Steps for decommissioning at Fukushima Daiichi NPS

廃炉を知る
Learn about decommissioning

What is happening NOW in Fukushima.

September 15, 2019 Vol.10

Next issue schedule: December 15, 2019

Fukushima Nuclear Safety Measures Division

http://www.pref.fukushima.lg.jp/sec/16025c/

CONTAMINATED WATER

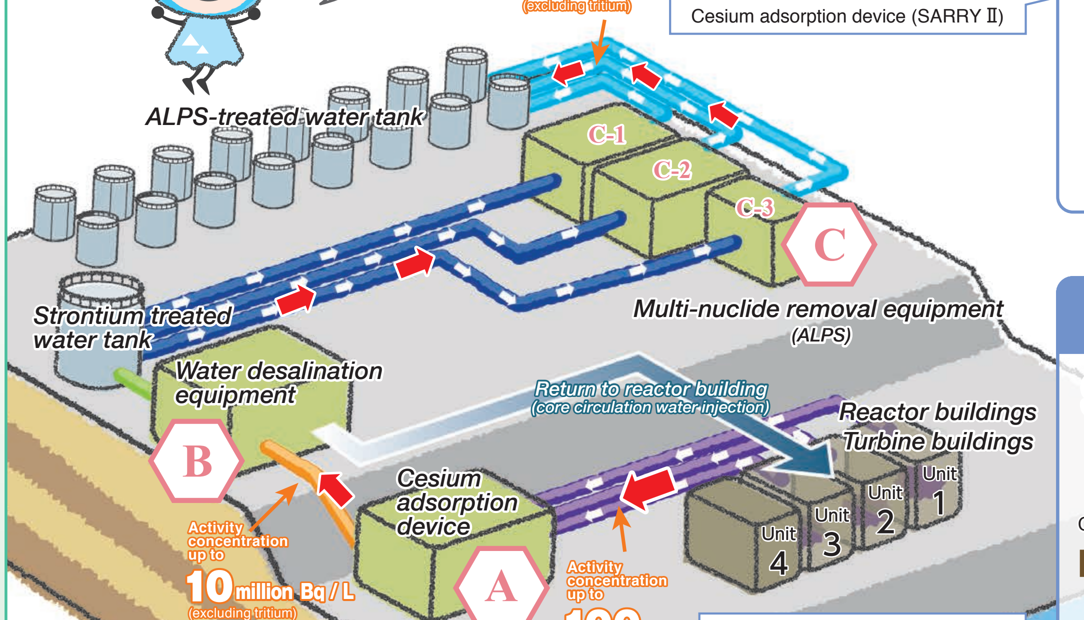
Contaminated water refers to water that contains highly-concentrated radioactive material which generated when rainwater, groundwater, or water to cool the reactor touched the fuel debris that has melted down due to an accident (formally stagnant water containing radioactive materials). These are accumulated in the reactor building and the turbine building.

Main radioactive materials contained in contaminated water

Radioactive materials derived from nuclear fuel (uranium) such as cesium, strontium, iodine, manganese, cobalt, antimony, and ruthenium.

Remove the contamination source (radioactive materials)

In order to remove radioactive materials from the contaminated water remaining in structures such as the reactor building, the contaminated water is treated in multiple purification facilities including multi-nuclide removal apparatus (ALPS).



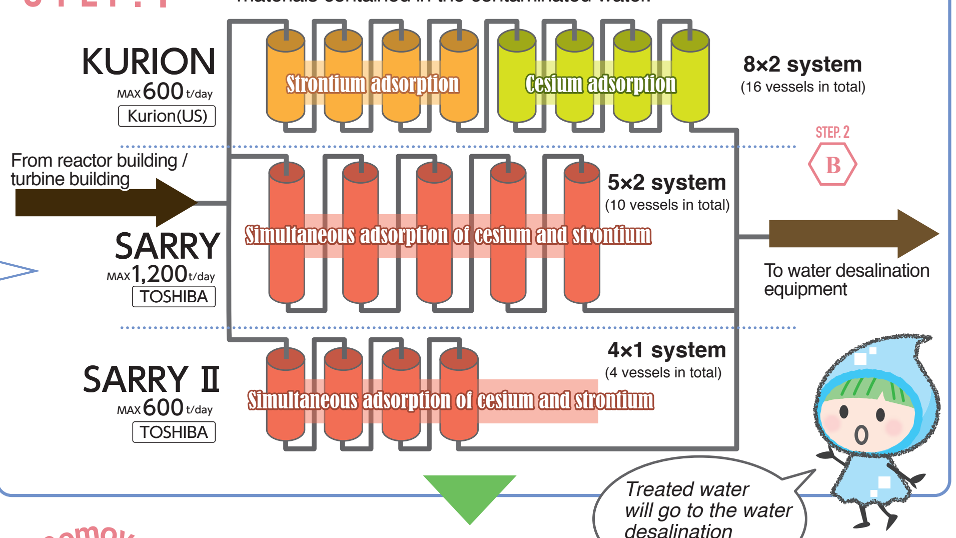
Cesium adsorption device (SARRY II)

High-performance ALPS

Water desalination equipment

Removal STEP.1 A CESIUM ADSORPTION DEVICE

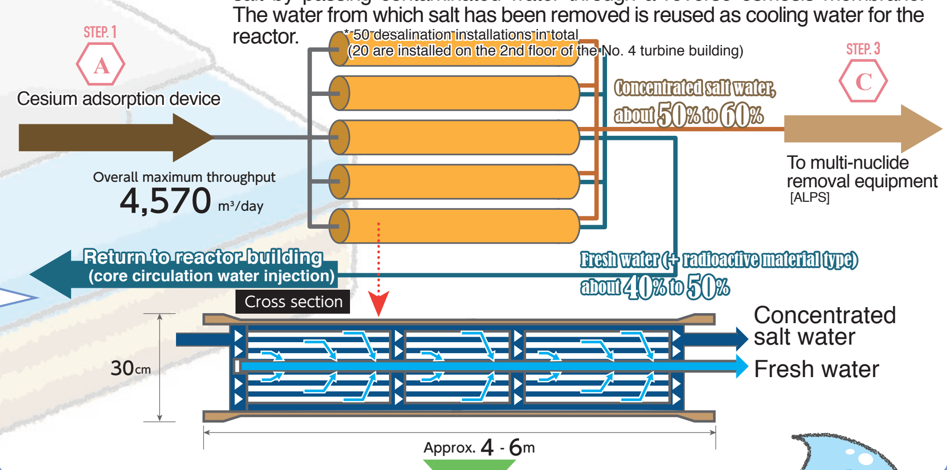
Cesium and strontium are removed first since they are most of the radioactive materials contained in the contaminated water.



Removal STEP.2 B WATER DESALINATION EQUIPMENT

HITACHI | Ace water treatment

The seawater contained in contaminated water must be removed to prevent corrosion of equipment and facilities. Water desalination equipment removes salt by passing contaminated water through a reverse osmosis membrane. The water from which salt has been removed is reused as cooling water for the reactor.

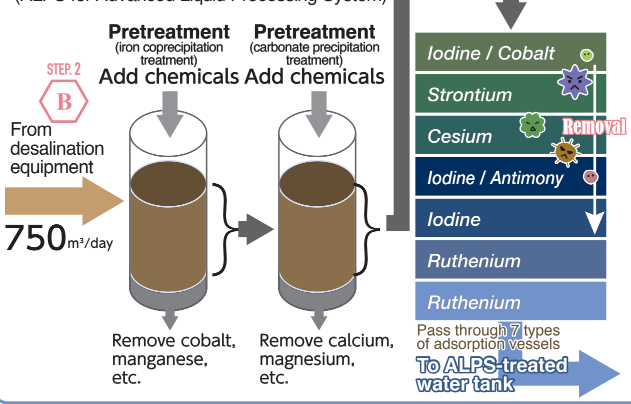


Radioactive materials can be further removed by three types of ALPSs.

Removal STEP.3 C MULTI-NUCLIDE REMOVAL EQUIPMENT (ALPS)

C-1.Multi-nuclide removal equipment (existing ALPS) TOSHIBA

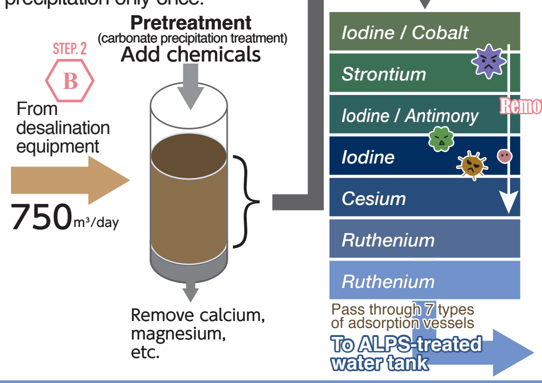
Radioactive materials are removed by two precipitation treatments and 7 types of 16 adsorption vessels. The official name is a multi-nuclide removal equipment (ALPS for Advanced Liquid Processing System)



or

C-2.Extended multi-nuclide removal equipment (extended ALPS) TOSHIBA

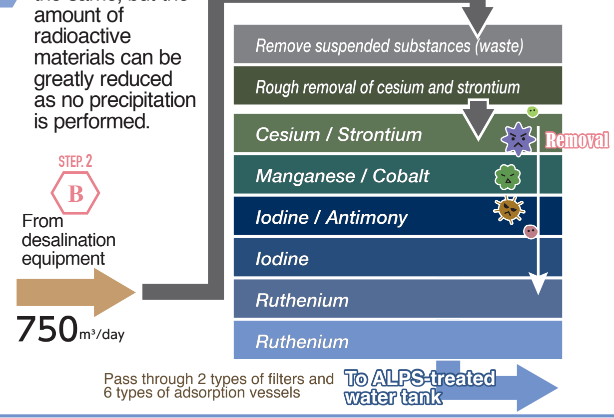
Radioactive materials are removed by one precipitation treatment and 7 types of 16 adsorption vessels. The generation amount of radioactive waste can be reduced by performing precipitation only once.



or

C-3.High-performance multi-nuclide removal equipment (High-performance ALPS) HITACHI

Radioactive materials are removed by 2 types of 4 filters and 6 types of 18 adsorption vessels. The removal performance is the same, but the amount of radioactive materials can be greatly reduced as no precipitation is performed.



See back for detailed explanation on ALPS-treated water

Learn about decommissioning

廃炉を知る Vol.10 Steps for decommissioning at Fukushima Daiichi NPS

The amount of ALPS-treated water stored

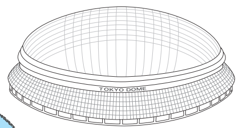
ALPS-treated water is referred to water which most of the radioactive materials besides tritium (hydrogen-3) are removed through the multi-nuclide removal equipment (ALPS). As of the end of June 2019, 1.01 million tons of ALPS-treated water have been stored.The activity concentration of ALPS-treated water meets national criteria to be stored in tanks within the power plant site (effective dose less than 1 mSv/y at the site boundary), but most of the concentration does not meet the concentration limit determined in the public notice (National criteria to release radioactive materials to the environment). As the ALPS cannot technically remove tritium, the government is currently working toward a solution on how to handle the tritiated water and the social aspects.

The amount of ALPS-treated water stored

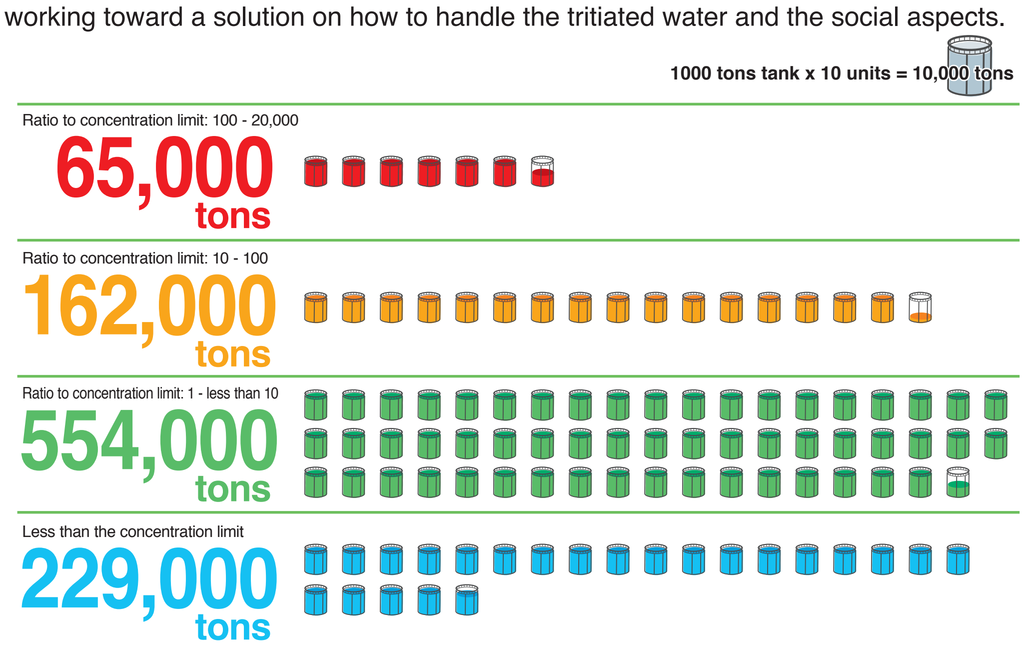
Total

1.01 million tons

"How much is 1.01 million tons?"



"It is about 80% of the volume of Tokyo Dome!"

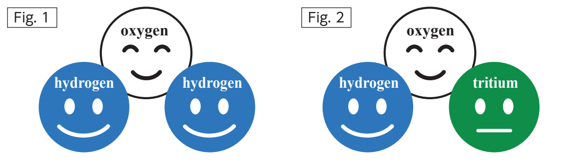


* Data as of the end of June 2019

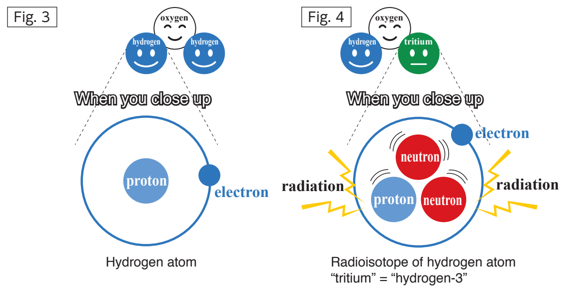
What is tritiated water?

What is tritiated water?

Normal water (Fig. 1) consists of one oxygen and two hydrogens, while tritiated water (Fig. 2) consists of one oxygen, one hydrogen and one tritium.



Water molecules of normal water (H_2O) Water molecule of tritiated water (HTO)



Hydrogen atom Radioisotope of hydrogen atom "tritium" = "hydrogen-3"

Tritium (Fig. 4) is a combination of one proton and one electron of hydrogen (Fig. 3) plus two neutrons.It looks like hydrogen, but it emits radiation because of its unstable nature.

Why is tritiated water generated?

When the nuclear fuel uranium undergoes fission, trace of tritium atoms are generated, and they become tritiated water by getting together with oxygen and hydrogen.

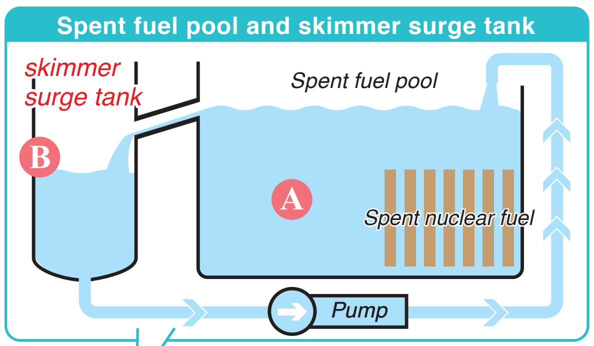
Why can't it be removed?

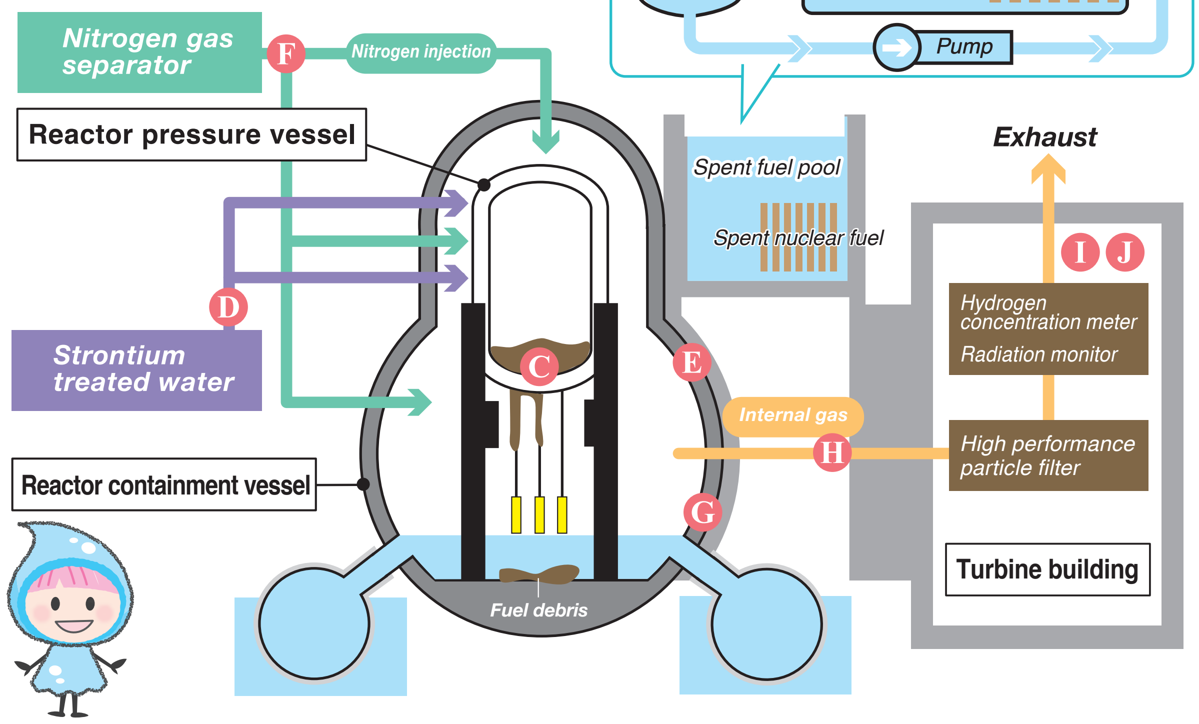
Although tritium is slightly heavier than hydrogen, it has almost the same chemical properties as hydrogen and is not easy to separate or concentrate. It is considered difficult to remove only tritiated water from ALPS-treated water with current technology.

The 10 DATA MONITORED BY FUKUSHIMA PREFECTURE

In Fukushima Prefecture, various data, such as whether fuel debris and spent fuel are properly cooled or whether there are no abnormalities in the internal temperature and pressure are monitored to confirm that the steps toward decommissioning are proceeding safely.

* Data as of August 16, 2019





A Spent fuel pool water temperature

(appropriate range: Unit 1 60°C or less, Unit 2 or 3 65°C or less)

We monitor whether the nuclear fuel stored in the spent fuel pool is cooled stably and whether the circulating cooling is maintained.

Unit 1 33.8°C
Unit 1 34.4°C
Unit 1 36.9°C

B Skimmer surge tank water level

We monitor whether the spent fuel pool (hereinafter referred to as the pool) maintains a full water condition. A skimmer surge tank (hereinafter referred to as a tank) is a tank that is installed next to the pool to collect overflow water and return it to the pool. If the tank water level is 0m or higher, it indicates that the pool is full.

Unit 1 1.79m
Unit 2 3.57m
Unit 2 3.03m

C Bottom temperature

(appropriate range 80°C or less)

We monitor whether fuel debris in the reactor pressure vessel is stably cooled.

Unit 1 26.4°C
Unit 1 34.1°C
Unit 1 28.7°C

D Water injection status

We monitor whether water is being injected so as not to increase contaminated water while stably cooling the bottom of the pressure vessel.

Unit 1 3.00m³/h
Unit 2 3.04m³/h
Unit 3 3.05m³/h

E Reactor containment vessel pressure

When the internal pressure is low, external air (oxygen) enters the interior and mixes with hydrogen which will increase the risk of hydrogen explosion. Therefore, nitrogen is injected to increase the air pressure inside. On the other hand, if the internal pressure is too high, there is an increased risk of internal dust leaking outside, which is why we need to keep monitoring the pressure.

Unit 1 0.72kPag
Unit 2 3.82kPag
Unit 3 0.39kPag

F Nitrogen injection amount

We monitor whether a sufficient amount of nitrogen gas is continuously injected to prevent hydrogen explosion.

Unit 1 28.13Nm³/h
Unit 2 13.35Nm³/h
Unit 3 16.87Nm³/h

G Reactor containment vessel internal temperature

We monitor whether the fuel debris which leaked from the pressure vessel is sufficiently cooled.

Unit 1 26.5°C
Unit 2 32.0°C
Unit 3 29.9°C

H Gas management system exhaust flow rate

The gas in the reactor containment vessel is pulled out through a filter and released, and the internal pressure is adjusted by controlling this amount and the amount of nitrogen injected into the vessel. We confirm it by monitoring the exhaust amount.

Unit 1 20.8m³/h
Unit 2 18.7m³/h
Unit 3 18.3m³/h

I Hydrogen concentration

(appropriate range 2.5 vol% or less)

We monitor whether the hydrogen concentration is maintained at 2.5 vol% or less as hydrogen explosion occurs when it exceeds 4.0 vol%.

Unit 1 Less than detection limit
Unit 2 0.02vol%
Unit 3 0.06vol%

J Activity concentration

(appropriate range 1Bq/cm3 or less)

We monitor the criticality by measuring the activity concentration as the activity concentration of the internal gas rises when the fuel debris reaches criticality.

Unit 1 0.00114 Bq/cm³
Unit 2 Less than detection limit
Unit 3 Less than detection limit

Notice about Nuclear Disaster Prevention Drill

To be prepared in case we face a nuclear disaster, Nuclear Disaster Prevention Drill is carried out every year in Fukushima Prefecture. This year, it is conducted the drill based on the scenario that the function to cool spent fuel was lost at the Fukushima Daiichi NPS due to the earthquake. During the training, we will conduct an emergency information distribution training using emergency alert email, publicity cars and local government wireless system. We ask for your understanding and cooperation to this drill.

- Emergency alert email
  October 16 (Wednesday) from 10:00 am to 4:00 pm/Naraha-machi and surrounding area
- Other emergency information distribution training
  October 16 (Wednesday) from 10:00 am to 4:00 pm／Tamura City (Miyakoji-machi) and Naraha-machi
  November 16 (Saturday) from 7:00 am to 8:00 am／Tamura City (Miyakoji-machi)