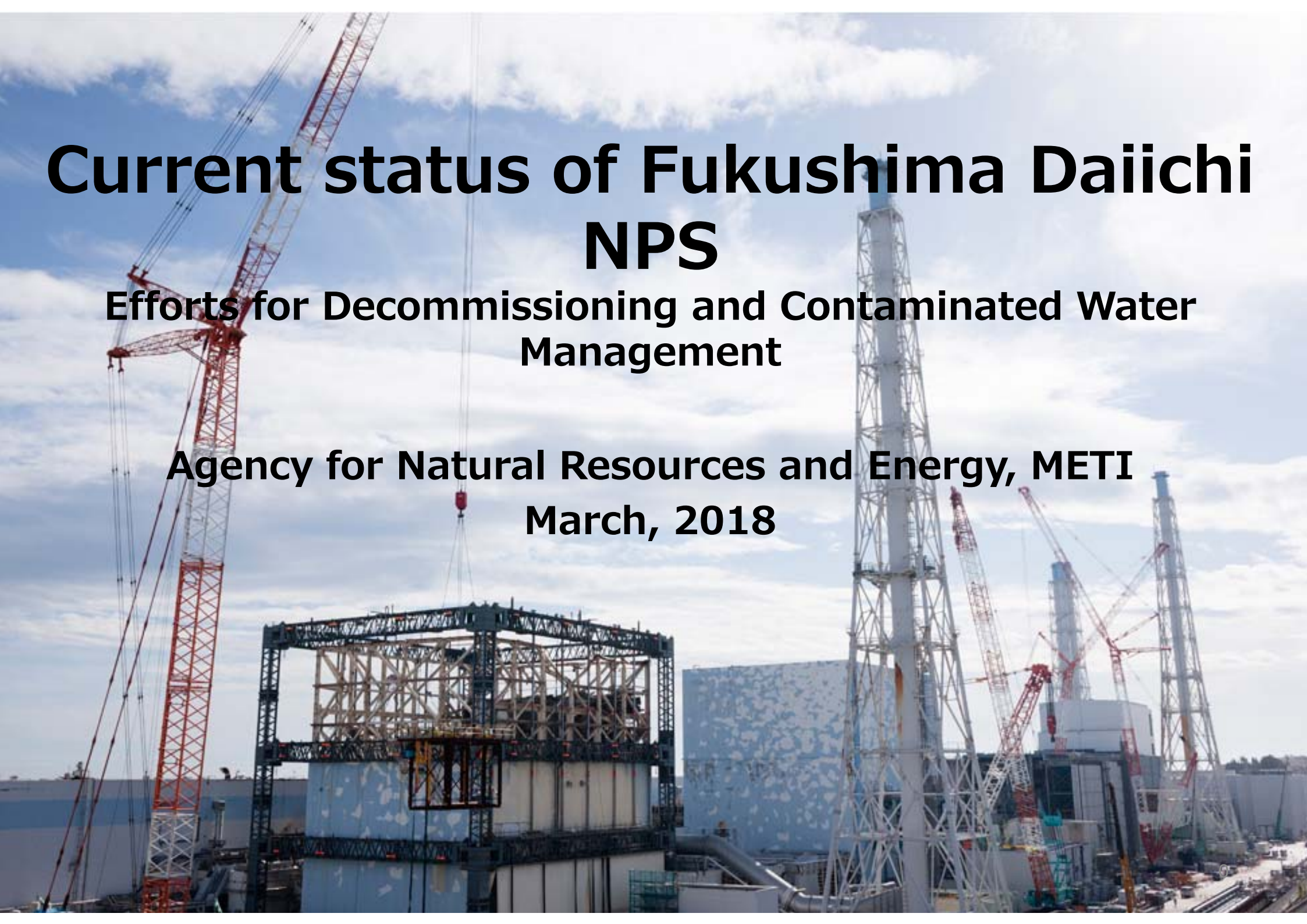


Current status of Fukushima Daiichi NPS

Efforts for Decommissioning and Contaminated Water Management

Agency for Natural Resources and Energy, METI

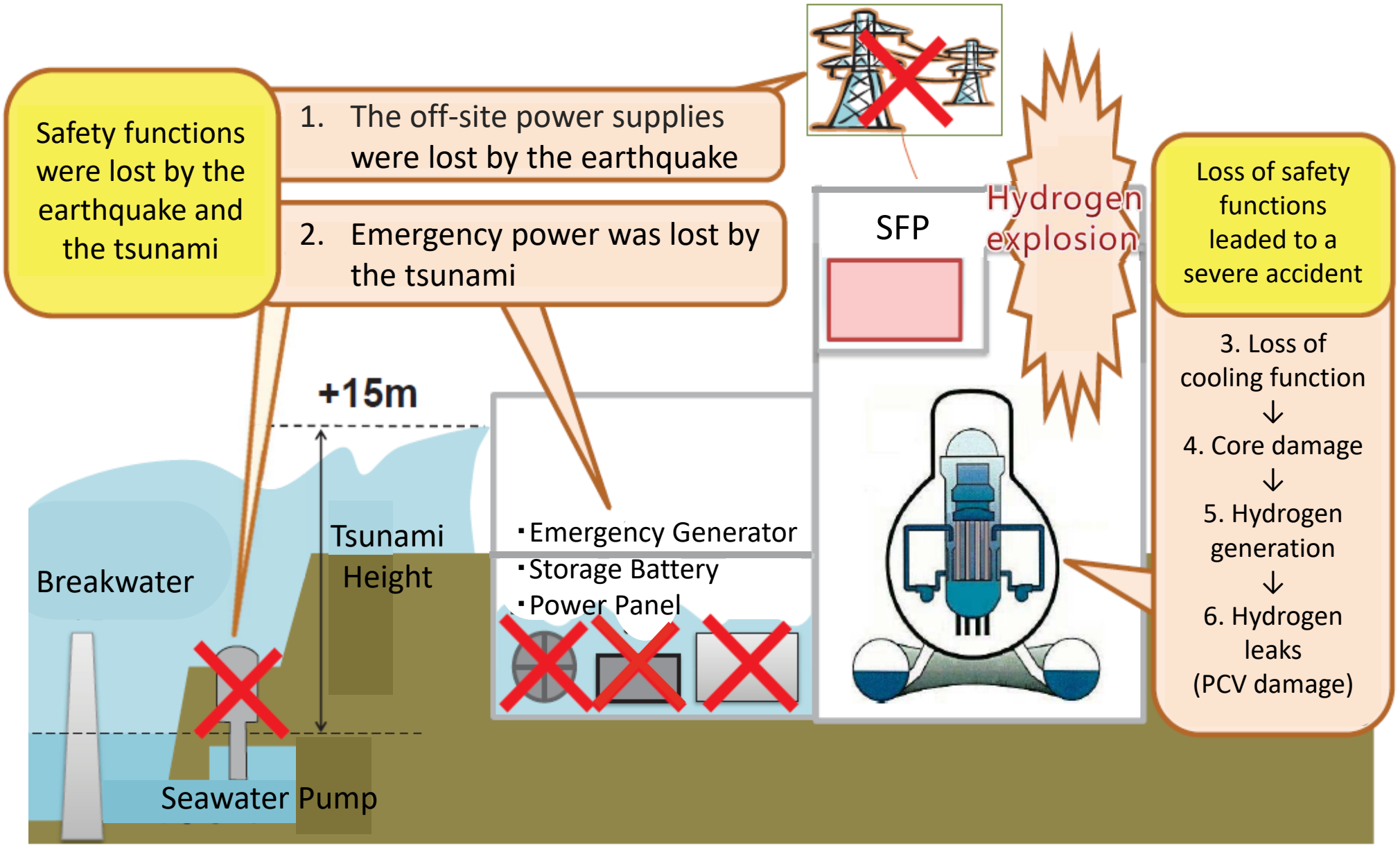
March, 2018

Outline

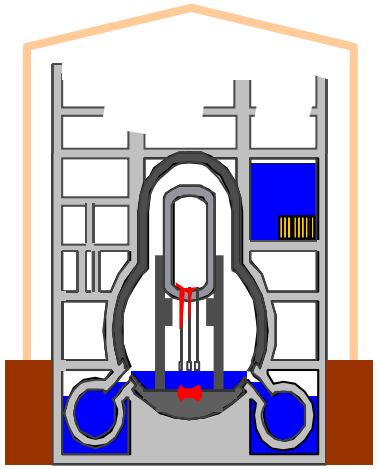
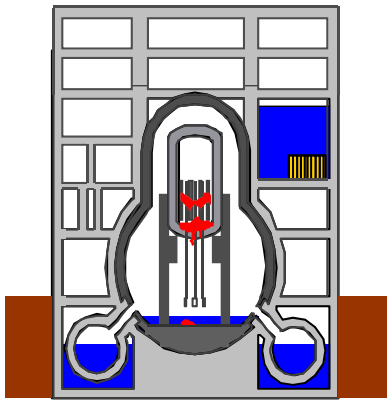
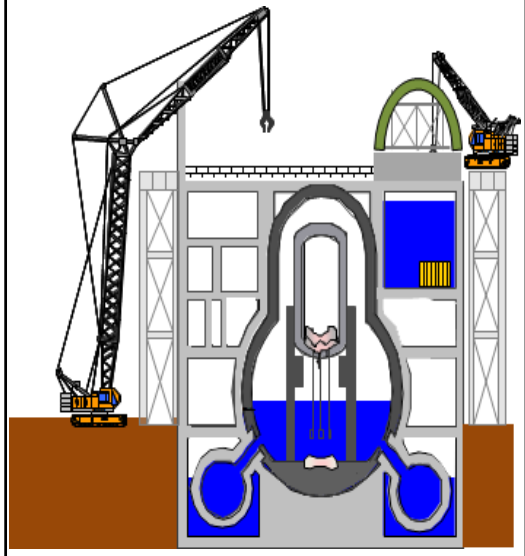
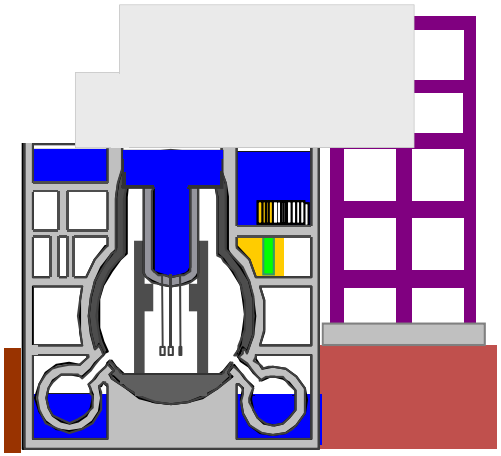
1. Summary of Fukushima Daiichi NPS Accident
2. Overview and Main Progress in Decommissioning Work
3. Overview and Main progress in Contaminated Water Management
4. Improvement of working conditions
5. Revising Mid-and Long-term Roadmap
6. Communication with the public
7. Cooperation with International Communities

Summary of Fukushima Daiichi NPS Accident - The Cause of Severe Accident

- At the Fukushima Daiichi NPS, the safety functions were lost due to the earthquake and the tsunami.
- Thus, the following severe accident could not be prevented.



Summary of Fukushima Daiichi NPS Accident - The Damage of each Unit

	Unit 1	Unit 2	Unit 3	Unit 4
				
Status at the accident	In Operation	In Operation	In Operation	Not in Operation (Under planned outages)
Fuels in SPF	392	615	566	1533
Core melt	☑	☑	☑	
Hydrogen explosion	☑		☑	☑

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The Current Status of each Unit

Unit 1

✓ Hydrogen explosion
✓ Core melt

<At the Time of the Accident> <Now>

・Installation of windbreak fences to further reduce dust scattering during rubble removal from the operating floor was completed in December 2017. And the removal of the rubble on the operating floor started from January 2018

Unit 3

✓ Hydrogen explosion
✓ Core melt

<At the Time of the Accident> <Now>

- An equipment to cover the upper part of the building as well as a crane has been installed since August 2017 to start removing spent fuel from the pool in the middle of the 2018 fiscal year.

Unit 2

➢ No hydrogen explosion
✓ Core melt

<At the Time of the Accident> <Now>

- Currently, TEPCO is proceeding with preparation work, such as removal of rubble around the reactor building and building scaffolding.

Unit 4

✓ Hydrogen explosion
➢ No core melt

<At the Time of the Accident> <Now>

- On December 22, 2014, all (**1533**) fuel removal from Unit 4 SFP was completed.

Measures to Deal with the Aftermath of the Accident at Fukushima Daiichi Nuclear Power Station (Measures for decommissioning)

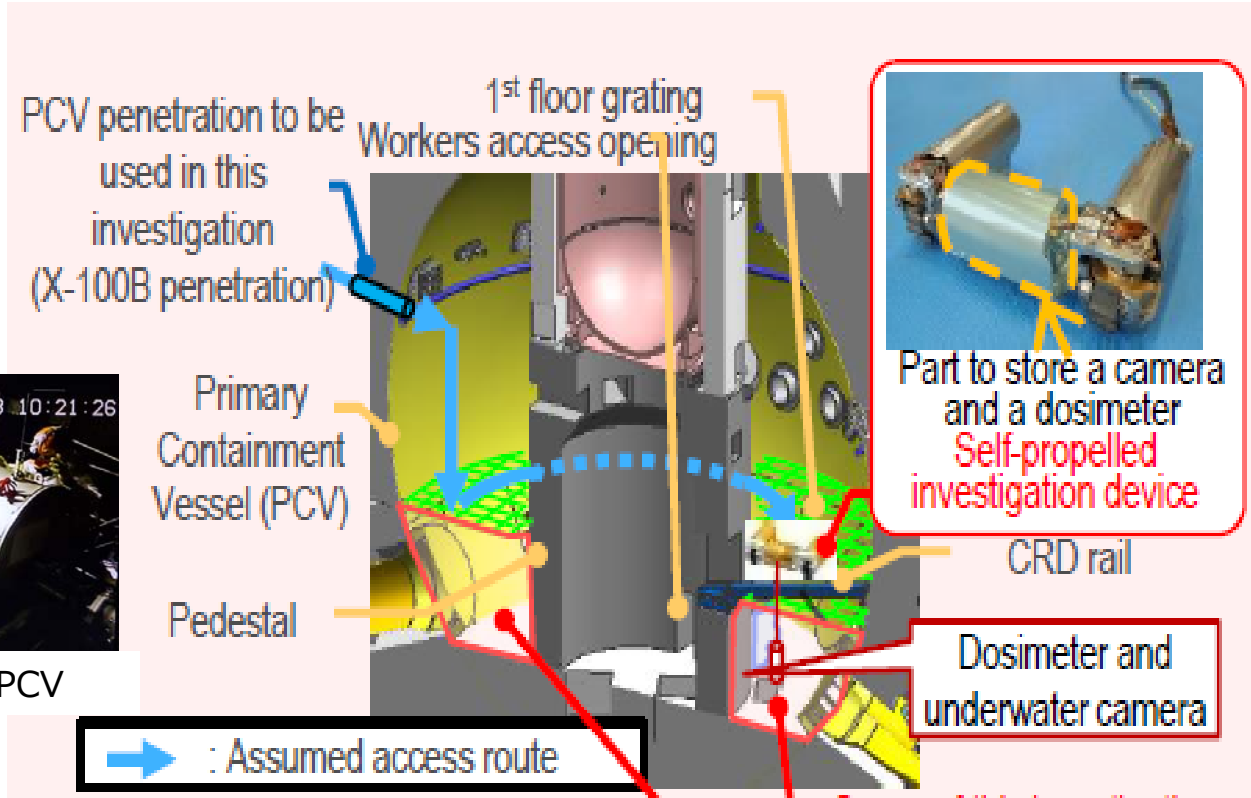
- Concerning measures for decommissioning, **progress was made in activities such as the removal of fuels from the spent fuel pools and the retrieval of fuel debris** based on the Mid-and-Long-Term Roadmap

Measures		FY2015	2016	2017	2018	2019	2020	2021	2022	2023
Fuel removal	Unit 1	Started removal of the covers of the reactor building after implementation of measures to prevent scattering of dust【All roof panels were removed by October 2015.】	Completed removal of the covers of the building【November 2016】		<Image of the building at the time of the start of removal (FY2023)>					
		Dismantling of the building covers → Removal of rubble, decontamination, etc. → Installation of covers used for removal of fuels								Removal of fuels (FY2023)
	Unit 2	Decided which portions of the upper part of the Unit 2 building should be dismantled before the selection of removal plans【November 2015】	Started installation of a platform for access to the operating floor【September 2016】		<Image of the removal plans (decided in FY2017)> Plan 1 (a common container plan) Plan 2 (a plan for specializing in fuel removal)					
		Preliminary construction			Dismantling of the upper part of the building, etc.					Removal of fuels (FY2023)
	Unit 3	(Reference) The condition of the operating floor immediately after the accident	Completed removal of the largest piece of rubble (appox. 25 tons) in the spent fuel pool【August 2015】	Started installation of removal equipment【January 2017】 Completed decontamination of the operating floor【June 2016】 Completed installation of shields【December 2016】	<Image of the building at the time of start of removal (around the middle of FY2018)>					
		Removal of rubble and decontamination → Installation of shields → Installation of covers used for removal of fuels, etc.			Removal of fuels (around the middle of FY2018)					
Fuel debris retrieval	Unit 1	Examination of the inside using cosmic ray muon【May 2015】	Started full-fledged operation of Naraha Remote Technology Development Center【April 2016】	Implemented detailed examination of the inside based on the result of the previous examination【March 2017】	Decide the policy for debris retrieval (around summer)	Finally decide the method of debris retrieval (first half)	Continue to conduct R&D based on knowledge and wisdom collected from within and outside Japan			
	Unit 2	Examination of the inside using a snake-shaped robot【April 2015】		Examination of the inside using cosmic ray muon【July 2016】 Examination of the inside using a scorpion-shaped robot【February 2017】						
	Unit 3	Conducted a preliminary survey in preparation for examination of the inside using robots【October 2015】 Internal situation		Examination of the inside using cosmic ray muon【May to Sept. 2017】 Examination of the inside using a submersible robot【July 2017】						
		Grasp of the situation in the nuclear reactor container and consideration of the method of debris retrieval			Engineering work, etc.	Preparation for debris retrieval				Start of debris retrieval for the first unit

Investigation inside the Unit1 PCV (March 2017)

- In order to grasp the internal conditions of the PCV, from March 18th to 22nd 2017, a robot equipped with a dosimeter and underwater camera was remotely inserted into the PCV and a investigation was conducted.
- According to the analysis so far, it is estimated that fuel debris was distributed to the outside of the pedestal in the basement floor. In this investigation, the dosimeter and the underwater camera were suspended from the first floor, and information inside the PCV was gathered.

Outside the PCV



<Image of investigation inside the PCV>

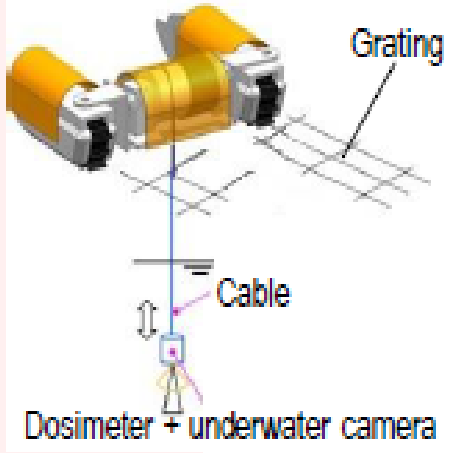


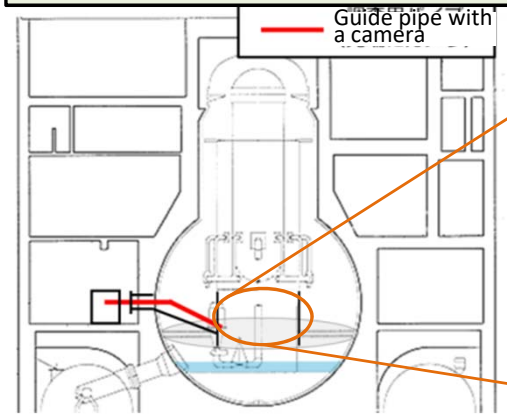
Image of hanging of dosimeter and camera

Image near the bottom

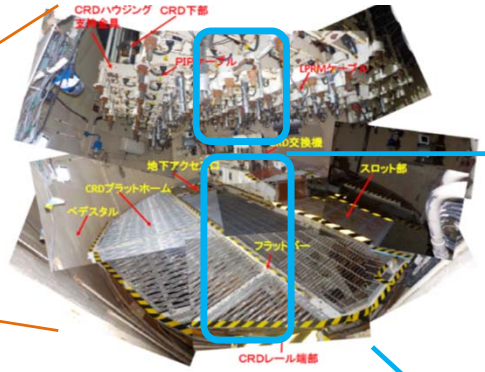
The progress of the investigation inside the Unit 2 PCV (Jan. – Feb. 2017)

- To determine the status inside the Unit 2 PCV, a camera and a robot were inserted close to the RPV by remote control from 26th January to 16th February.
- From the results of this investigation, the fallen scaffold below the RPV and the status of deposits were identified directly for the first time. In the PCV, many images were taken. Also, actual measurement of radiation and temperature were implemented. Effort toward the decommissioning of Unit 2 is progressing steadily.
- Through this investigation, there was and will be no effect by the radioactive material to the outside the PCV.

Camera investigation(26th Jan. and 30th Jan. 2017)



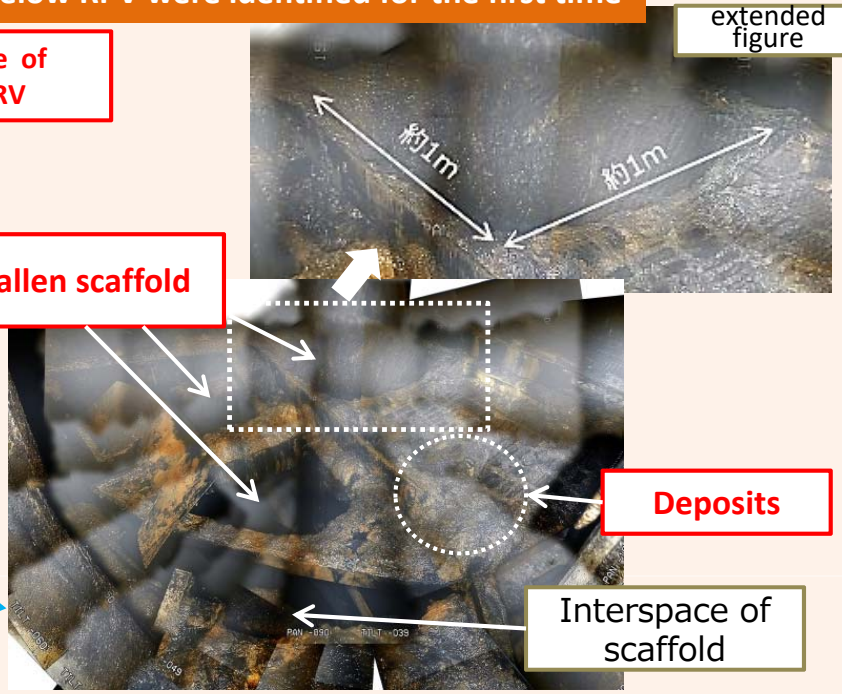
※Before the accident



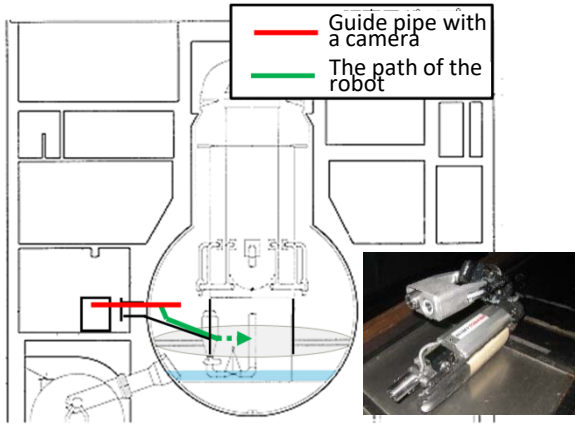
The status below RPV were identified for the first time

No massive damage of facilities below PRV

Fallen scaffold

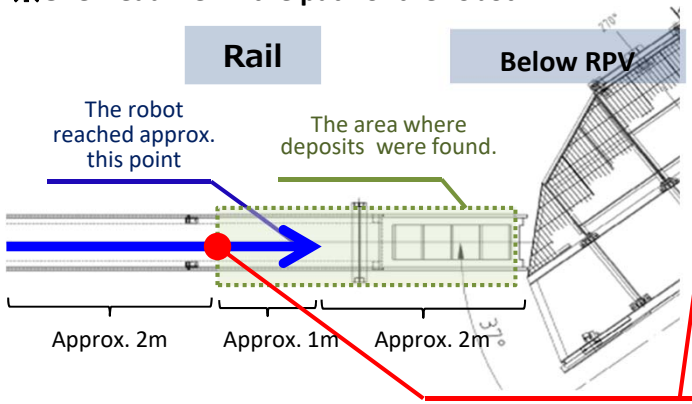


Robot investigation(16th Feb. 2017)



The investigation robot

※Overhead view : the path of the robot

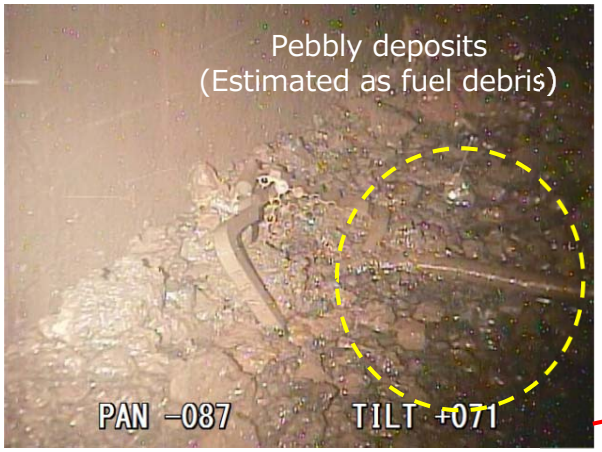


Success of the actual measurement

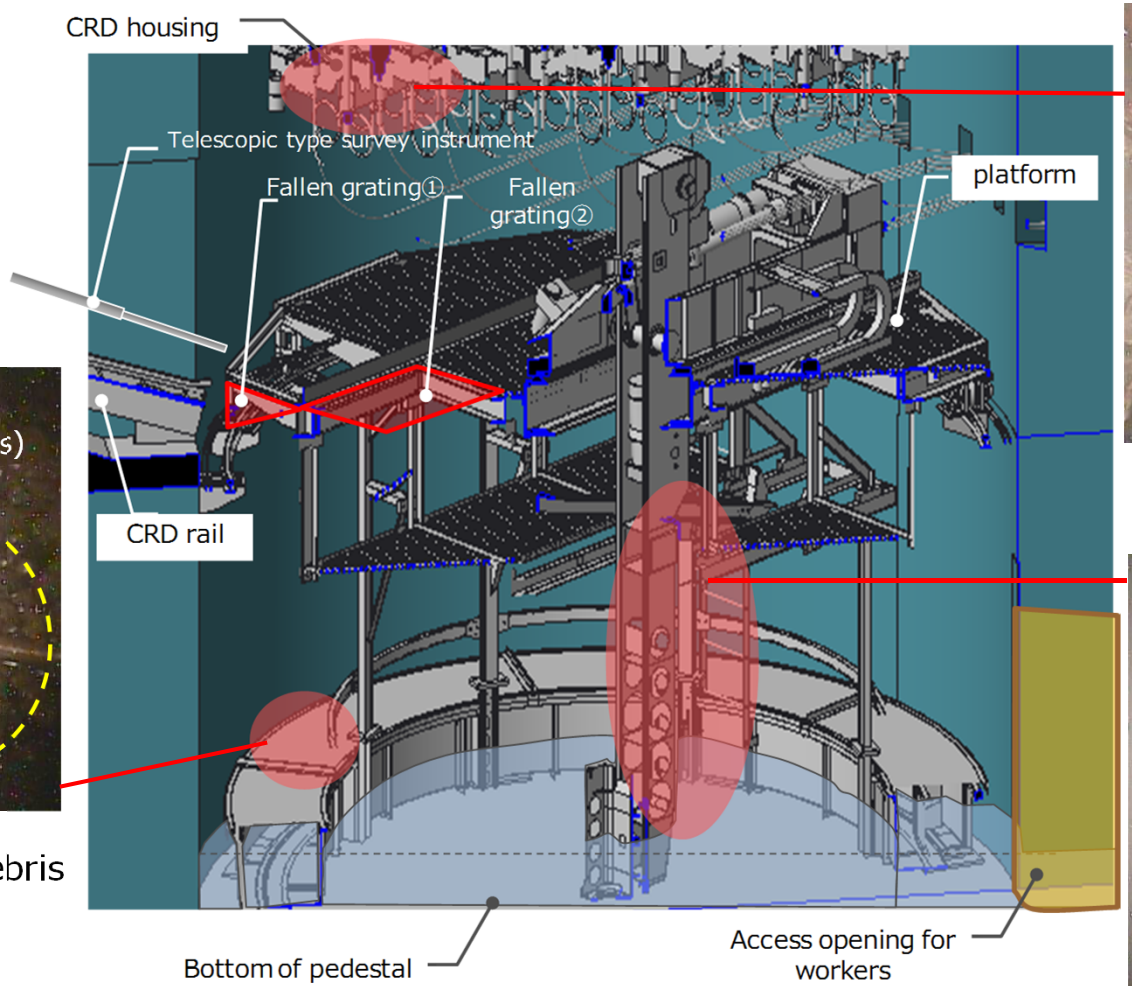
Radiation dose：Approx. 70 Sievert per hour*
*This radiation dose is inside of the PCV shielded by the thick steel vessel, and concrete. The radiation dose outside of the PCV is approx. 5 to 6 mSv/h. There was and will be no effect of the radioactive material outside the PCV.
Temperature ：Approx. 16.5 degrees**
It is almost the same temperature as that measured by the constantly monitoring thermometer (18.7 degrees). **There is no abnormality in the cold shutdown condition.

The results of the investigation inside the Unit 2 PCV (January 2018)

◇On January 19, the inside of the Unit 2 PCV was investigated. As a result of it, recording the images were succeeded.
◇Through the image of the camera, the lower part of the lattice-like scaffold just below the pressure vessel was seen. It was confirmed that part of the fuel assembly dropped to the bottom of the containment vessel, and deposits considered to be fuel debris in the RPV. In addition, the dose tended to be lower inside the pedestal than outside the pedestal.
◇from now on, detailed analysis and evaluation of data acquired images and dose will be advanced.



Deposits estimated to be fuel debris

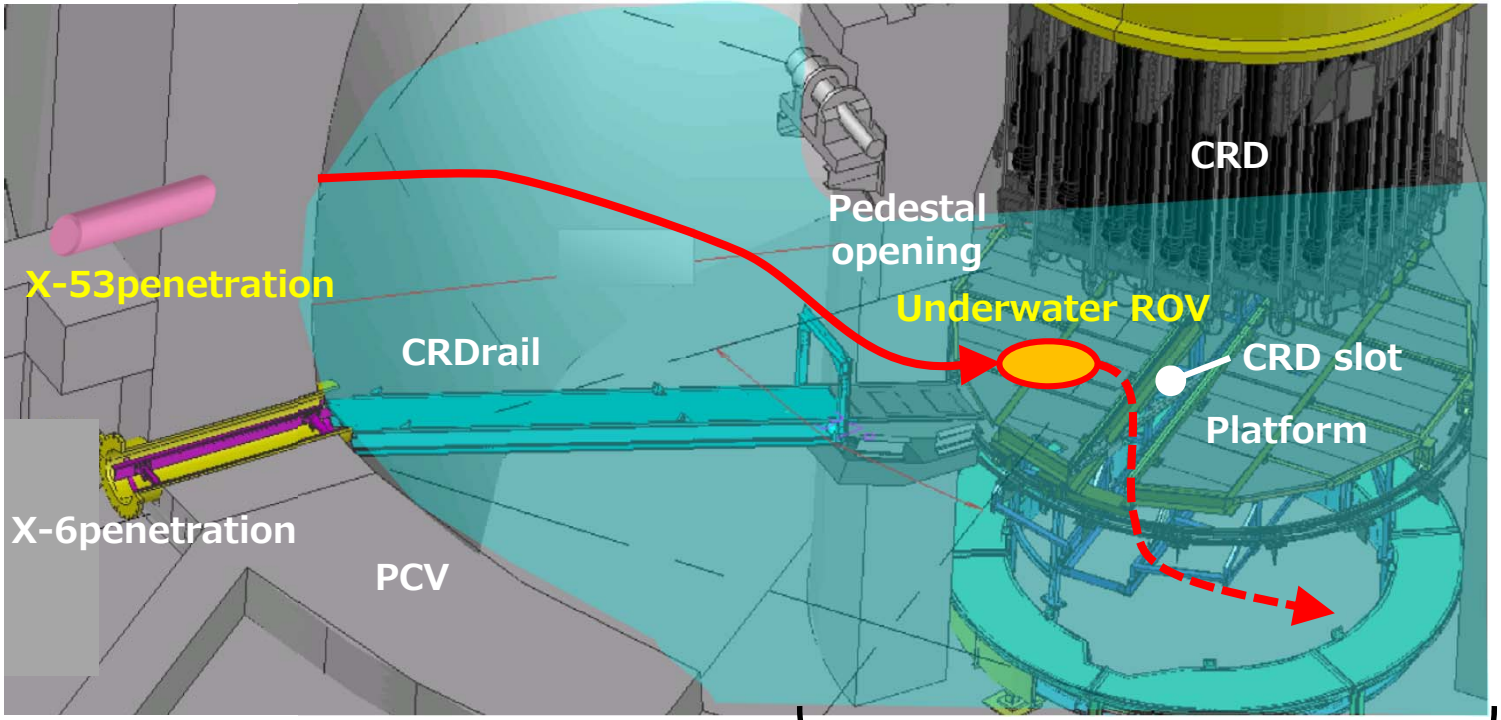


CRD housing support

Direction: the access opening for workers

Investigation inside the Unit 3 PCV (July 2017)

- In July 2017, the interior of the PCV was investigated using the underwater ROV (remotely operated underwater vehicle) to inspect the inside of the pedestal.
- The investigation identified several fallen obstacles and deposits, such as seemingly solidified molten materials and grating, inside the pedestal.



Underwater ROV

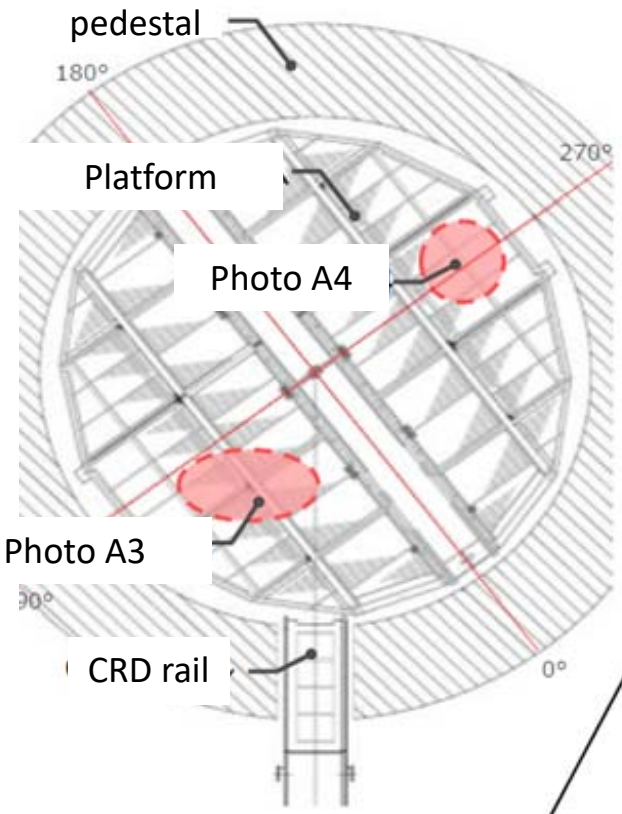
Lower center in Pedestal

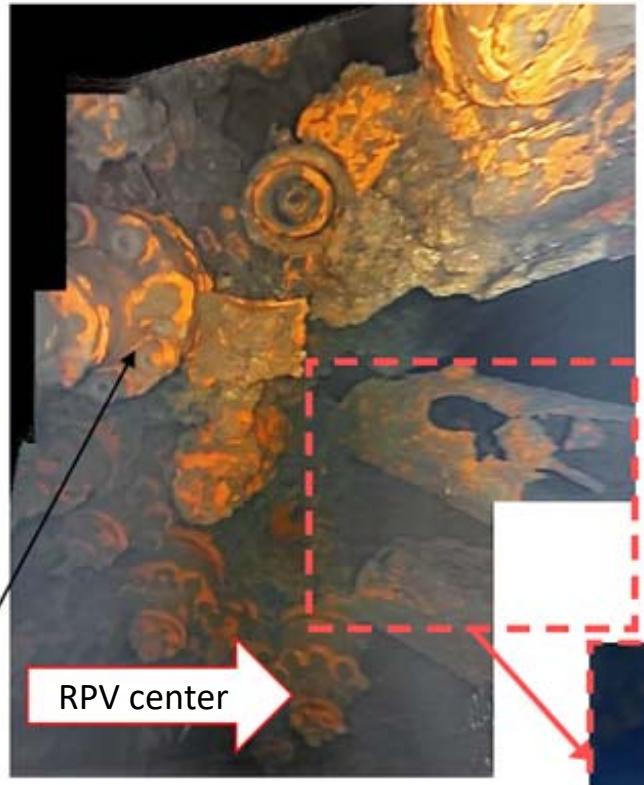
Inside Pedestal

Close to the wall in Pedestal

The results of the investigation inside the Unit 3 PCV (November 2017)

○"CR guide pipe" that should be at the lower part of the RPV was at the bottom of the PCV.
○Therefore, there is a possibility that holes of several tens of centimeters in diameter are opened at the bottom of the RPV.





CRD housing flange

Waste management（Storage）

◇TEPCO HD were published Solid Waste Storage Management Plan in Mar. 2016.
◇Solid waste storage volume will reach about 750,000 m³ on Mar. 2029 from 350,000 m³ on Mar. 2017. Volume reducing treatment facility, incinerator and waste storage building will developing, and temporary outdoor storage areas will released in FY 2028.
◇Large-scale waste storage building will be developing, and secondary waste from water treatment will be stored in the building.

Present condition

Storage volume is about 350,000 m³on 2017

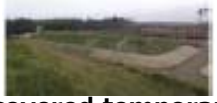
Storing status of rubble, etc.

Rubble (flammable)
Felled tree
Used protective clothing

Outdoor storage

Rubble (metal, concrete etc.)

over 1mSv/h



Soil covered temporary storage facility

Solid waste storage

0.005 – 1 mSv/h

Outdoor seat covered storage

under 0.005mSv/h

Contaminated soils

Storing status of Secondary waste from water treatment

Used vessels

AREVA sludge

Stored in sludge storage facility

Concentrated waste liquid

D area tank

H2 blue tank

Storage volume will reach about 750,000 m³ on 2029

Plan of waste management (～ FY2028)

Incineration treatment

1. Expansion of Incinerator
2. Pretreatment of Incineration facility

Storage volume will reach about 230,000 m³ on 2029 after volume reduction treatment

Volume reduction treatment

3. Volume reducing treatment facility

Reuse and reduce is future task

Process method is future task

(A)

: planned construction

Storage management

Solid waste storage building (Storage capacity is about 190000 m³)

Established solid waste storage building(Units 1 to 8) (about 50000 m³)

Expansion solid waste storage building (about 140000 m³) 4

Temporary storage building of Contaminated soils 6

Temporary storage building of used vessels of water treatment

Large-scale storage building of used vessels of water treatment 5

By TEPCO

Waste management（Characterization）

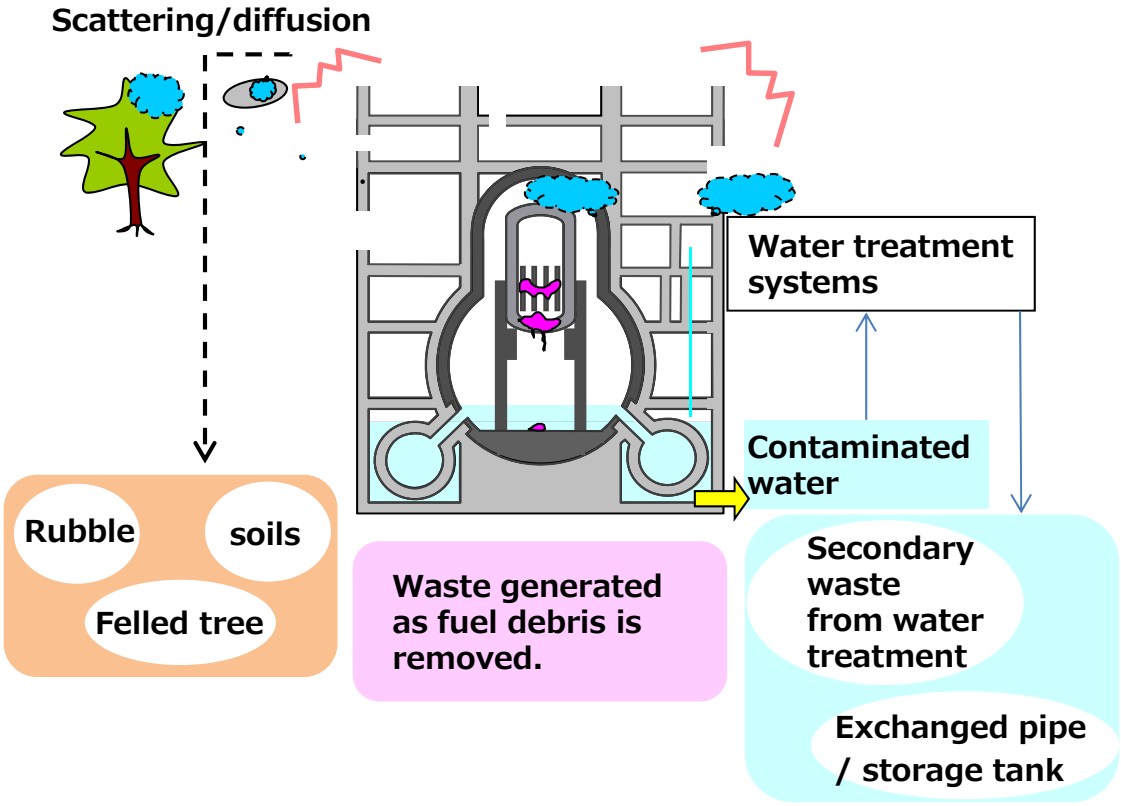
◇ Nuclide composition and concentration of waste are presumed to be diverse.

For safe processing and disposal, it is necessary to understand characterization and plan research and development the different from conventional.

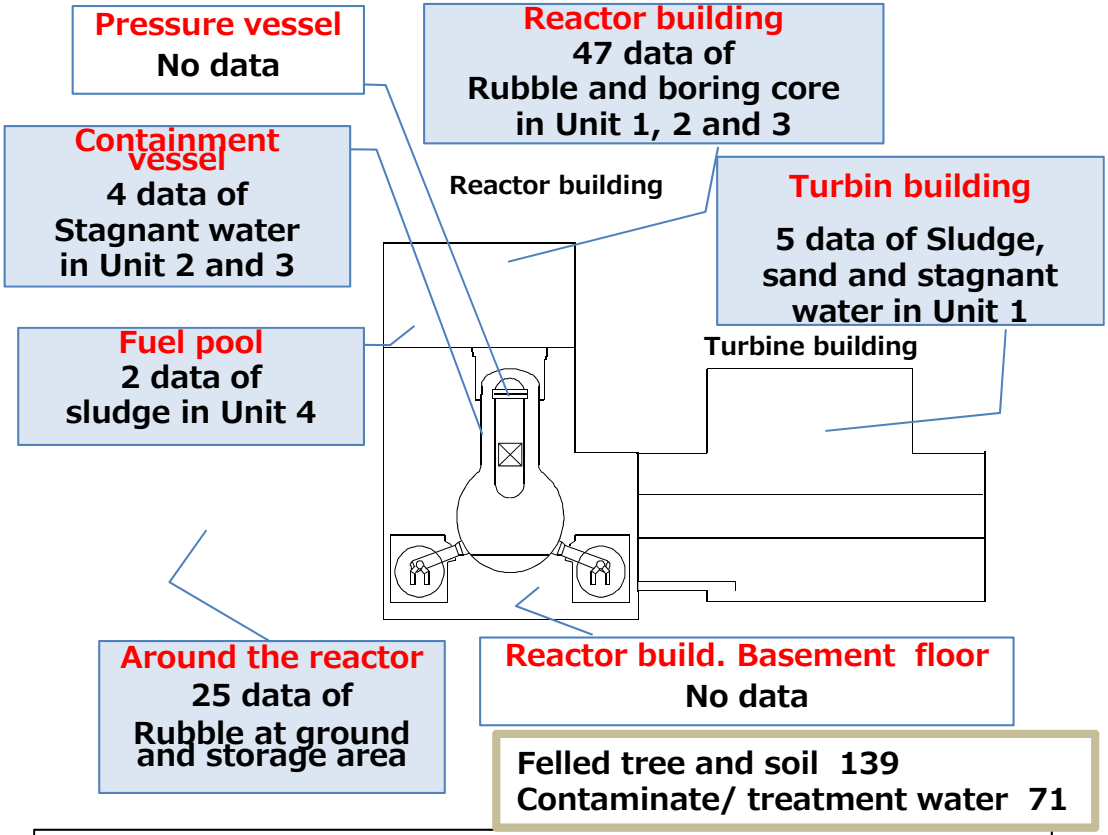
◇ In order to proceed with consideration of treatment and disposal, it is necessary to understand the properties(nuclide composition, radioactivity concentration) and generation amount of waste.

However, analytical data are **not** sufficient (about 300 samples at present).

◇ The construction of a method to understanding the characterization will be needed to proceed by combining analytical data and model based methods, because data will be clarified after debris removal progress and plan clarification.



Outline of waste pollution sources and routes



Sampling and analysis situation for characterization

The ninth solid waste storage building

◇The purpose of setting the ninth tower of solid waste storage is to store debris generated in the decommissioning work and radioactive solid waste stored from before the accident, like the first to eighth buildings installed in the premises.

◇From February 2018, operation of the ninth tower of solid waste building began.

Exterior of the storage building

Sectional view of the storage building

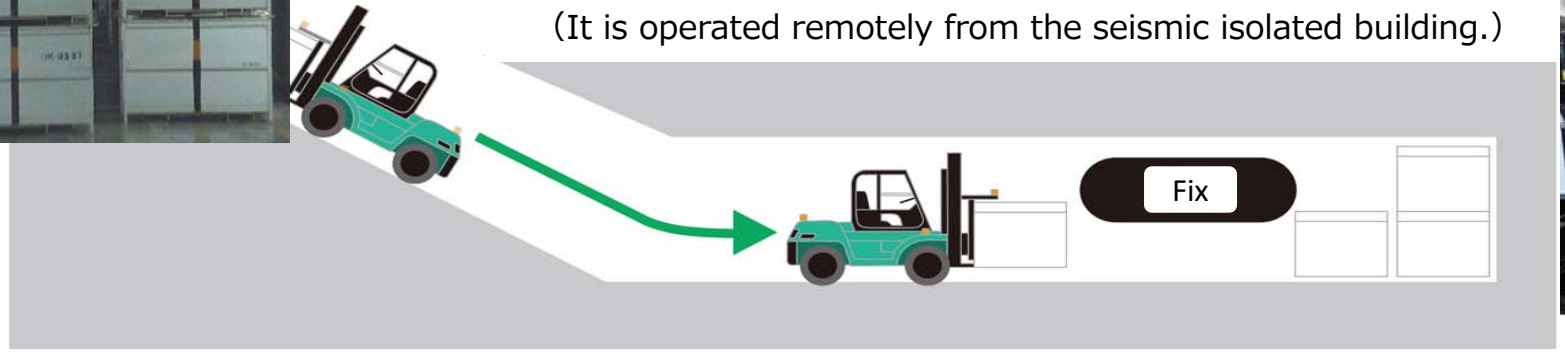
The storage capacity: approx. 61,200m^3 (corresponding to 200 ℓ × 110,000 cans)

Cf: Total amount of the first to the eighth storage capacities are corresponding to 200 ℓ × 284,500 cans

Rectangular containers

● Unattended remote forklift

(It is operated remotely from the seismic isolated building.)



Seismic Isolated Building

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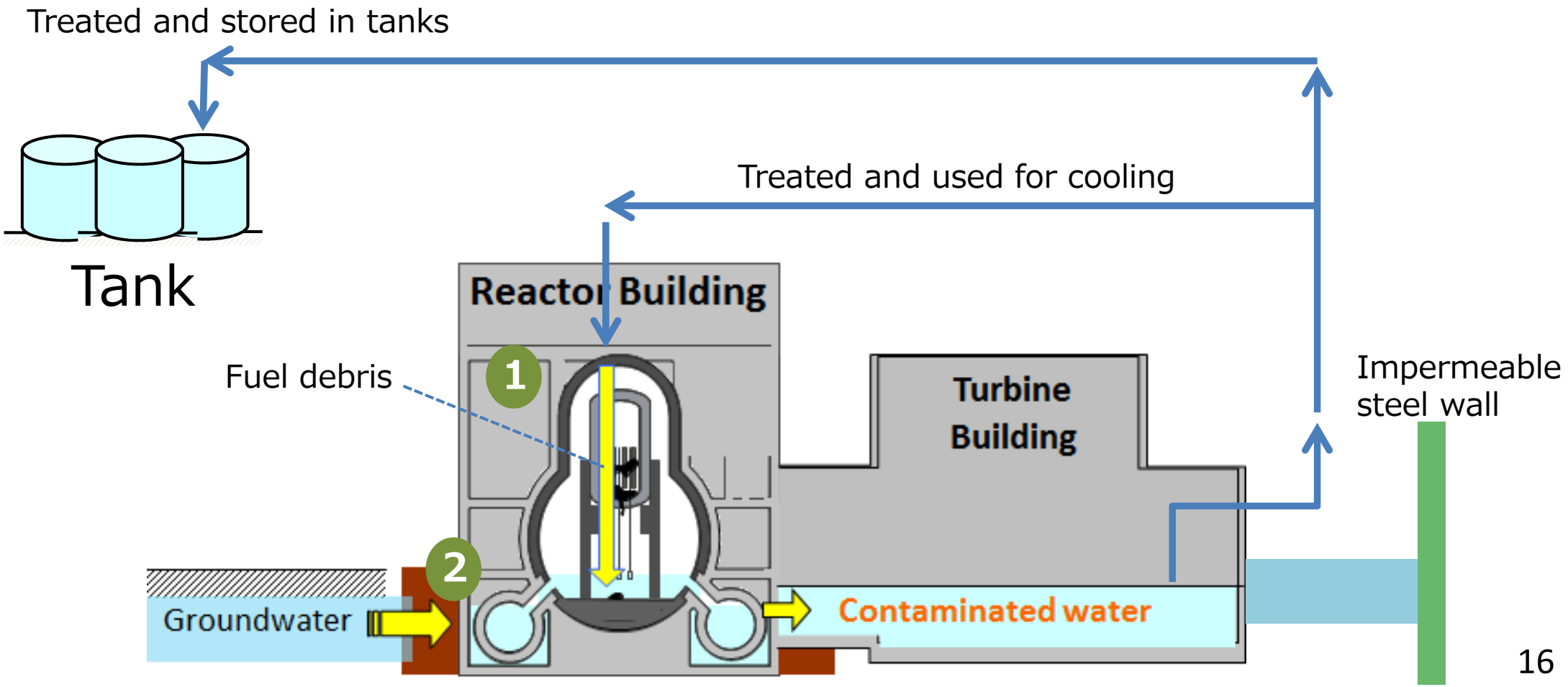
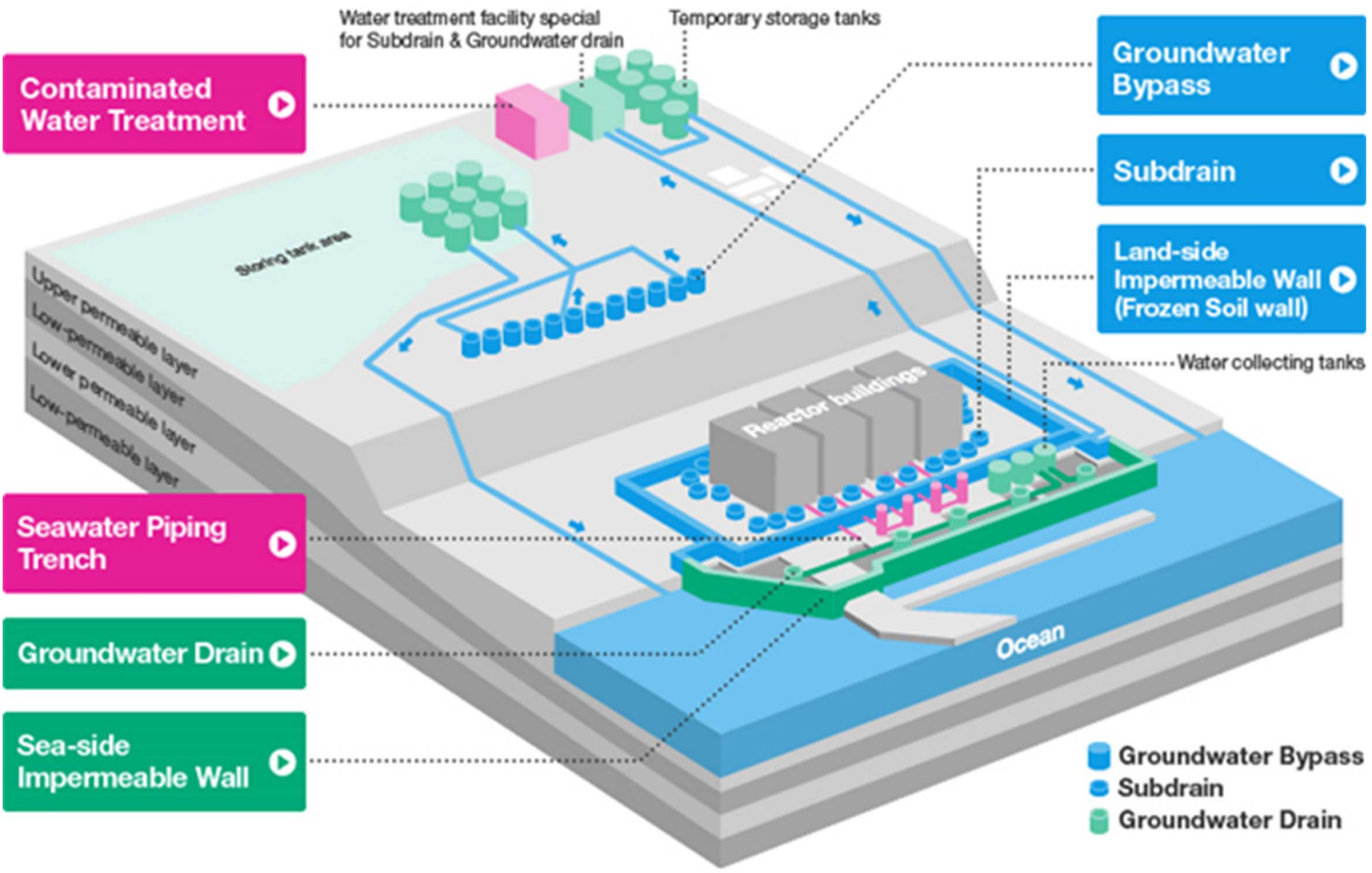
Mechanism by which of contaminated water is created

- In the PCVs, cooling is continued by spraying water on the molten and solidified fuel.(①)
- In order to prevent the stagnant water in the buildings from flowing to outside, the water level is pumped so that it stays lower than the groundwater level outside the building. This is known as water sealing.
- As a result, the groundwater flows into the buildings and mixes with the stagnant water, and new contaminated water is created in the buildings.(②)



Overview of Water Management



Overview of Water Management

Three Basic Principles for Water Management

1. "Isolating" groundwater from the contamination source

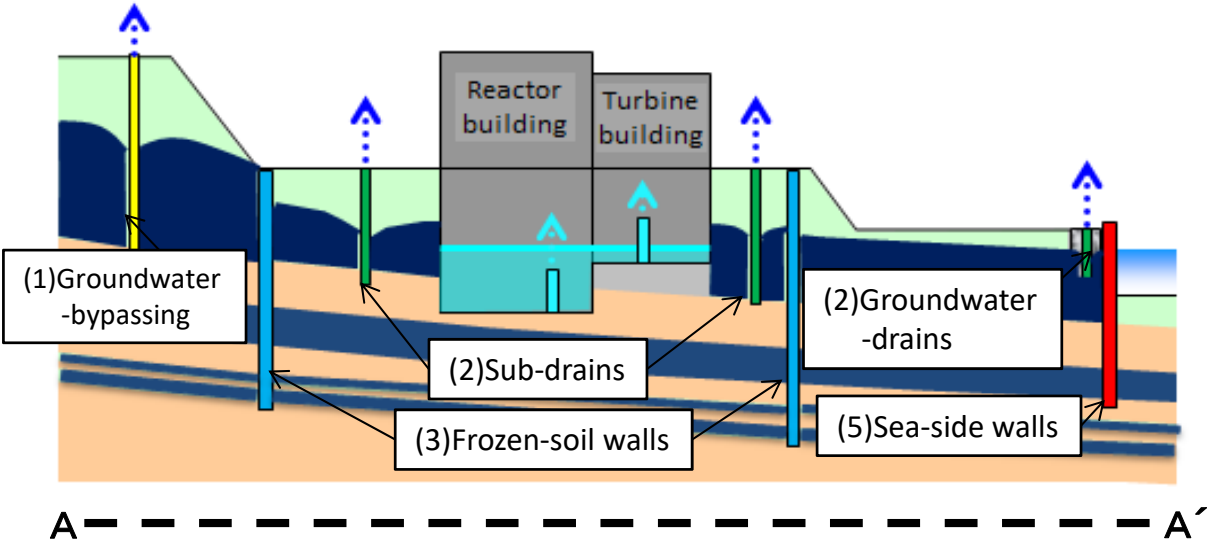
Measures are taken to reduce the generation of contaminated water. ((1)(2)(3)(4) of the right figure)

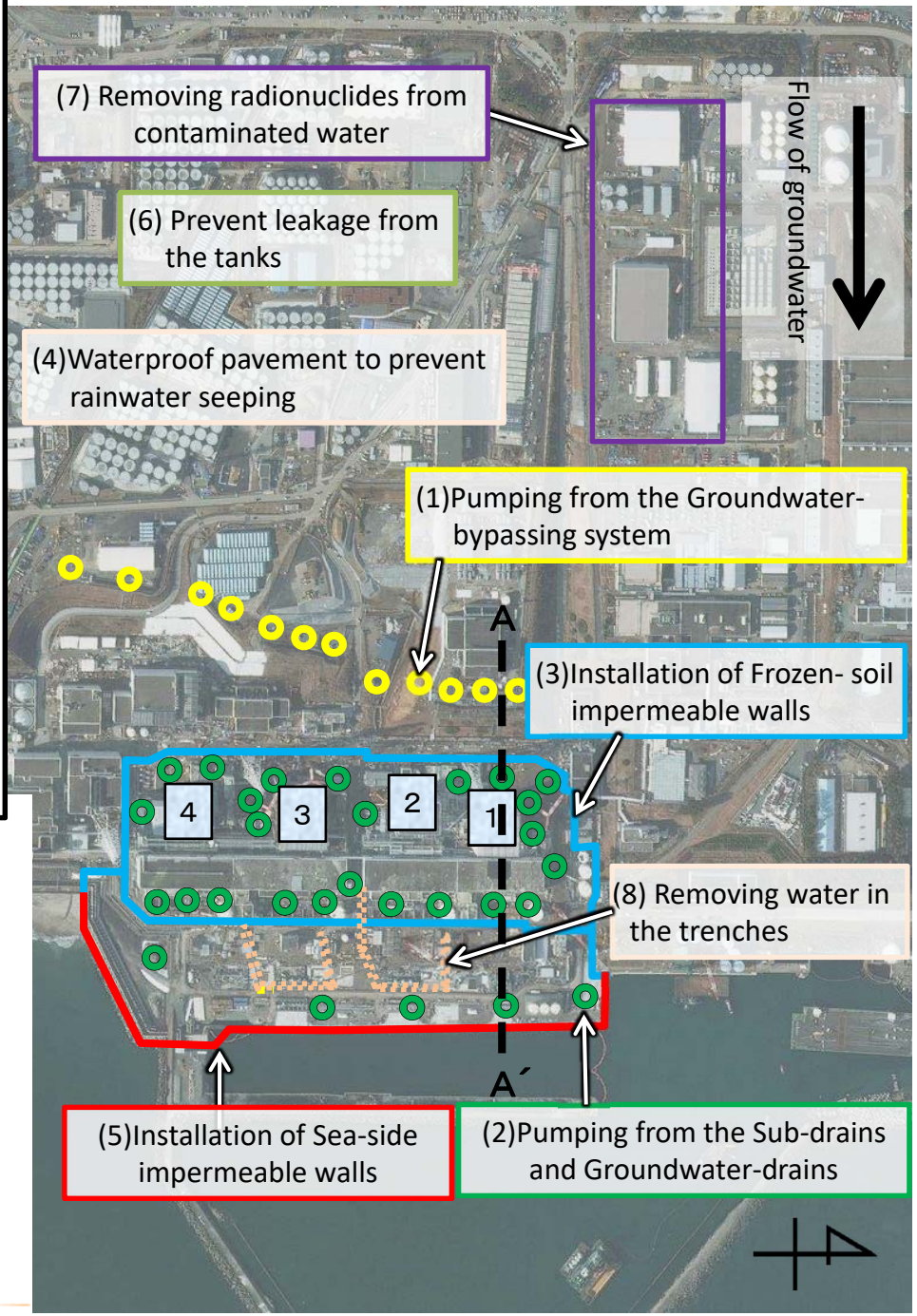
2. "Preventing leakage" of contaminated water

Measures are taken for preventing leakage of contaminated water to the sea. ((5)(6) of the right figure)

3. "Removing" the contamination source

Measures are taken for removing the radioactive nuclides from the contaminated water in the tanks and in the trenches. ((7)(8), etc.)





Concept of Cyclic Cooling in Reactor Building

◆ To stably cool down the fuel debris, circulated cooling water is continuously injected into primary containment vessel .

Spent fuel pool

Reactor Building

Primary containment vessel

Reactor pressure vessel

Turbine Building

Groundwater inflow (A) *

70~80m³/day (average in December)

Groundwater

Contaminated water

Pumping water around the bank area (B)*

40~50 m³/day (average in December)

Added Sr removal function

Cesium removal equipment

KURION

SARRY

500~550 m³/day

Reactor cooling water

200~220m³/day

Cyclic cooling

Pump

Tank

(Gross β: a few hundred Bq/L)

(Gross β: a few million Bq/L)

(Gross β: a few hundred million Bq/L)

Desalination device (RO)

300~330m³/day

(A)+(B) equivalent

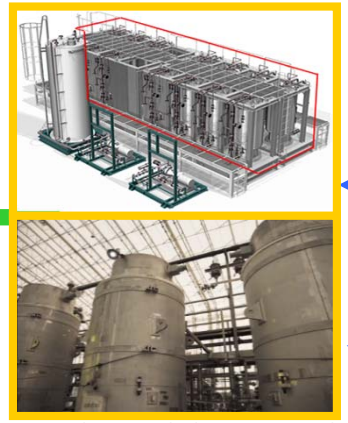
ALPS treated water

About 850,000m³

(As of January, 2018)

Storage tanks

Removing 62 types of nuclides except Tritium



Multi-nuclide removal equipment (ALPS)

Sr treated water

About 180,000m³

(As of January, 2018)

Storage tanks

Completed reduction of Sr concentration

RO concentrated saline water

0m³

(Completed on May 27, 2015)

Storage tanks

※Residual water: about 700m³

* (A) and (B) vary depend on the measures and the precipitation.