

**Panel Discussion:**  
**Strategy, Planning and Licensing of  
Facilities and Activities for RWM**

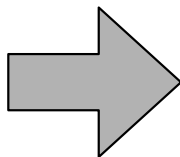
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# Characteristics of the waste after the accident

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- Influence of injected sea water
  - Sea water affect disposal, corrosion
  - Influence of injected chemicals to protect corrosion
- Influence of injected boron, etc.
  - Boron affect the environment (consider when disposal)
- A great variety of radioactive waste
  - Radioactive materials were carried by hydrogen explosions
  - Non radioactive waste change into radioactive waste
- Influence of core melt down
  - Nuclides originated fuel distributed various place in plant
  - All waste is treated as trans-uranium waste ??

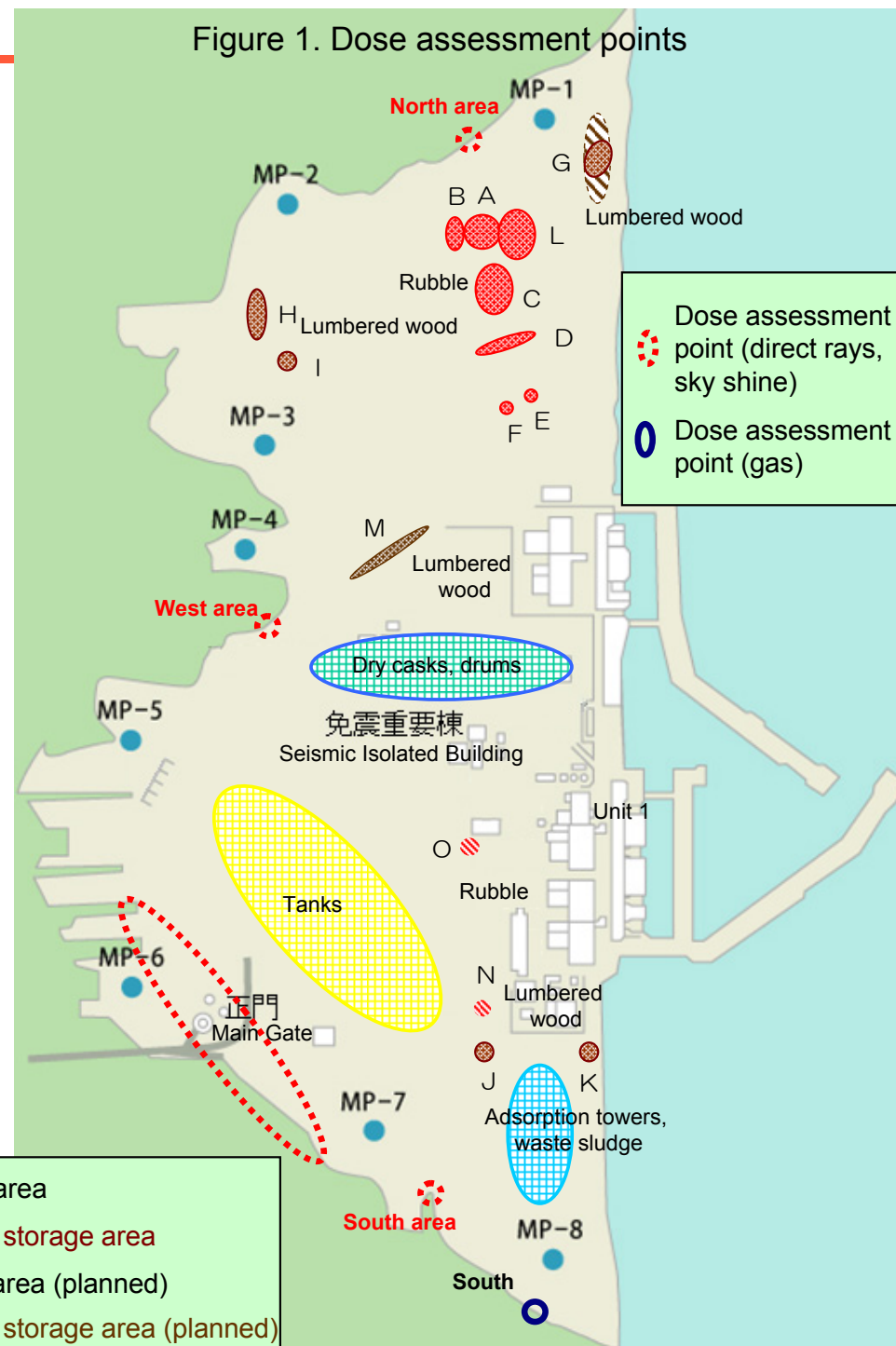


**R&D consider these characteristics**

# Plan to reduce site boundary dose

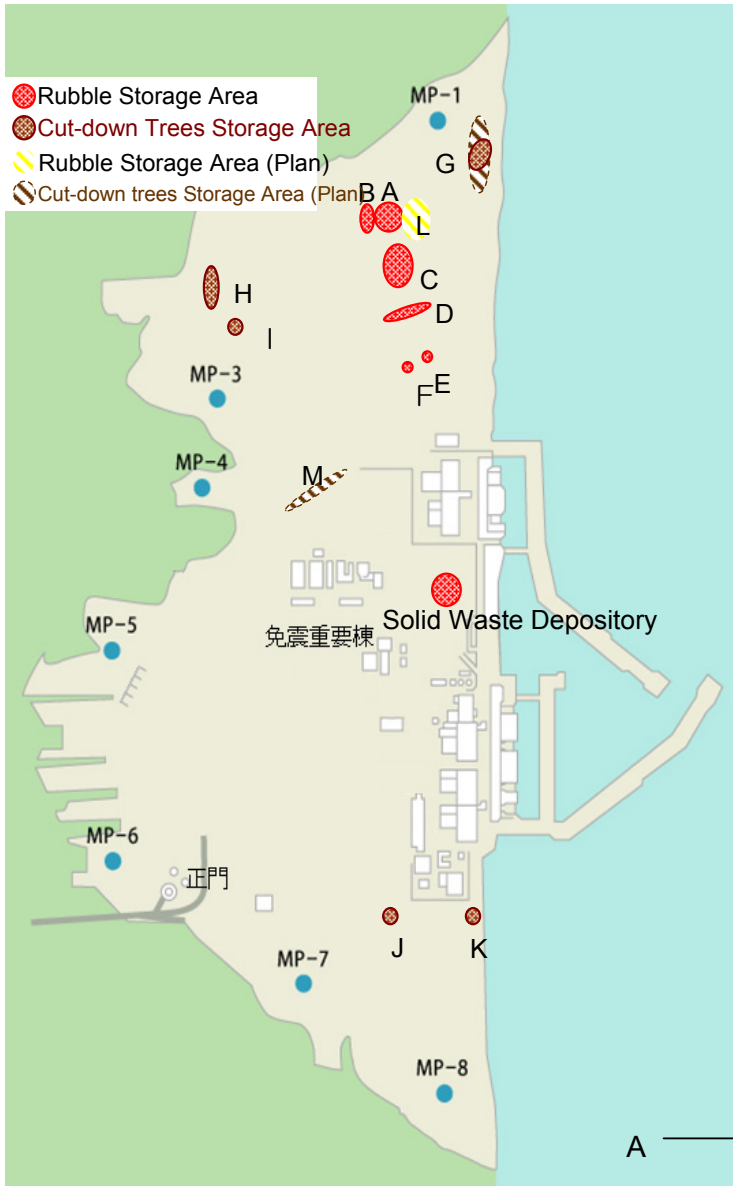
The plan calls for various dose reduction measures to be implemented to aim for the total assessment value of site boundary dose (gas, liquid, and solid) from newly released radioactive materials and radwaste generated after the accident to be less than 1mSv/year.

- Closing Unit 2 blow out panel opening
- Installing multi-nuclide removal system and related shielding
- Installing soil covered temporary storage facility and move rubble to the facility
- Moving rubble to locations away from site boundary
- Covering lumbered trees with soil
- Installing shielding for spent cesium adsorption vessels and move such vessels



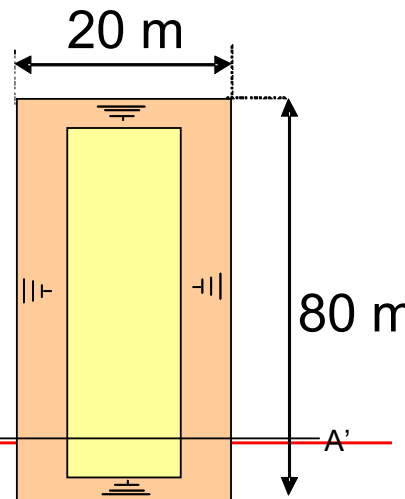
# Processing and Disposal of Waste

- ✓ 49,000 m<sup>3</sup> of concrete/metal and 61,000 m<sup>3</sup> of Cut-down trees are stored.
- ✓ Temporary storage facilities with shielding measures using soil and sandbags, etc were built to reduce radiation dose at the site boundaries.

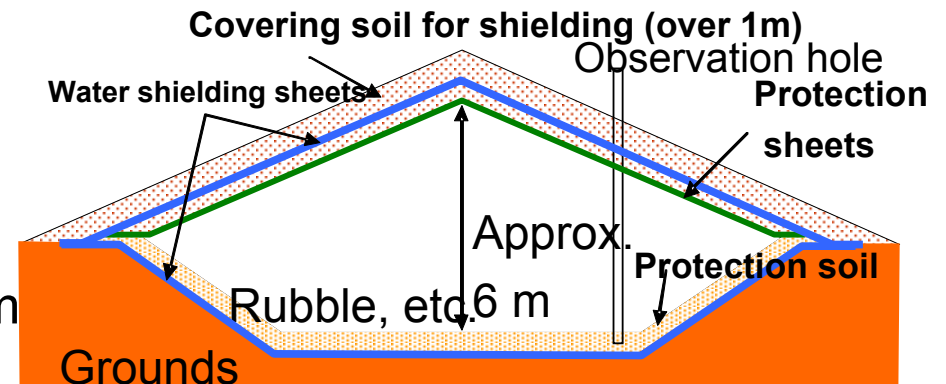


Storage Area	Type	Storage Method	Amount	Area Occupancy
Solid Waste Depository	Concrete, Metal	Container	2,000 m <sup>3</sup>	35%
A: Northern Site	Concrete, Metal	Temporary Storage Facility	11,000 m <sup>3</sup>	98%
B: Northern Site	Concrete, Metal	Container	4,000 m <sup>3</sup>	98%
C: Northern Site	Concrete, Metal	Outdoor Yard	20,000 m <sup>3</sup>	03%
D: Northern Site	Concrete, Metal	Outdoor Yard	2,000 m <sup>3</sup>	66%
E: Northern Site	Concrete, Metal	Outdoor Yard	3,000 m <sup>3</sup>	90%
F: Northern Site	Concrete, Metal	Container	1,000 m <sup>3</sup>	98%
L: Northern Site	Concrete, Metal	Covering Soil Type Temporary Storage Facility	2,000 m <sup>3</sup>	25%
Total(Concrete, Metal)			49,000 m <sup>3</sup>	76%
G: Northern Site	Cut-down trees	Outdoor Yard	16,000 m <sup>3</sup>	63%
H: Northern Site	Cut-down trees	Outdoor Yard	16,000 m <sup>3</sup>	83%
I: Northern Site	Cut-down trees	Outdoor Yard	11,000 m <sup>3</sup>	100%
J: Southern Site	Cut-down trees	Outdoor Yard	12,000 m <sup>3</sup>	77%
K: Southern Site	Cut-down trees	Outdoor Yard	5,000 m <sup>3</sup>	100%
M: Western Site	Cut-down trees	Outdoor Yard	6,000 m <sup>3</sup>	28%
Total(Cut-down trees)			71,000 m <sup>3</sup>	74%

Plain View



A-A' Cross-section View



Overview of Covering Soil Type Temporary Storage Facility

# Example of radioactive waste

Scene	Waste	Dose rate [mSv/h]	Volume of the waste
Treatment for contaminated water	Sludge	Approx $10^3$	597 m <sup>3</sup>
	Zeolite	Approx $10^4$ at vessel surface	460 vessel
	Concentrated liquid waste	Approx $10^4$ beta ray	Approx 200,000 m <sup>3</sup>
Actives for plant restoration	Debris	Approx from $10^{-3}$ to $10^3$	Approx 54,000 m <sup>3</sup>
	Logged tree, Soil	Approx from $10^{-3}$ to $10^3$	Approx 69,000 m <sup>3</sup>
	Liquid waste from decontamination	Investigation from now on	—
Dismantling	Waste from decommissioning, decontamination	Investigation in the future	—

As in the end of Nov., 2012

# Examples of secondary waste produced by the treatment of contaminated water



Sludge (made by JAEA)



Tank for concentration liquid waste



Cesium adsorption vessel



Zeolite



# Examples of Debris

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removal



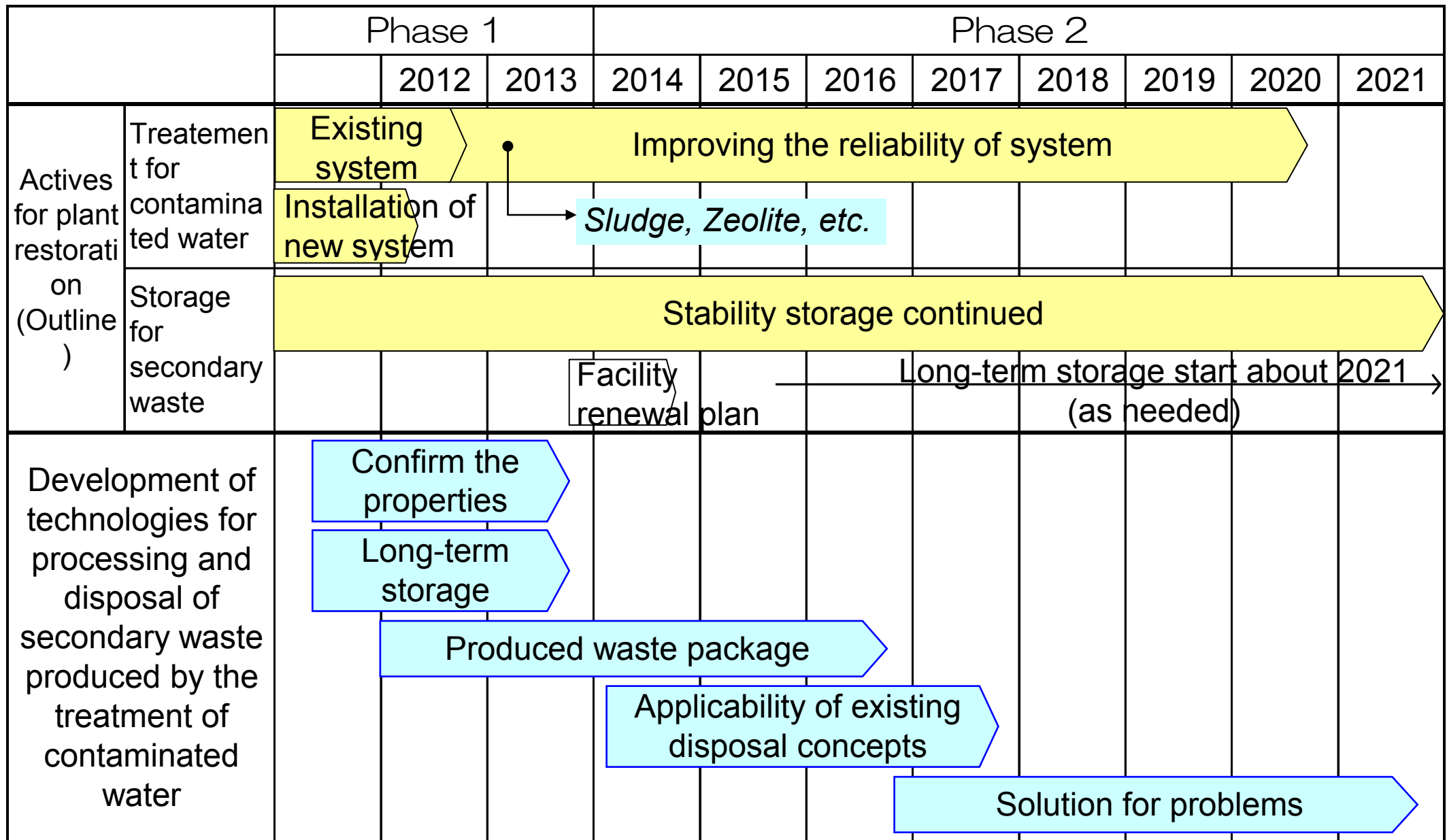
Between Unit 2 and 3



Inside of tent

Area of accumulated debris

# R&D for Secondary waste produced by the treatment of contaminated water





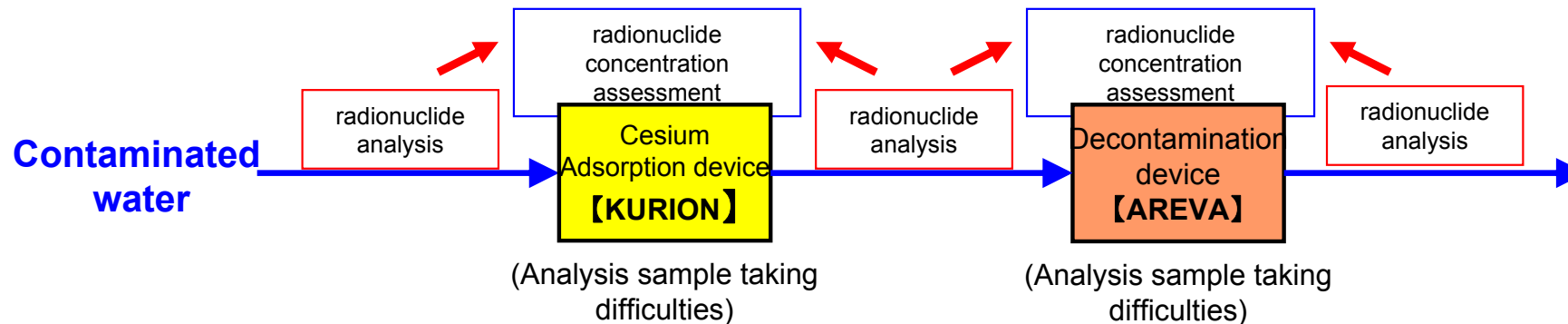
# Contaminated water treatment system / Sampling points for radioactive analysis

## Contaminated water analysis objective:

- Assessment of the concentration of radionuclide in waste zeolite and sludge, etc.

Difficulties with sampling waste zeolite/sludge directly: High dose, difficulties with remote operation.

⇒ Indirectly assessed from the radionuclide analysis of water samples taken from upstream and downstream of contaminated water treatment devices.



## Radionuclide to be analyzed

- Radionuclide important when considering waste disposal(38 nuclide)

$\gamma$  nuclide: Co-60, Nb-94, Cs-137, Eu-152, Eu-154

$\beta$  nuclide: H-3, C-14, Cl-36, Ca-41, Ni-59, Ni-63, Se-79, Sr-90, Zr-93\*, Mo-93\*,

Tc-99, Pd-107\*, Sn-126\*, I-129, Cs-135\*, Sm-151\*, Pu-241

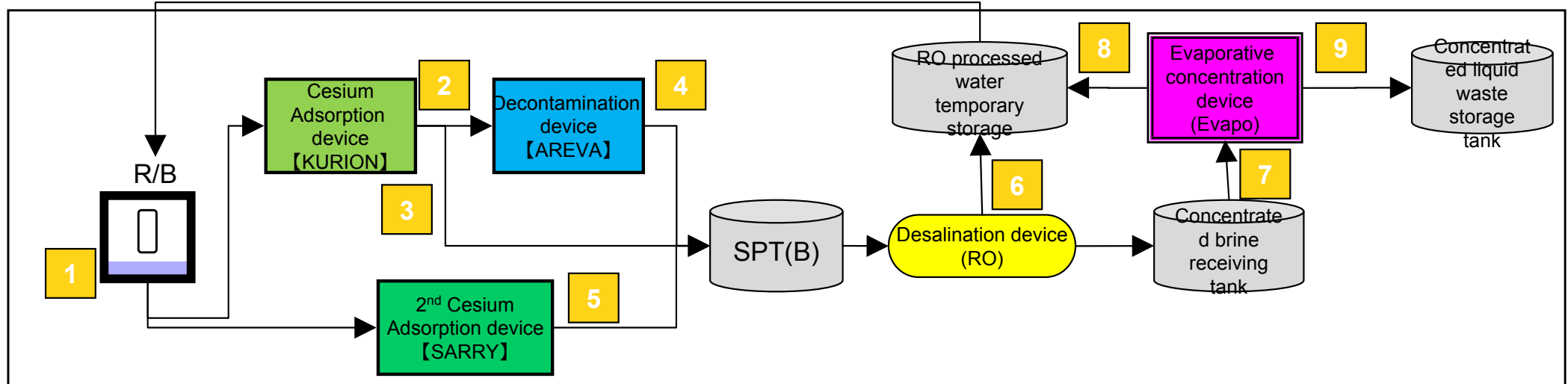
$\alpha$  nuclide: U-233, 234, 235, 236, 238, Np-237, Pu-238, 239, 240, 242,

Am-241, 242m, 243, Cm-244, 245, 246

\*Development of analysis technology necessary, R/D will be implement

# Contaminated water treatment system / Sampling points for radioactive analysis

## Sampling tank points



No.	1	2	3	4	5
Sample Name	Concentrated RW basement highly contaminated water (Accumulated water)	Water after cesium adsorption device Processing (Continuous)	Water after cesium adsorption device Processing (Single)	Water after decontamination device processing	Water after 2 <sup>nd</sup> cesium adsorption device processing
	6	7	8	9	
	Desalination device outlet water	Evaporative concentration device inlet water	Evaporative concentration device outlet water	Evaporative concentration device concentrated waste water	

## Analysis conditions

- **Sample amount:** 5ml/sample
- **Minimum detection limit:** 0.5 Bq/ml (Minimum detection limit lowered for radionuclide for which it can be lowered)
- In order to effectively leverage resources (analysts, equipment, time, etc.) and efficiently proceed with the radionuclide analysis of Fukushima accident waste, **No.2~8 analysis shall be omitted when No.1,9 radioactivity concentration were below minimum detection limits.**

# Challenges

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## 1. Sampling of debris, logged trees

Waste grouping method, Number of sample, Typical sample

## 2. Influence and measure for chlorides

- If we except chlorides in the waste, how treated with chloride isotopes.
- Reasonable disposal method for chloride

## 3. Sampling of zeolite inside of cesium adsorption vessel

Because of strong structure and high dose rate, it is difficult to sampling and it is necessary for exclusive instrument to sampling

## 4. Selection for important nuclides on safety evaluation

Especially in this accident, which nuclide we should consider

## 5. Systematize and prioritize for processing and disposal of a great variety of waste<sup>2</sup>

# Examples of Lessons learned from Foreign Organization

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## ■ Integrated Waste Management

- ✓ Fukushima Daiichi(1F)-specific waste management strategy is needed. It has to be regarded as key principles in designing decommissioning procedures.
- ✓ The waste management strategy should include not only **long-term storage** but also **re-using** and **recycling** of materials. The facility and site plans should be established considering their prioritization.
- ✓ Precise estimations of the future waste generation is important in long-term decommissioning planning. Close communication between **decommissioning process management-** and **waste management-**teams is indispensable.