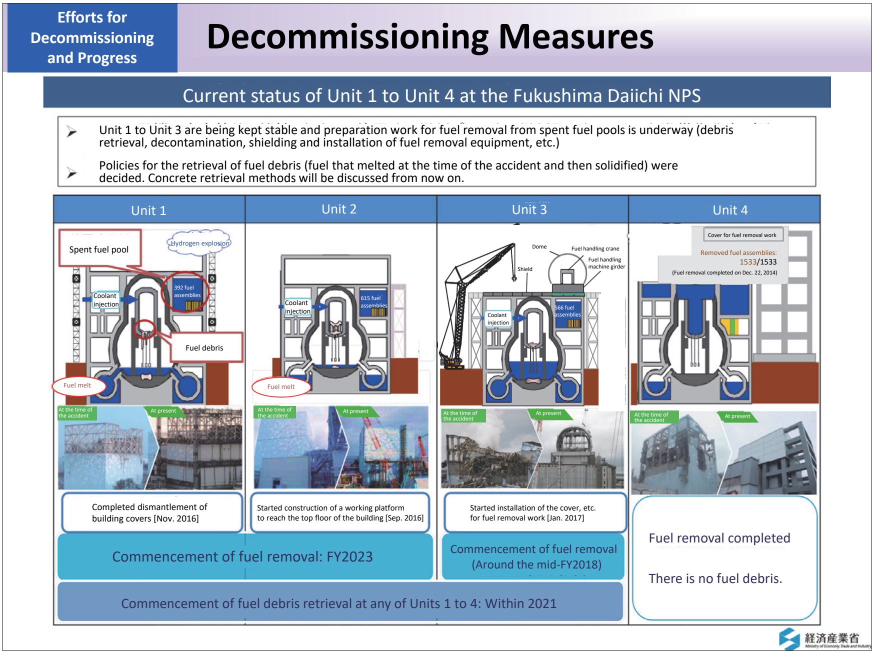

< Removal of spent fuel >

Removal of all 1,533 fuel assemblies from the spent fuel pool was completed at Unit 4 in December 2014 and risks were significantly reduced.

At present, preparations are being steadily progressed at Unit 1 to Unit 3 for removal of rubble. At Unit 3, a dome was installed and fuel removal is scheduled to be commenced around the mid-FY2018.

< Retrieval of fuel debris >

The Mid- and Long-term Roadmap revised in September 2017 indicates a step-by-step approach to first try to access the fuel debris existing at the bottom of the containment vessels (CVs) from the side in the air and then to expand the scale gradually.

Investigations of the inside of CVs by using robots based on cutting-edge technologies have been conducted so far. Investigations and R&D will be further continued with the aim of commencing removal of fuel debris at any Unit by the end of 2021.

(Source: Subcommittee on Management of ALPS-treated Water (1st meeting) on November 11, 2016)
http://www.meti.go.jp/earthquake/nuclear/osensuitaisaku/committtee/takakusyu/pdf/001_02_01.pdf (in Japanese)

Included in this reference material on February 28, 2018