

# Revised Mid-and-Long-Term Roadmap towards the Decommissioning of TEPCO's Fukushima Daiichi NPP Units 1-4

Tatsuya Shinkawa

Director, Nuclear Accident Response Office,  
Agency for Natural Resources and Energy, METI

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# Overview of the Mid-and-Long-Term Roadmap

## **March 11, 2011**     **The Great East Japan Earthquake**

**December 21, 2011**     The Government and TEPCO Council adopted “the Mid-and-Long-Term Roadmap towards the Decommissioning of TEPCO’s Fukushima Daiichi NPP Units 1-4 (Mid-and-Long-Term Roadmap ver. 1.0)”

**July 30, 2012**     Mid-and-Long-Term Roadmap was revised (ver. 1.1).

**February 8, 2013**     The Nuclear Emergency Response Headquarters established “**The Council for the Decommissioning of TEPCO's Fukushima Daiichi NPP**”

- Enhance the further collaboration between on-site work and R&D through involvement relevant R&D bodies into Government of Japan and TEPCO.

**June 10, 2013**     “The draft of concept for the revised Mid-and-Long-Term Roadmap” was released.

- Opinions from Fukushima Prefecture, local governments, and experts.

**June 27, 2013**     **The Council adopted the revised Mid-and-Long-Term Roadmap ver. 2.0.**

# Three Major Points of the revised Roadmap

1. Reviewing the schedule based on the condition of each unit
  - To pursue the possibility of the acceleration of the target data for fuel debris removal
  - With multiple option plans for the removal of the fuel rods and fuel debris to fit the on-site situation
2. Strengthen communications with local stake holders and across all levels of society
  - Establish the Fukushima Advisory Board (provisional title), with the participation of Fukushima Prefecture, local governments, relevant local organizations, and experts in order to strengthen the provision of information and communications.
3. Developing a comprehensive structure to gather international expertise
  - Appoint international advisors who provide advice to the R&D management organization
  - Establish an international collaboration department in the R&D organization and an international decommissioning expert group consisting of foreign experts in various fields

# Basic Principles of Mid-and-Long-Term Roadmap

Principle 1: Systematically tackle the issues while placing top priority on the safety of local citizens and workers.

Principle 2: Move forward while maintaining transparent communications with local and national citizens to gain their understanding and respect.

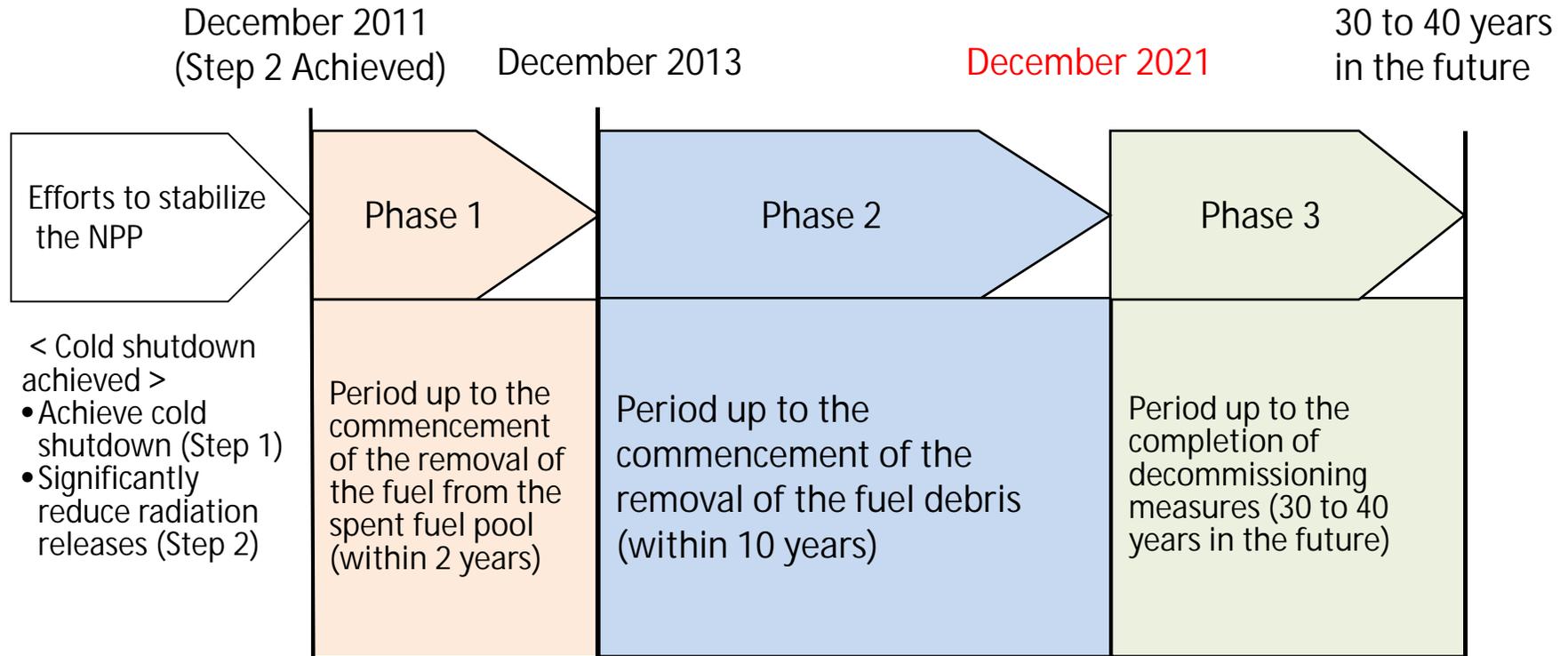
Principle 3: Continuously update the roadmap in consideration of the on-site situation and the latest R&D result.

Principle 4: Harmonize the efforts of TEPCO and Government of Japan to achieve the goals indicated in this Roadmap. The Government of Japan should take the initiative in promoting the efforts to implement decommissioning measures safely and steadily.

# Basic Concept for Ensuring Safety

- ❑ Ensuring safety as Specified Nuclear Power Facilities (under regulation by NSA)
- ❑ Efforts to ensure safety
  - To set the priority on the removal of the hazards such as fuel rods in Spent Fuel Pool (SFP) and fuel debris as soon as possible
  - To set the urgent action for the contaminated water treatment
  - To consider on safety, gain the understanding of the local and other citizens, consider the holistic plan for the decommissioning, use the best available technologies, and employ the most rational and achievable measures
- ❑ Preparations for the Development of New Standards and Regulatory Response Actions

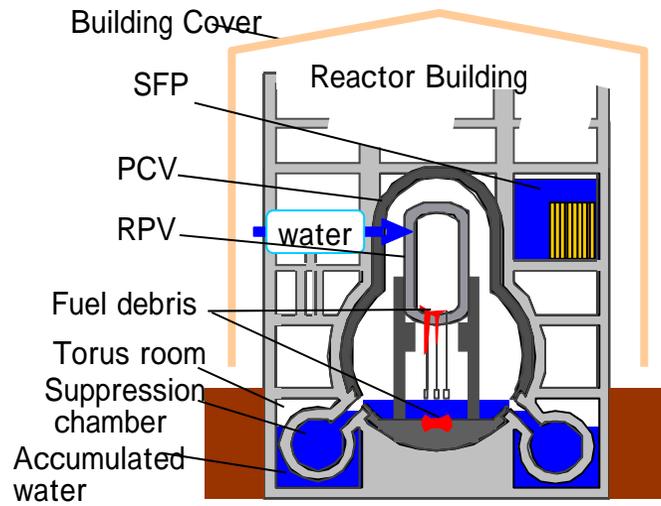
# Targets of Roadmap



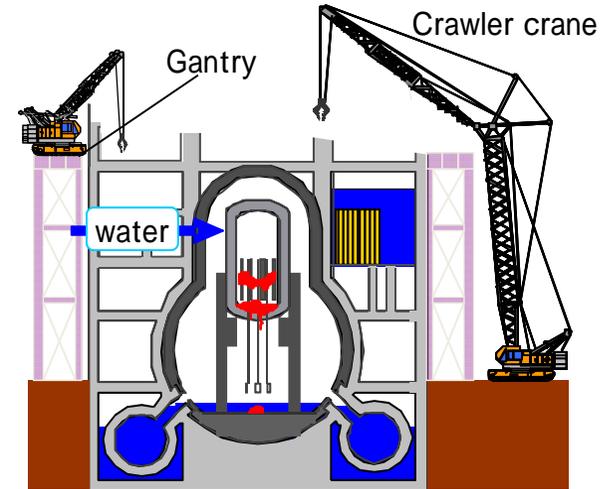
Now: Under preparation of first fuel rods removal from Unit 4 SFP as target of Phase 1

# Current Status of Fukushima Daiichi NPP

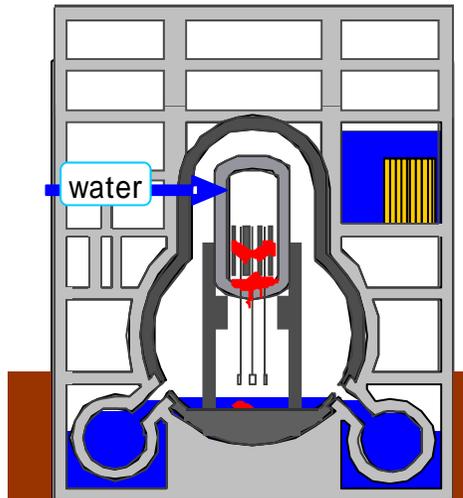
## Unit 1



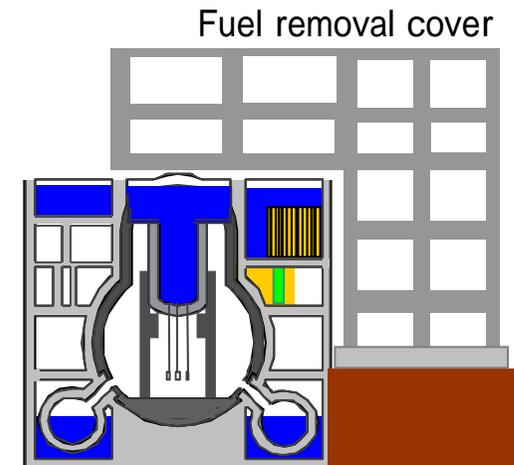
## Unit 3



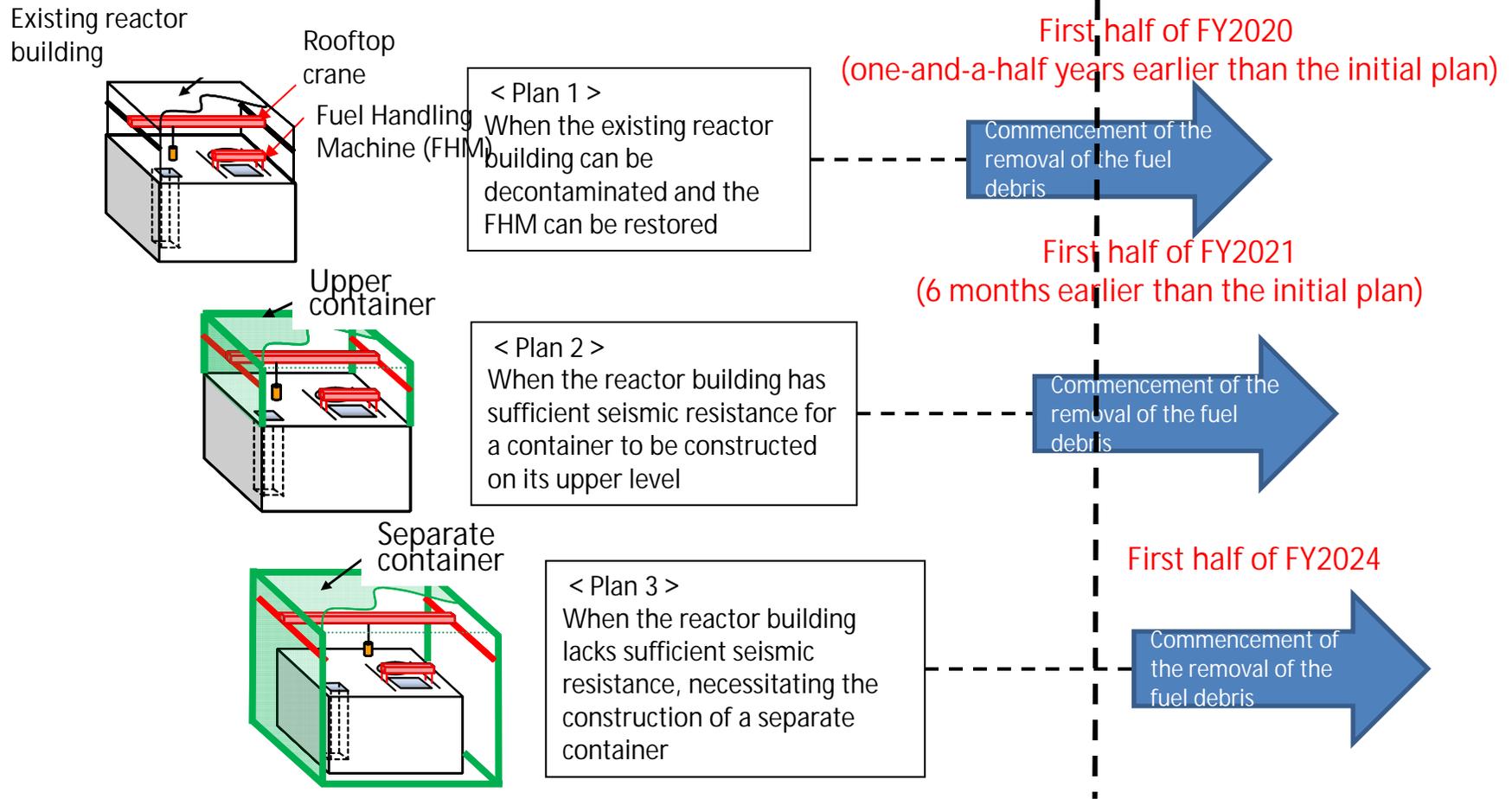
## Unit 2



## Unit 4



# Plan under the Revised Roadmap (example: Unit 2)



Future plans will be narrowed down in the first half of FY2014 based on the results of analysis of the likelihood of the existing reactor building's decontamination or restoration of the FHM, as well as the results of the assessment of the seismic resistance of the existing reactor building.

# Planned Schedule for Each Unit (Summary)

	Fuel rods removal from SFPs (Target schedule)	Fuel debris removal (Target schedule)
Initial Target	December 2013 (the earliest unit)	December 2021 (the earliest unit)
Unit 1	First half of FY2017 (the earliest case) ~ Second half of FY2017	<u>First half of FY2020 (one-and-a-half years earlier than the initial plan)</u> ~ <u>Second half of FY2022</u>
Unit 2	Second half of FY2017 (the earliest case) ~ First half of FY2023	<u>First half of FY2020 (one-and-a-half years earlier than the initial plan)</u> ~ <u>First half of FY2024</u>
Unit 3	First half of FY2015	Second half of FY2021 (the earliest case) ~ Second half of FY2023
Unit 4	<u>November 2013 (one month earlier than the initial plan)</u>	-

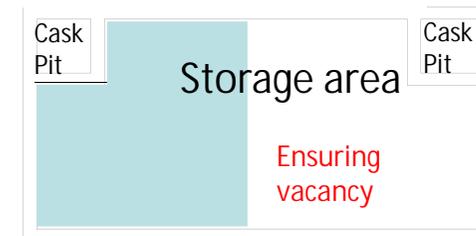
# Fuel Rods Removal from SFP

1. Rubbles in the upper level of the reactor building needs to be removed (Unit 4: completed, Unit 3: ongoing)
  2. A cover or a container for the entire reactor building is to be constructed and the Fuel Handling Machine is to be installed (Unit 4: Under construction)
  3. The fuel rods stored in the common pool is to be moved to the temporary cask custody area to make vacancy in the common pool for the fuel removed from the spent fuel pool (SFP)
  4. The fuel rods removed from the spent fuel pool of each damaged units will finally be packed into transport containers after confirming the soundness and transported.
- Transportation of the fuel rods removed from Unit 4 is scheduled to commence in November 2013.

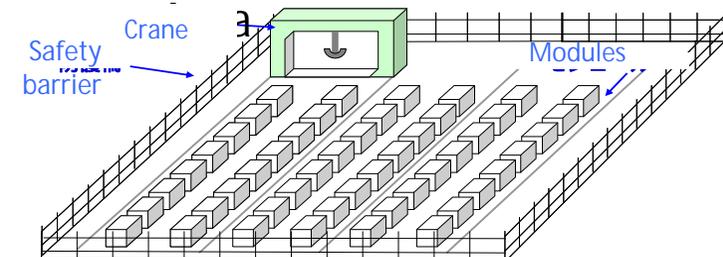
Fuel Removal Cover on Unit 4



Common Pool

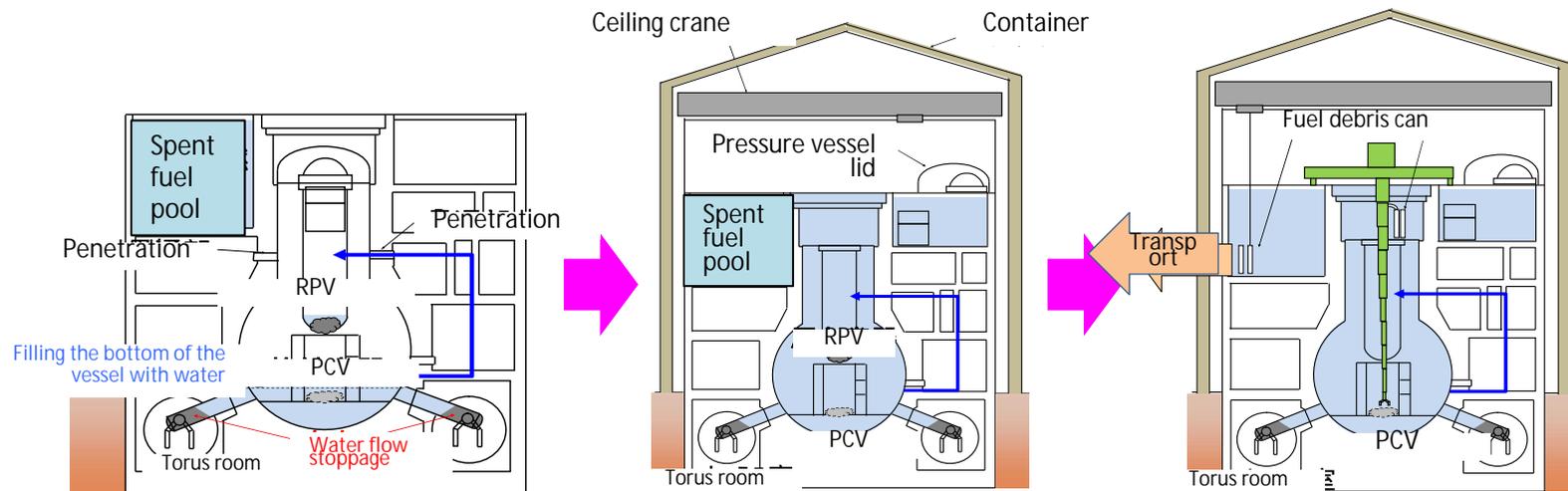


Temporary Cask Custody



# Work Processes to the Removal of the Fuel Debris

- ❑ The most reliable method of fuel debris removal is to remove the fuel debris in keeping them covered with water in terms of reducing the risk of radiation exposure during work processes.
- ❑ The fuel debris will be examined and the primary containment vessel (PCV) will be examined and repaired for filling the PCV with water. Furthermore, R&D for the removal and storage of fuel debris will be implemented.
- ❑ In addition to the submerged method, backup plans have been considered.



Rough picture of the process from repairing the bottom of the RCV (water flow stoppage) to filling the bottom of the vessel with water

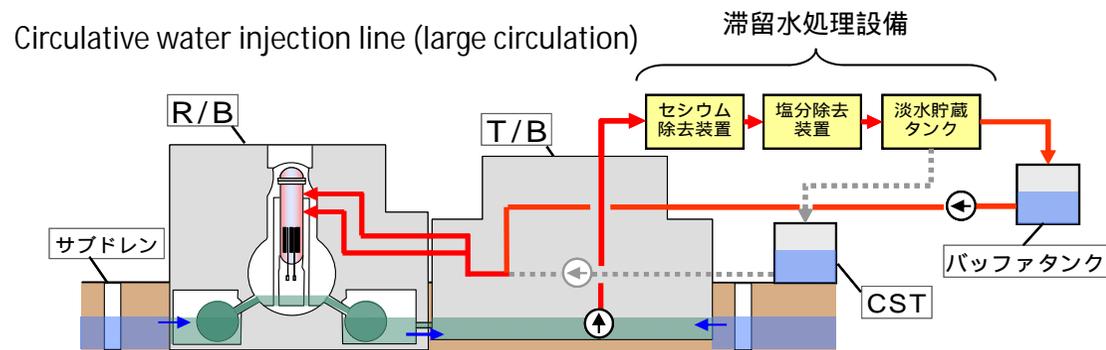
Rough picture indicating the process of removing the fuel debris

## ❑ Keep the cold shutdown state

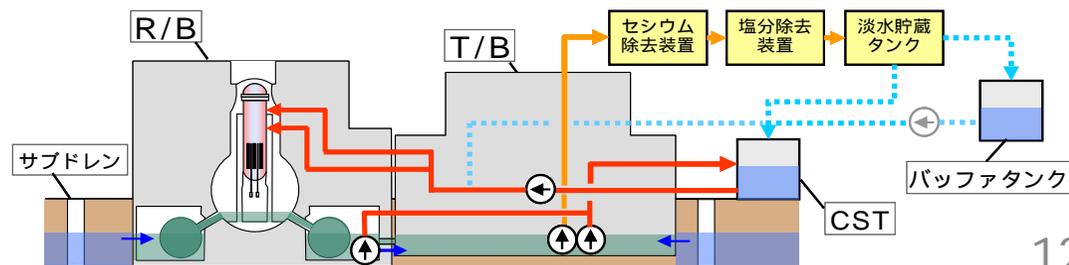
- Improve backup system of the monitoring temperatures in the PCVs and RPVc

## ❑ Improving to small circulation loop

- Completion of constructing circulation loop in buildings by the end of FY2014
- Study of constructing a small circulation loop (containment vessel circulative cooling) of the reactor water injection line



Circulation loop in building

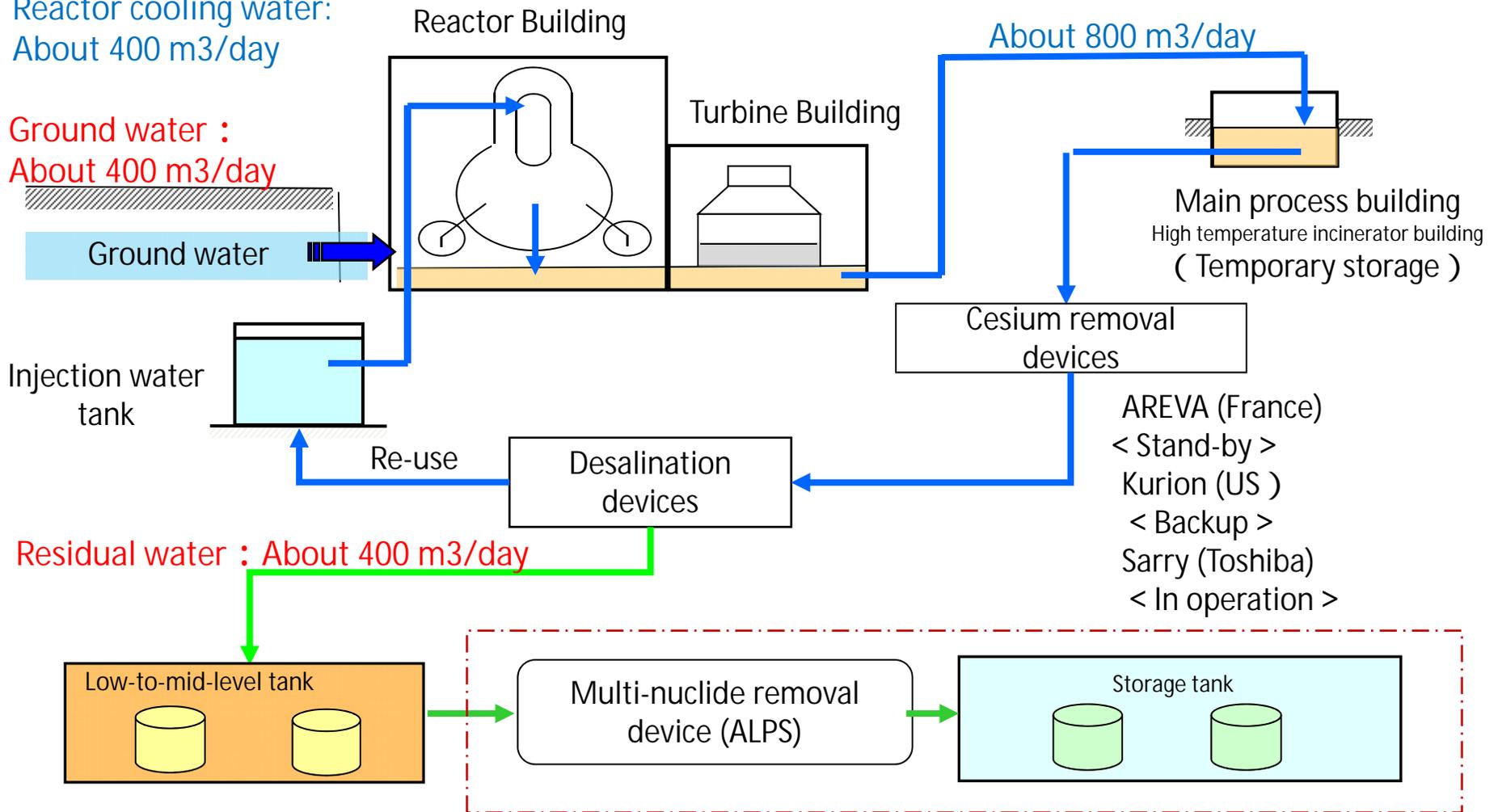


# Contaminated Water Treatment 1/2

## < Overview of the System >

Reactor cooling water:  
About 400 m<sup>3</sup>/day

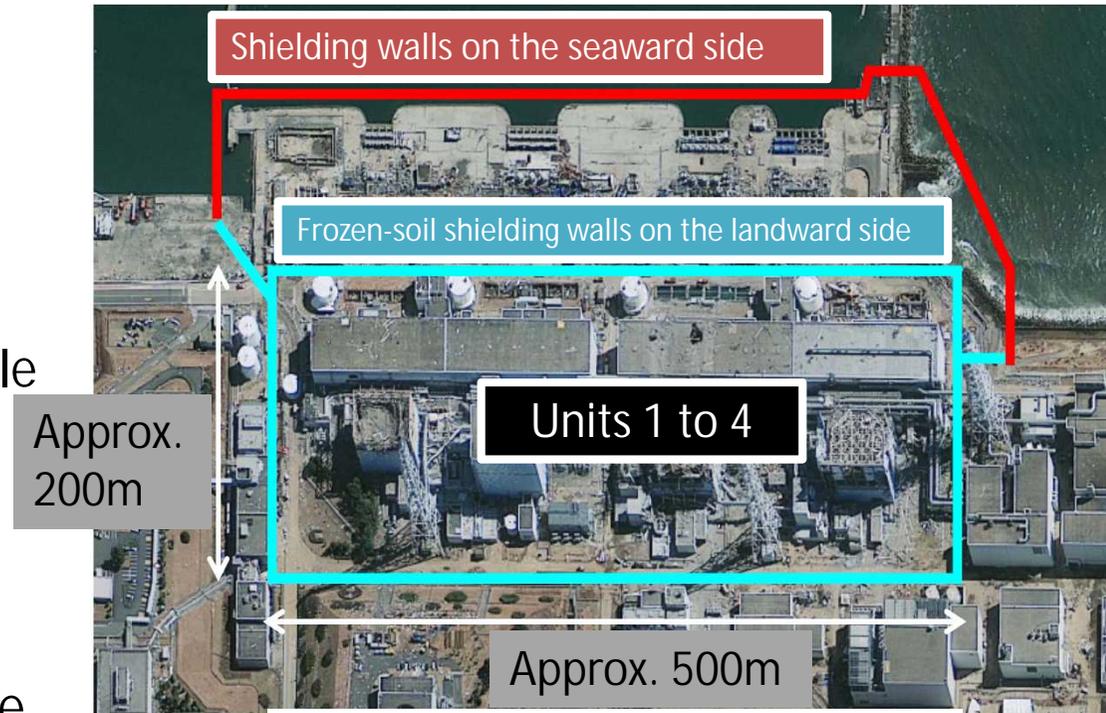
Ground water :  
About 400 m<sup>3</sup>/day



# Contaminated Water Treatment 2/2

Discharging of contaminated water into the ocean will not be implemented lightly.

1. Bypass of the under ground water
  - Construction is completed. Waiting for the local public acceptance.
2. Restoring the sub-drain
  - Under construction (for clean-up)
3. Frozen-soil shielding walls
  - Feasibility Study
4. Improvement of the capacity and stable operation of contaminated water treatment facilities
  - Operation of multi-nuclide removal equipment
5. Construction of new tanks to manage contaminated water
  - Increase the capacity to 0.8 million m<sup>3</sup> by FY2016



[Plan to construct shielding walls on the landward side]

# Reducing Radiation Doses of Entire Plant and Preventing Expansion of Contamination

- ❑ In order to prevent expansion of ocean contamination, the shielding walls on the seaward side will be constructed by the middle of FY2014.
- ❑ Countermeasure for increased concentration of radionuclides in groundwater near the seawall
  - Strengthening monitoring (including investigation of contamination routes, land improvement to prevent the expansion of contamination, and removal of contaminated water in the trench on the seaward side.
- ❑ Waste management and radiation dose reduction at the boundaries of the site will be continued.

- ❑ Proper Management and Reduction of Radioactive Waste
  - Proper waste management in consideration of environmental effect in and outside the site
  - Priority of waste management: Reduce the amount carried in > Minimize waste generation > Reuse > Recycle
  
- ❑ Processing and Disposal of Radioactive Waste
  - R&D for characterizing and analyzing waste properties will be promoted to explore processing and disposal methods.
  
- ❑ Decommissioning Scenarios
  - Decommissioning scenarios will be considered and established through gathering worldwide information on how to ensure safety of decommissioning in consideration of end state of facilities.

## □ Personnel Plan

- The number of personnel required is estimated at a same level for the next three years.
- Because it will be necessary to work under much higher dose rates in the mid-and-long-term, personnel plans will be reviewed when the Roadmap is revised.

## □ Improving Work Environment and Conditions

- Work safety and health management: Improvement of rest area, heat stroke preventive measures, ensuring of the medical system, etc.
- Radiation control: Expansion of areas where a full-face mask is not required, improving exit/entrance bases, etc.
- Efforts to ensure appropriate working conditions: Education concerning the ensuring of working conditions, survey on efforts made by prime contractors concerning working conditions, etc.

# Coexistence with Local Communities and Communication with All Levels of Citizens

## □ Coexistence with Local Communities

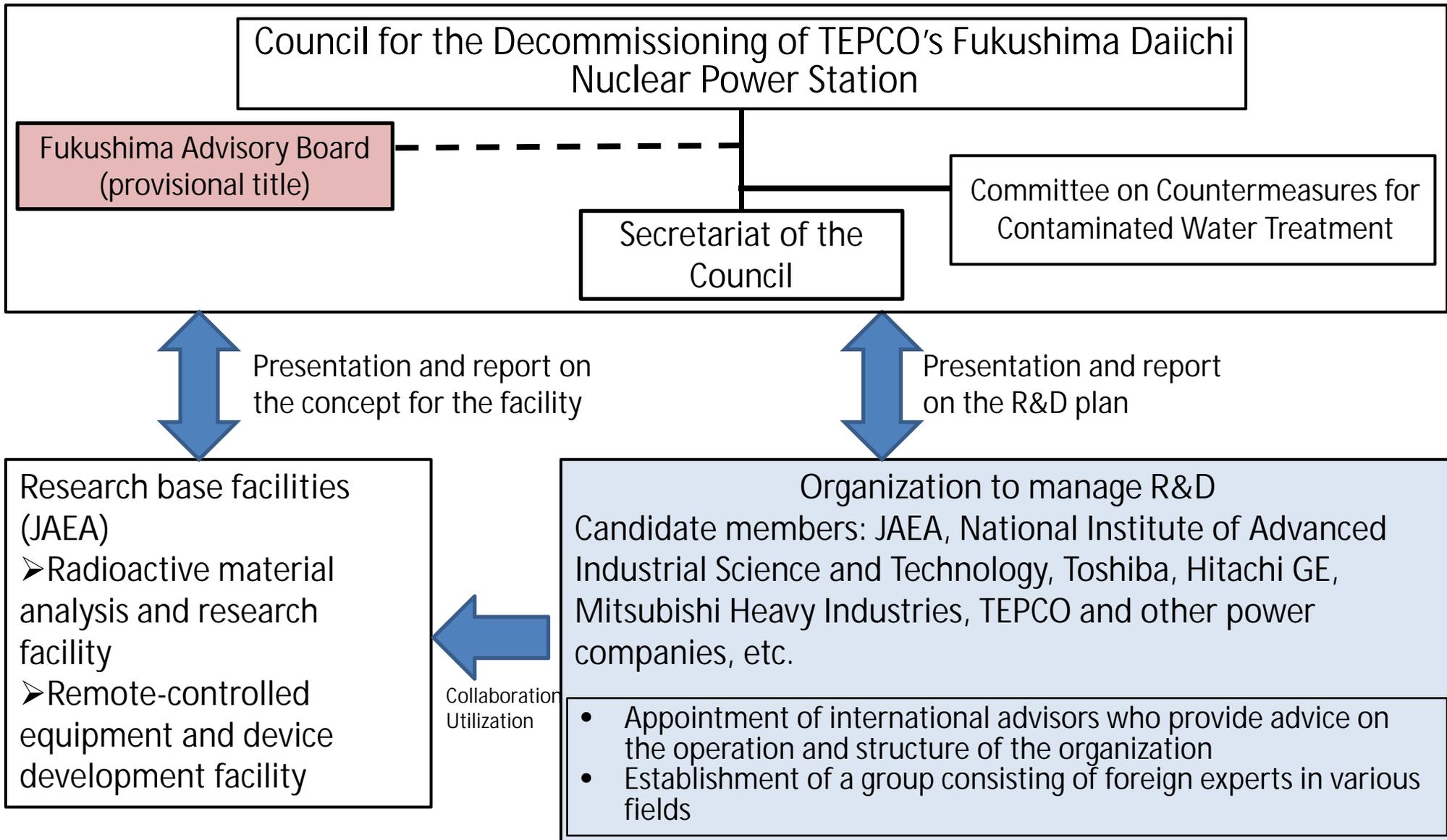
- Provide opportunities to participate in the decommissioning work
- Foster local companies that supply required equipment and machinery on a long-term basis
- Promote to set up new companies to revitalize local economies.

## □ Strengthen the provision of information and communications

- Establish the Fukushima Advisory Board (provisional title), with the participation of Fukushima Prefecture, surrounding local governments, relevant local organizations, and experts in the field of regional development and communications
- Enhance the PR activities for citizens and society

- ❑ Systematic promotion of R&D Plan
  - Removal of the fuel from the spent fuel pool
  - Preparation for the removal of the fuel debris
  - Processing and disposal of radioactive waste
  
- ❑ Establishment of an organization to manage R&D activities
  - Establish an organization to manage R&D activities in an integrated way
  - Gathering international expertise
    - international advisors, international decommissioning expert group
  
- ❑ Human resource development
  - Promote human resource development by setting priority fields and core bases from mid-and-long-term perspective.

# Structure to promote R&D



# R&D for preparation of fuel debris removal

## Development of remote decontamination technology on the reactor buildings



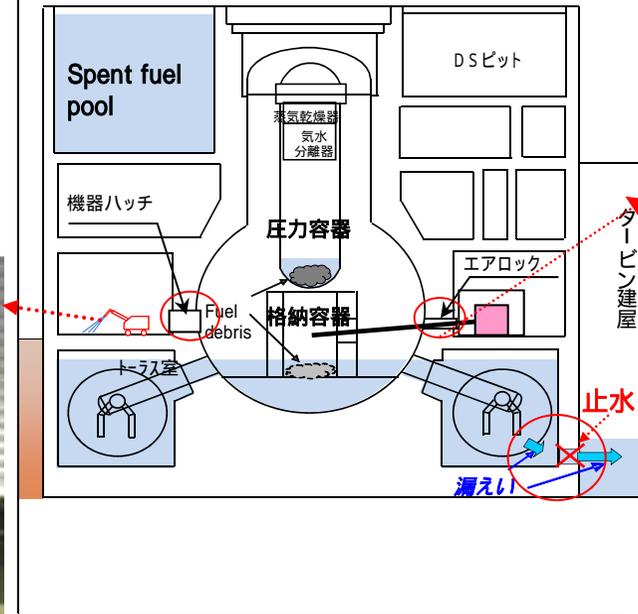
High water pressure



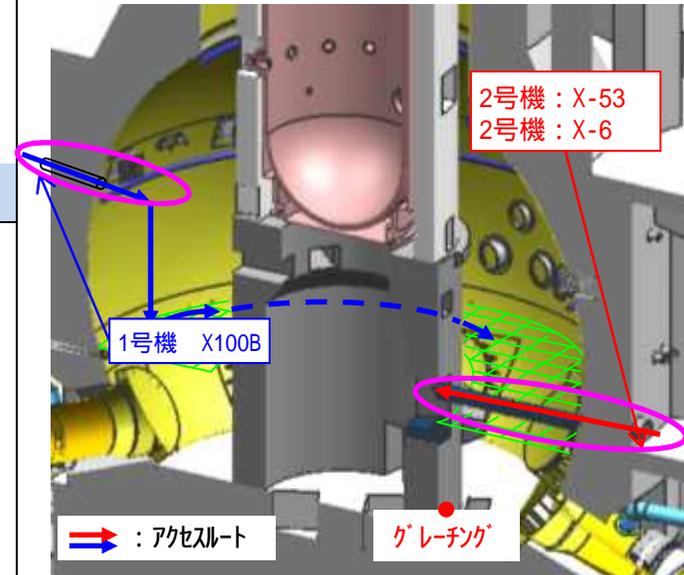
Dry-ice blasting



Blasting and vacuuming



## Development of investigation technology of inside PCV

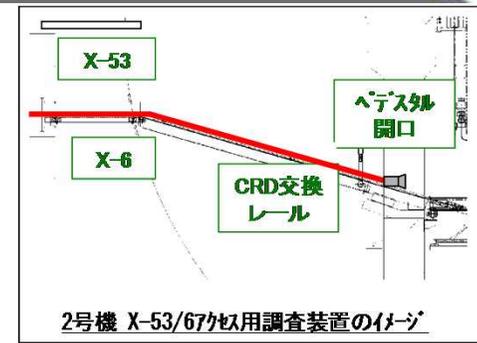


2号機 : X-53  
2号機 : X-6

1号機 X100B

グレーチング

⇒ : アクセルート



2号機 X-53/67号機用調査装置のイメージ

# International Cooperation

- ❑ Gathering the knowledge and expertise from Japan and abroad
- ❑ Sharing information and implement the decommissioning in transparent manner with international community
  - Recognize responsibility of this accident occurred country
- ❑ Gathering international expertise for the R&D management organization
  - Appoint international advisors
  - Establish an international collaboration department
  - Establish an international decommissioning expert group
- ❑ Improving an environment that encourages participation of overseas research institutions and businesses
- ❑ Multilateral and bilateral international cooperation

Thank you for your attention!

**Tatsuya Shinkawa**

Director, Nuclear Accident response Office,  
Agency for Natural Resources and Energy, METI

[shinkawa-tatsuya@meti.go.jp](mailto:shinkawa-tatsuya@meti.go.jp)