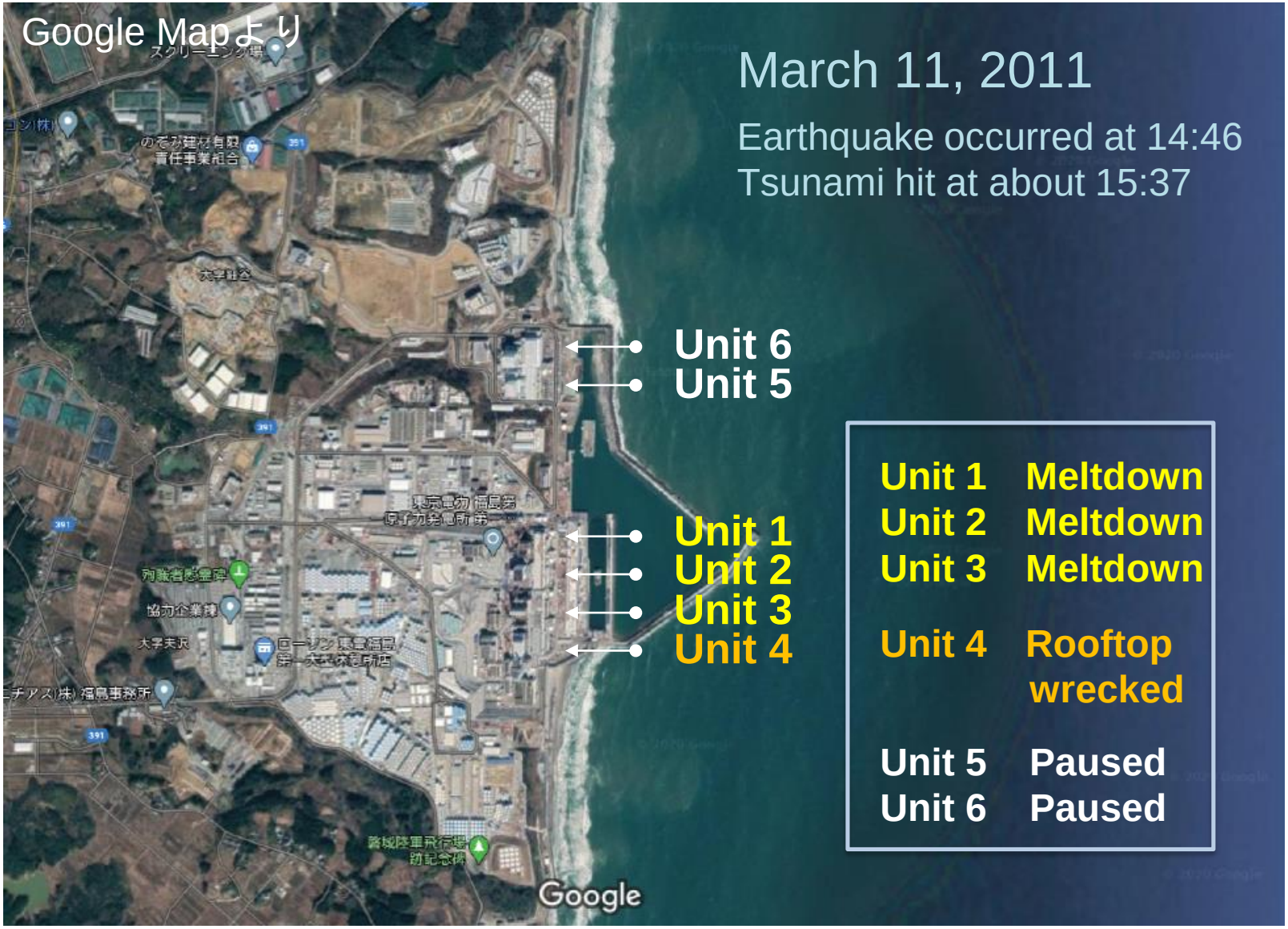
Ten years of the decommissioning of Fukushima Daiichi NPS

福島第一廃炉
10年の歩み

The accident occurred on March 11, 2011



What happened in the reactor?

Tsunami attacked
Power source lost

Damaged the sheds of Units 1,3 and 4 by hydrogen explosions

Leaked radionuclide from the containment vessel

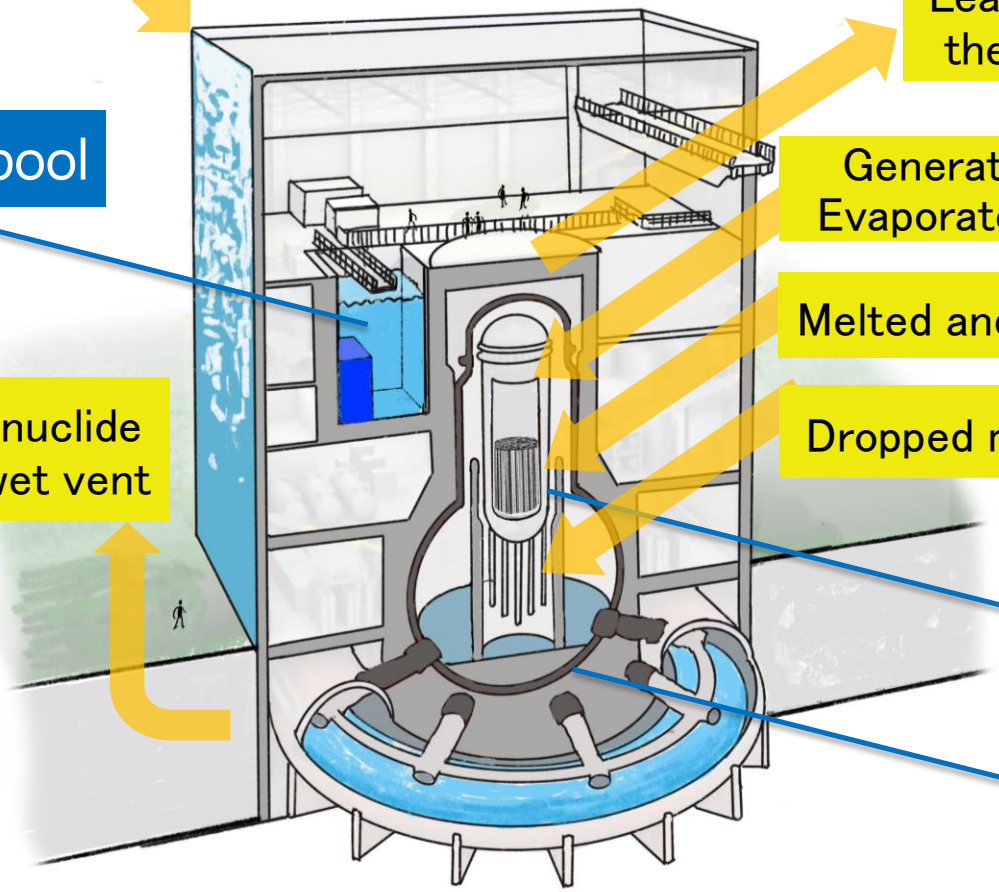
Spent fuel pool

Generated hydrogen/ Evaporated radionuclide

Melted and collapsed fuel assembly

Emitted radionuclide by dry vent/wet vent

Dropped molten core down



Primary Containment vessel (PCV)

Reactor Pressure vessel

What is the purpose of decommissioning?

Decommissioning is an activity to protect people and the environment from the risks posed by radioactive materials while promoting the dismantling of power plant facilities.

The goal of decommissioning is to reduce the risk to a low enough level.

High-risk conditions

Controlled and stable…. but still uncertain state

Certain risks remain ⇨ Ensuring safety with proactive management

After decommissioning

Low-risk conditions

Safe even if left unattended
Everyone can feel secure

The risks are infinitely low ⇨ The site can be used for other purposes

Major risk sources

1 Spent fuel removal

Remove and store safely

2 Fuel debris retrieval

Remove and store safely

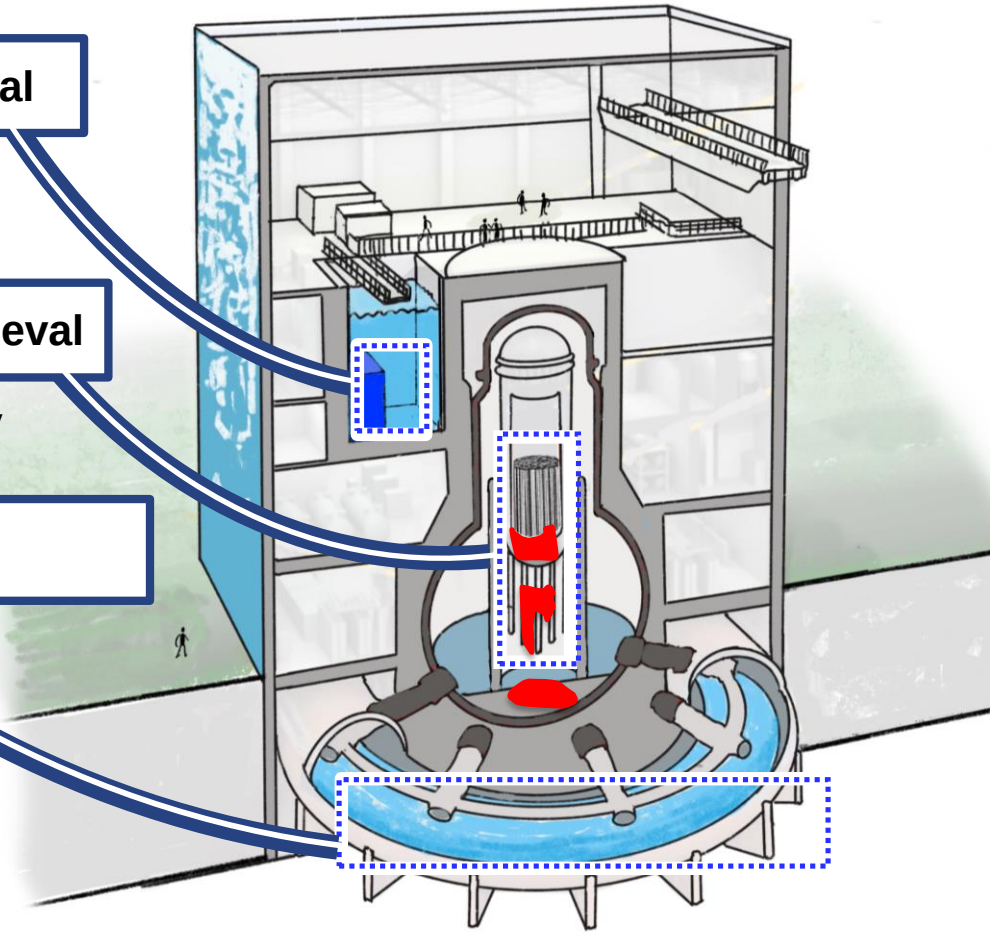
3 Contaminated water management

Purify, reduce generation and reduce the amount of remaining

4 Solid waste

Once in storage, stabilize, reduce volume and generation, and analyze properties

5 Various other contaminants, etc.



Long-term decommissioning plan (The government's policy)

Since March 11, 2011	December 2011	November 2013	October 2021	Within 2031
Accident **Early period**	**Phase 1**	**Phase 2**	**Phase 3**	Fulfilment
			Phase 3—①	**Phase 3—②**
• Cold shutdown • Significantly reducing the release of radioactive materials	• Before the start of spent fuel removal from the first implementing unit	• Before the start of fuel debris retrieval in the first implementing unit	• From the end of Phase 2 through the end of decommissioning (Target period will be 30 to 40 years after Step 2)	

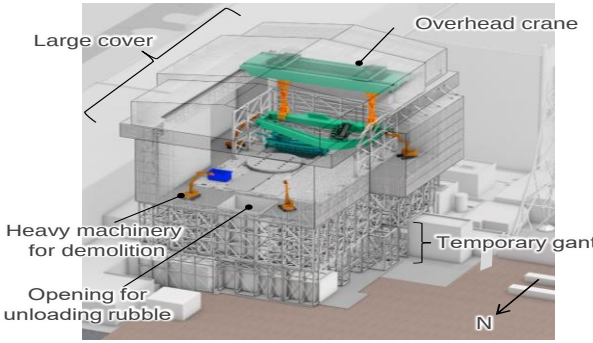
- PCV internal investigation
- Examining fuel debris retrieval method
- Stagnant water treatment in the buildings
- Spent fuel removal from Unit 3 and 4
- Preparing for spent fuel removal from Units 1 and 2

Spent fuel removal from Unit 3|TEPCO

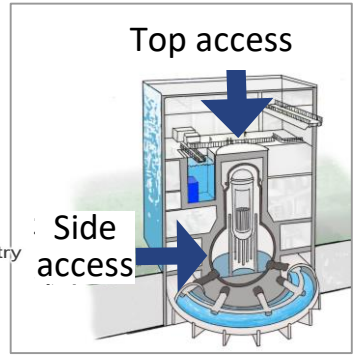
The underwater ROV for Unit 3 internal inspection| TEPCO

- Spent fuel removal from Units 1 to 6 completed
- Trial retrieval of fuel debris gets started
- Gradual expansion of fuel debris retrieval
- Minimize contaminated water generation
- Proceed with waste storage

Spent fuel removal

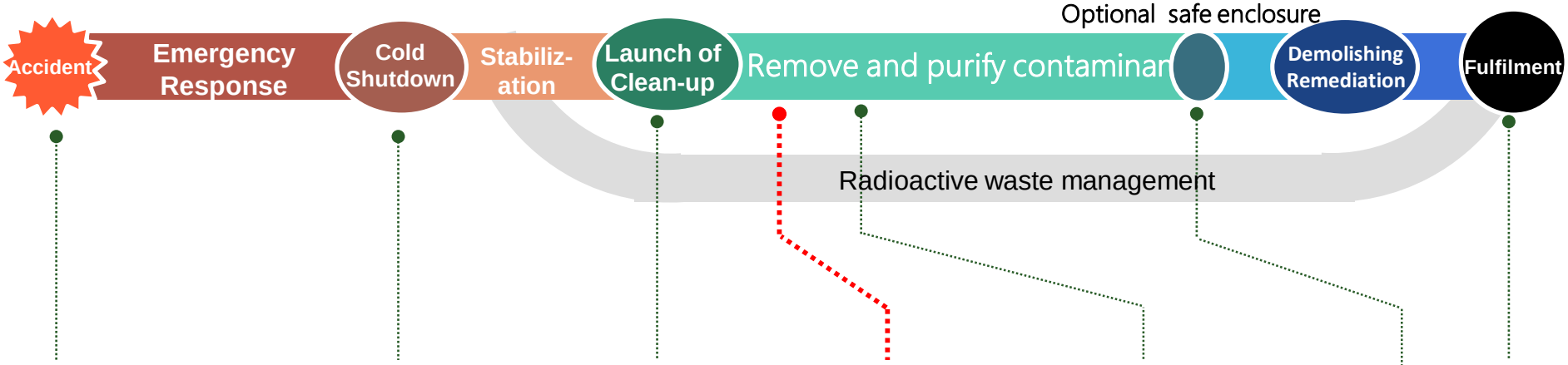


Retrieval of fuel debris

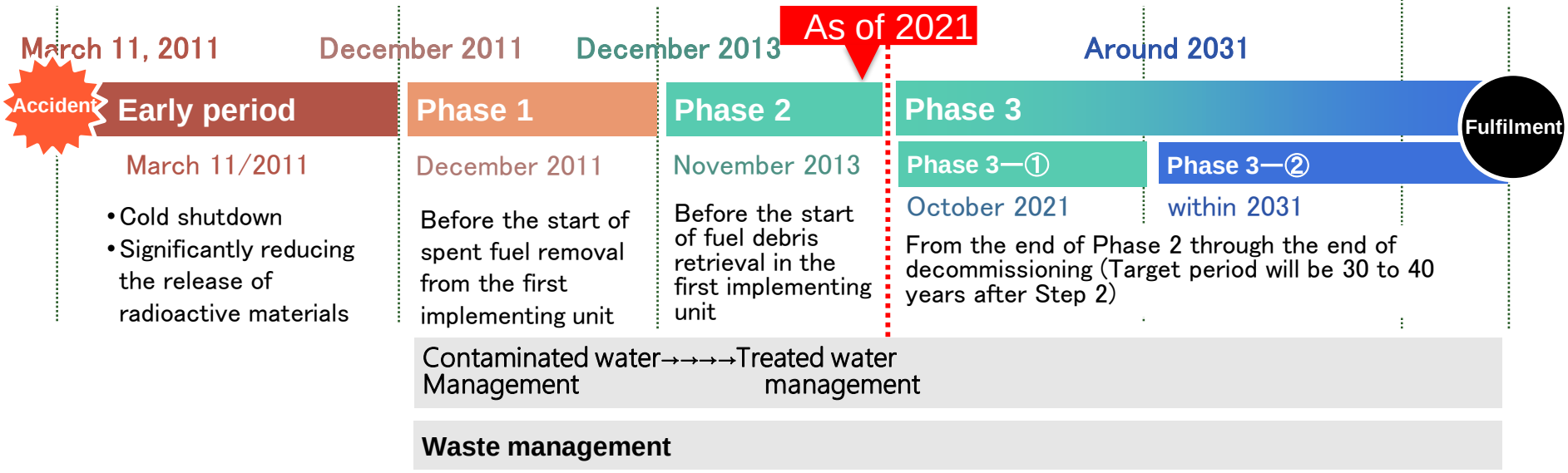


Road to decommissioning

Decommissioning process of accidental reactors as considered **internationally**

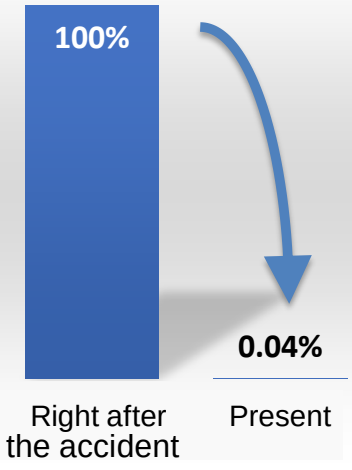


Decommissioining process of accidental reactors at **Fukushima Daiichi**

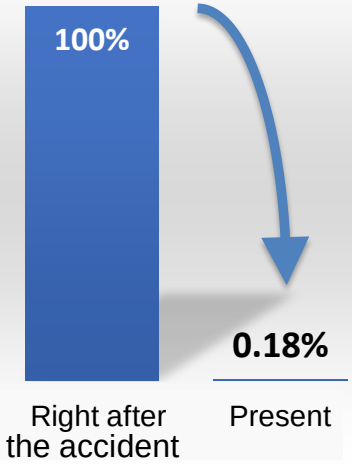


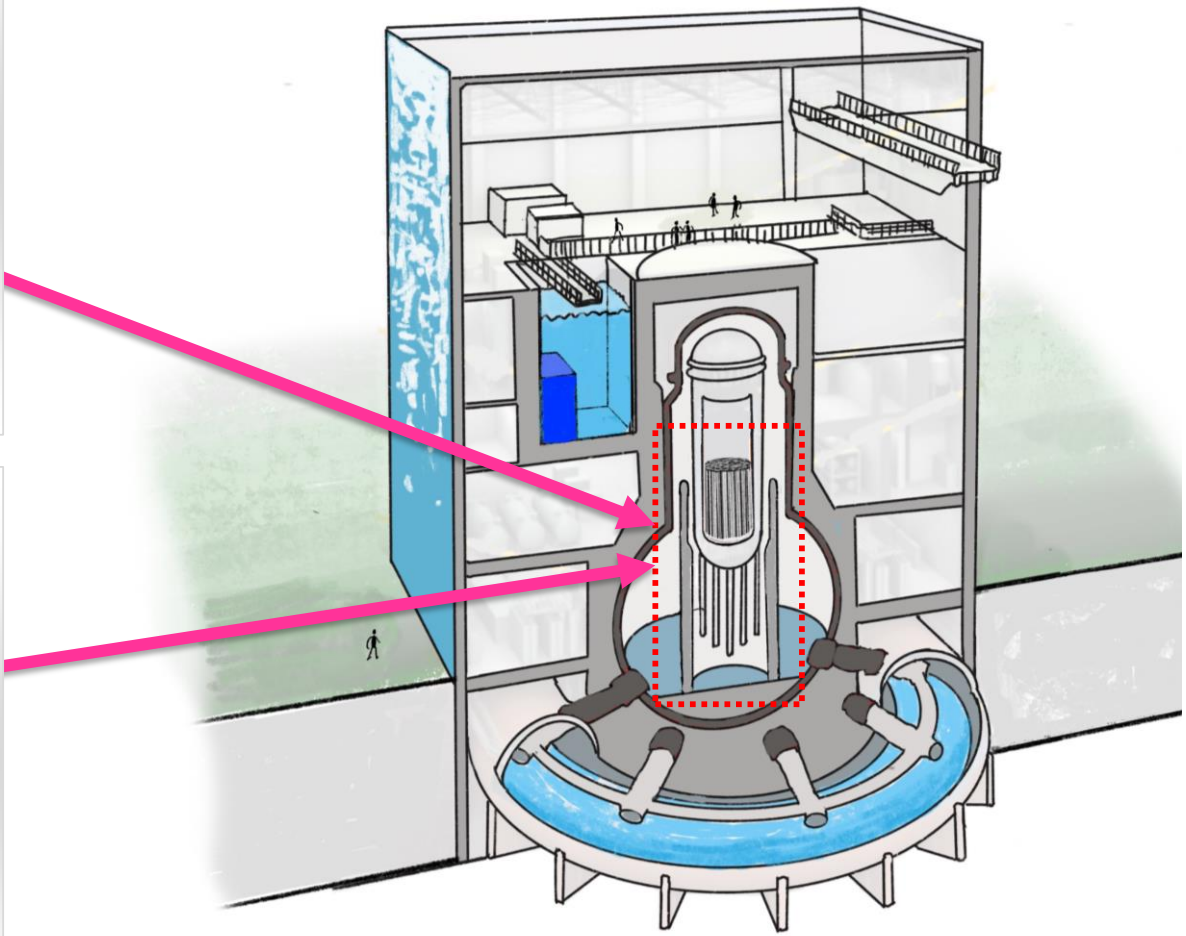
The danger level of reactors has decreased dramatically over time

Heating value of the reactor



Radioactivity of the reactor

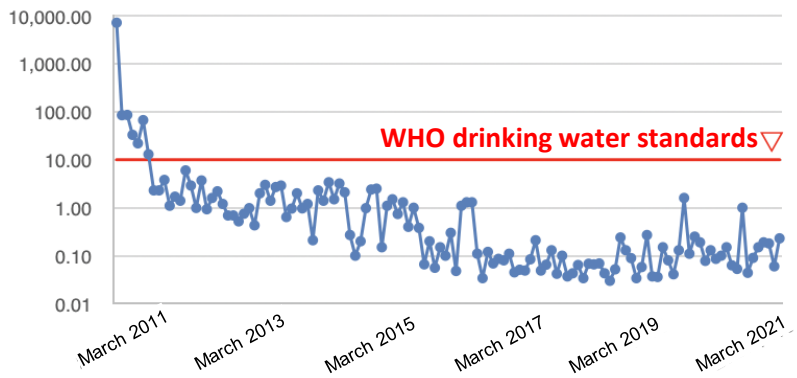




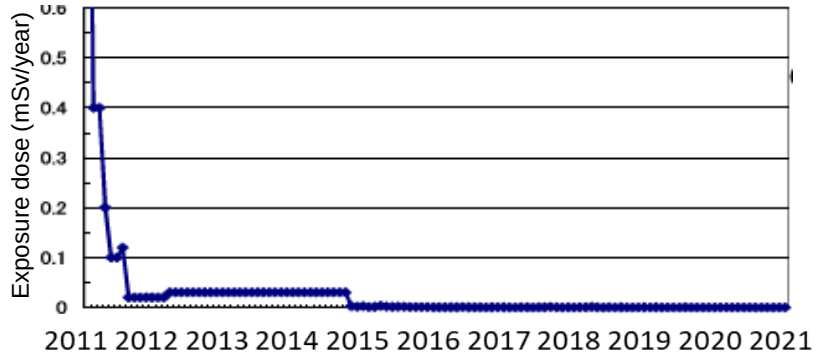
Value for Unit 3

Radiation safety has significantly improved in the last decade

Concentration of Cs-137 in seawater at the south side of the port



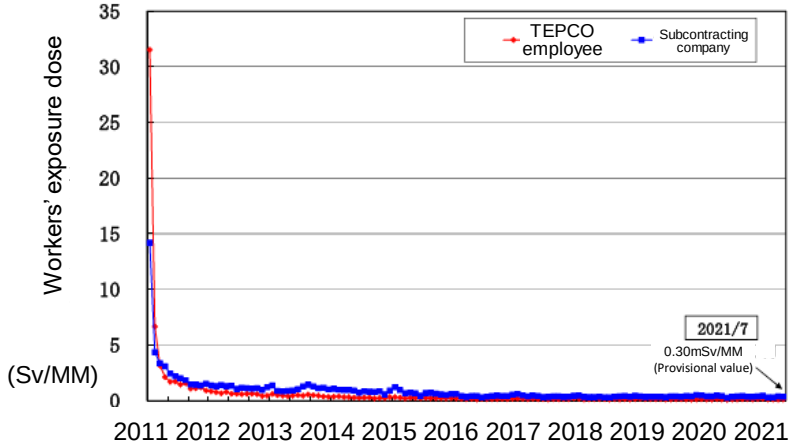
Cs-137 emitted from Units 1 to 4 over the past decade



The general public can also visit without protective gear

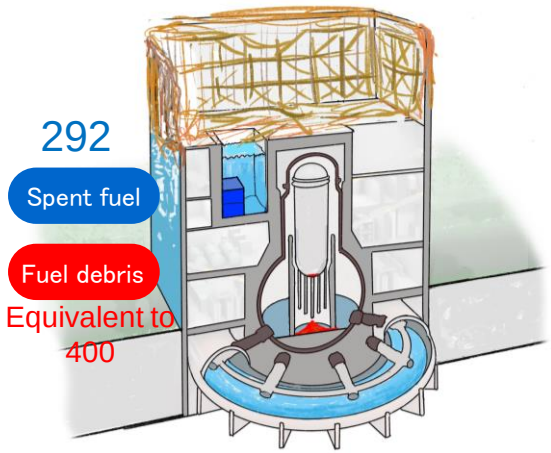
Site inspection by local residents in February 2020|METI

Monthly average exposure dose for workers



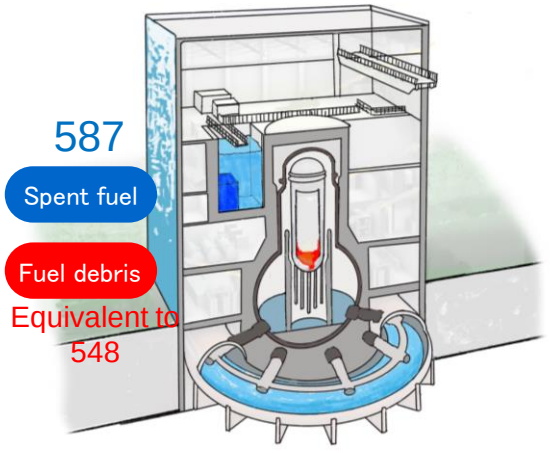
Immediate after the accident in 2011

Unit 1



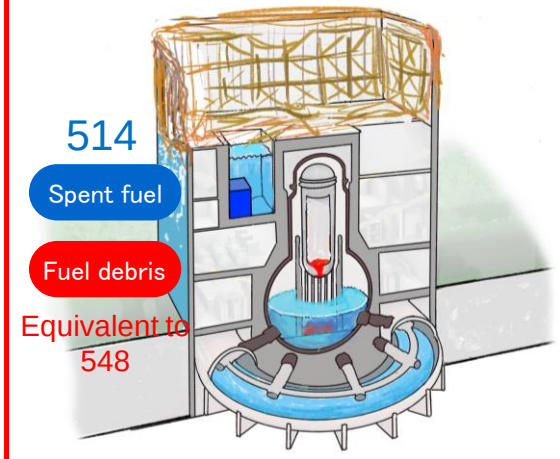
292
Spent fuel
Fuel debris
Equivalent to 400

Unit 2



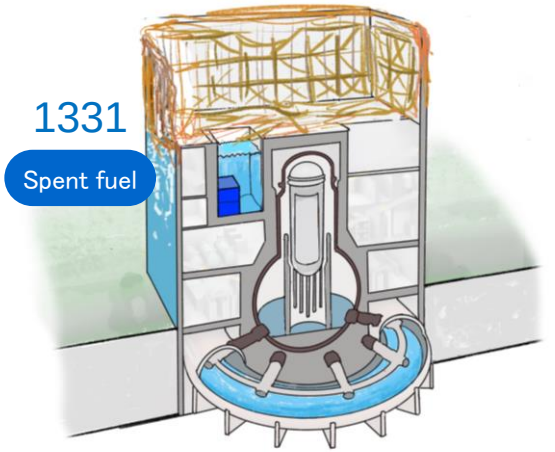
587
Spent fuel
Fuel debris
Equivalent to 548

Unit 3



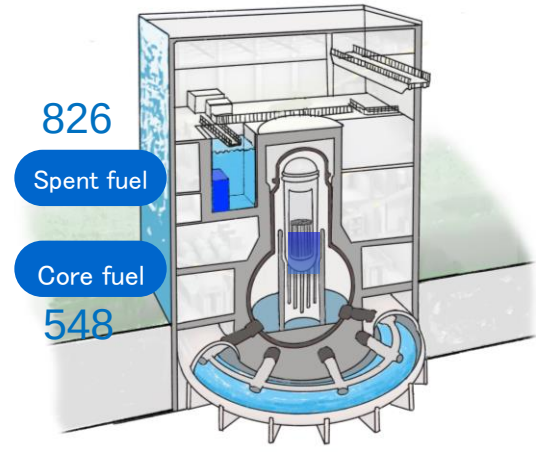
514
Spent fuel
Fuel debris
Equivalent to 548

Unit 4



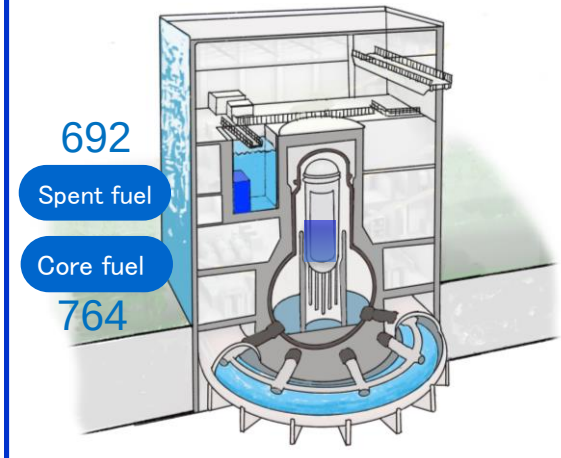
1331
Spent fuel

Unit 5



826
Spent fuel
Core fuel
548

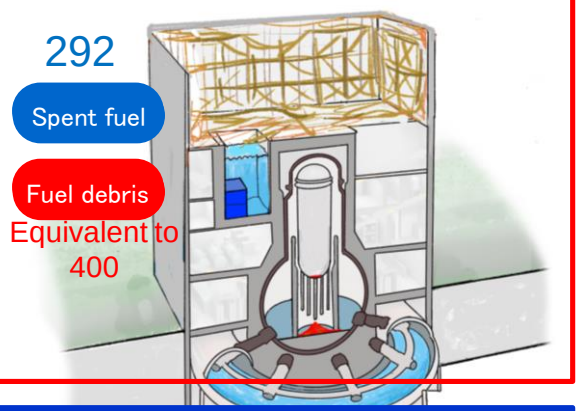
Unit 6



692
Spent fuel
Core fuel
764

In 2021

Unit 1



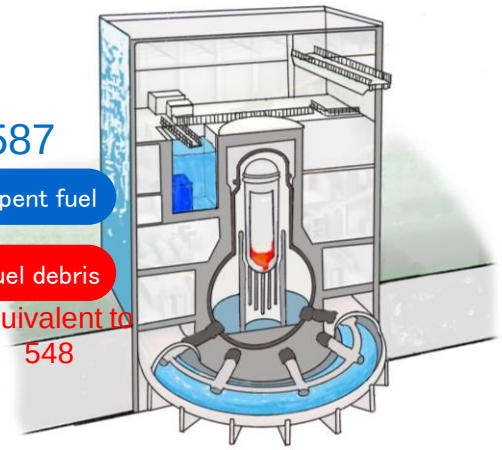
292

Spent fuel

Fuel debris

Equivalent to 400

Unit 2



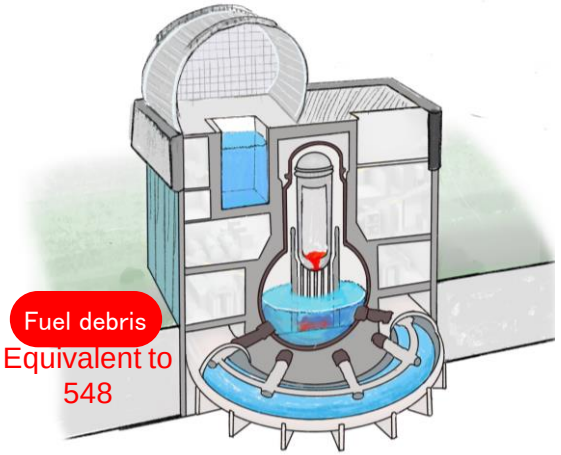
587

Spent fuel

Fuel debris

Equivalent to 548

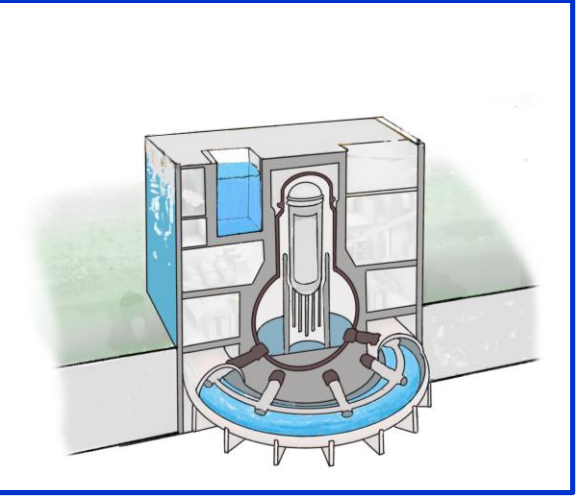
Unit 3



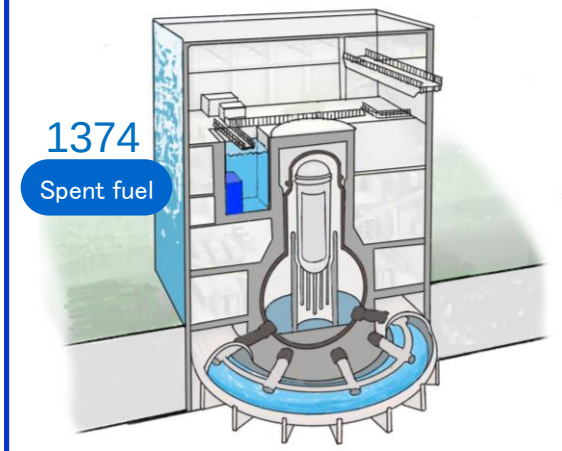
Fuel debris

Equivalent to 548

Unit 4



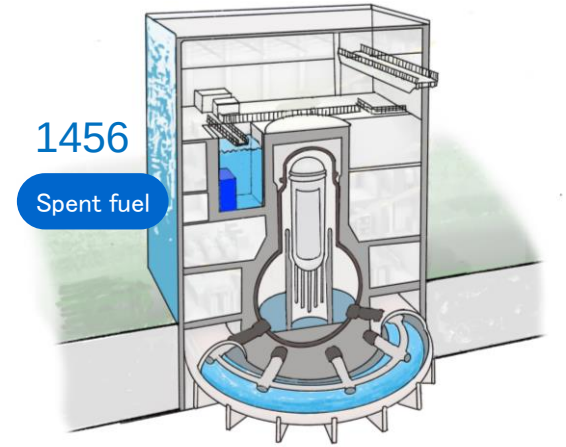
Unit 5



1374

Spent fuel

Unit 6

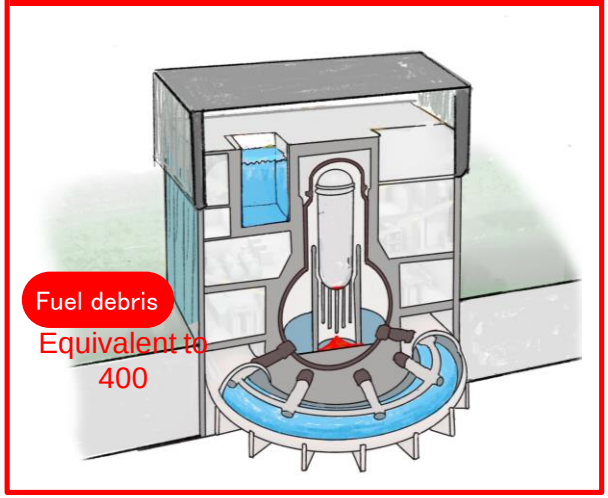


1456

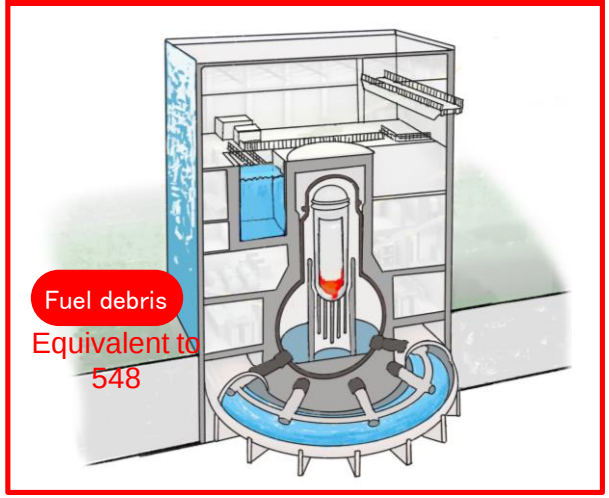
Spent fuel

Around 2031

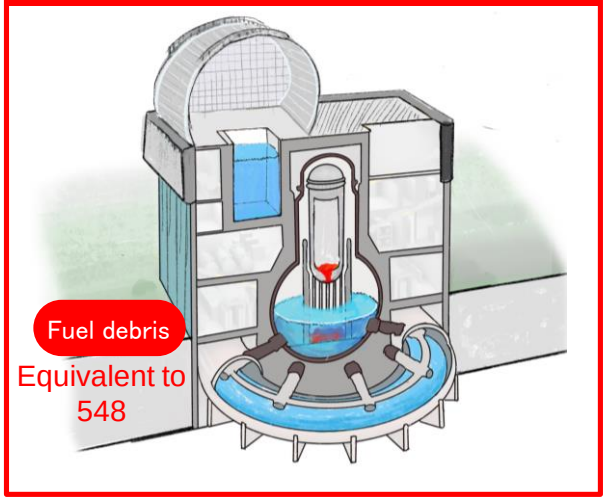
Unit 1



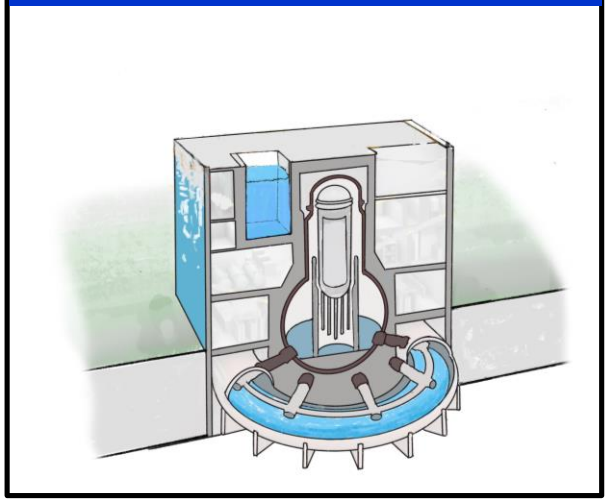
Unit 2



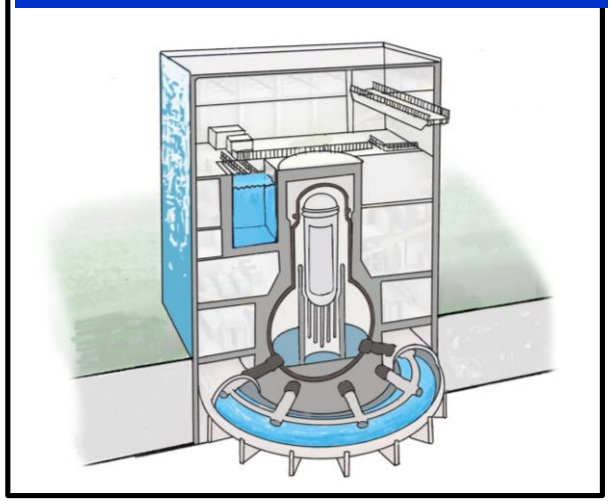
Unit 3



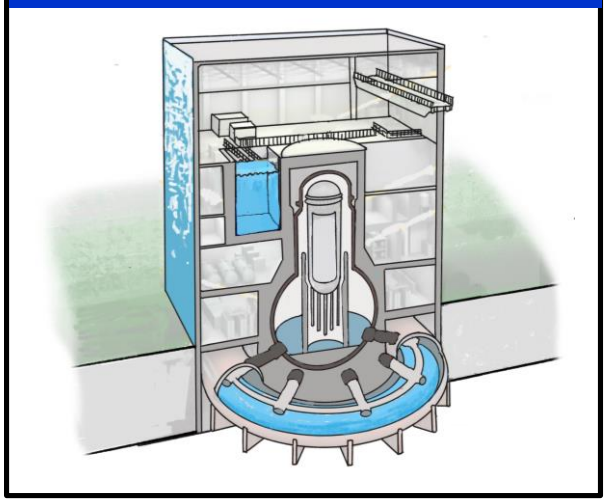
Unit 4



Unit 5



Unit 6



The priority is to ensure safe storage

- Spent fuel removed from accident reactor is securely stored in dry casks (custody facility).
- Large amount of solid radioactive waste has been stored in temporally storage will be stored in a robust waste storage facility that is being expanded, with efforts to reduce the amount generated in the future and volume of waste.


Spent fuel Storage custody facility


Rubble storage facility


Miscellaneous solid waste incineration facility

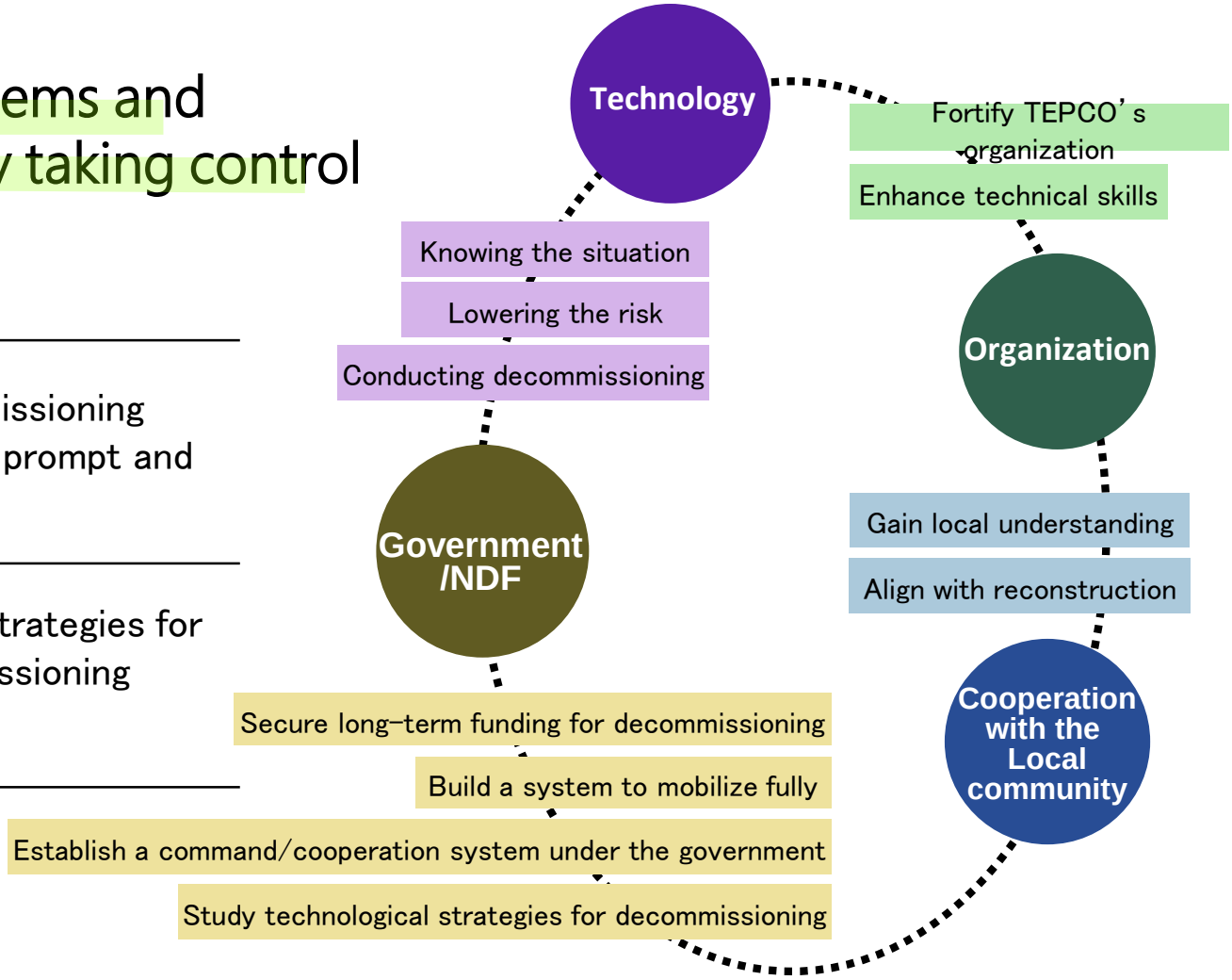

New waste storage

Cooperative systems has been established for the past 10 years…

Developing the systems and mechanisms by fully taking control of the situation

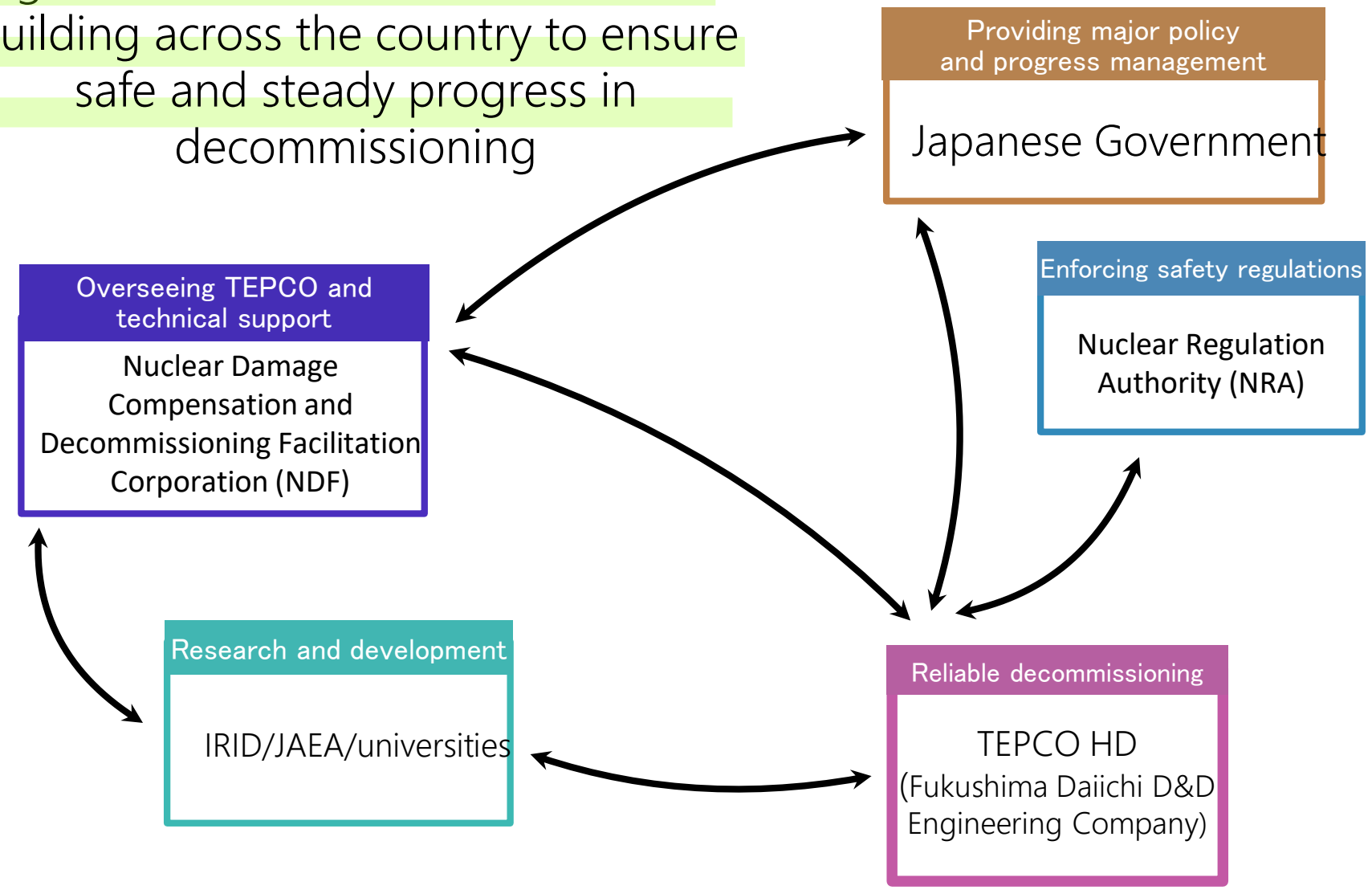
1 | To perform decommissioning project in a reliable, prompt and safe manner.

2 | To determine exit strategies for long-term decommissioning project.



Collaboration and roles toward decommissioning

Organizational collaboration has been building across the country to ensure safe and steady progress in decommissioning



Learn from global examples (International cooperation is essential)

Learn from the global examples

1979 to 1989

Fuel debris retrieval operation in
Three Mile Island Unit 2 in the US

The case of debris trapped inside the RPV. The operator retrieved remotely and the retrieval completed in 10 years. In the case of Fukushima Daiichi, since fuel debris is leaking out of the RPV, it will be a much larger scale operation. But helpful examples.

Over the past decade, Japan has built strong partnerships with various nations and international organizations.

Making technological decisions and gaining peace of mind still work in progress – ALPS-treated water issue

Insufficient information
Insecurity….
Reputational damages

Environmental Impact

Fuel debris
Should never discharge to the environment
Maximum effort required

Solid waste
No discharge to the environment
Careful approach required

Exists in the environment
Released before the accident
Massive amount stored on site

Tritium

decades

Hundreds of years

Tens of thousands of years

Disseminating information and dialogue with local residents

Sharing knowledge among stakeholders and organizations involved in decommissioning

The Fukushima Advisory Board for Decommissioning and contaminated and treated water management

Study on Specified Nuclear Facility Monitoring and Assessment

Safety Monitoring Council on decommissioning of Nuclear Power Station in Fukushima prefecture

Exchange of opinions with residents and young people at the International Forum on the Decommissioning of the Fukushima Daiichi NPS

Prospects for future decommissioning

Since March 11, 2011	December 2011	November 2013	October 2021	Within 2031
Accident				Fulfilment
Early period	**Phase 1**	**Phase 2**	**Phase 3**	
			Phase 3—①	**Phase 3—②**
• Cold shutdown • Significantly reducing the release of radioactive materials	• Before the start of spent fuel removal from the first implementing unit	• Before the start of fuel debris retrieval in the first implementing unit	• From the end of Phase 2 through the end of decommissioning (Target period will be 30 to 40 years after Step 2)	
				

Safety on nuclear installation	Accident reactors stably maintained Radiation leakage minimized/ensured monitoring Tsunami and earthquake resistance ensured Proceeded with processing of high-risk source Improved radiation safety environment	Strictly continue radiation containment and environmental improvement Dismantle/maintain unnecessary facilities
Contaminated water management	Measures to reduce contaminated water generation implemented Stagnant water in the buildings reduced **ALPS-treated water gradually accumulated**	Reduce contaminated water generation Reduce stagnant water Planning ALPS-treated water release
Spent fuel	Spent fuel removal from Units 3 and 4 completed Preparation of spent fuel removal from Units 1 and 2 initiated Stored part of spent fuel in dry cask storage	complete spent fuel removal Reactor internal inspection
Fuel debris	Inside of the accident reactors inspected/ internal conditions presumed Developed fuel debris retrieval equipment/ preparation of trial retrieval	Small scale fuel debris retrieval in Unit 2 Expanding scale of fuel debris retrieval in Units 1 to 3 Eliminate outdoor storage of rubbles
Radioactive waste	Waste storage facility expanded /volume reduction operation started Condition of waste in temporary storage improved Radioactive waste characterizing Radioactive waste analytical facility constructed	Store waste/reduce volume/stabilize Analyze waste and debris in analytical facilities

Carefully consider the long-term exit strategy (decommissioning plan) in line with the status confirmation and progress of retrieval method.

Future of reconstruction progressing together with decommissioning

2011 — 2021 — 2050

2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

Environment decontamination

Lifting evacuation orders

Development of specific reconstruction ands revitalization centers

Development of service infrastructure/return/ rebuilding of livelihoods/others

Further strengthening of infrastructure

Activation of educational human resources development

International center for education and research

Activation of Specified reconstruction and revitalization base

Creation of industry including Innovation Coast Framework

Decontamination of areas other than specified reconstruction and revitalization base

More residents returning home

Growing the number of relocation and exchange population

Thank you