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

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# Characteristics of the waste after the accident

- 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 ??

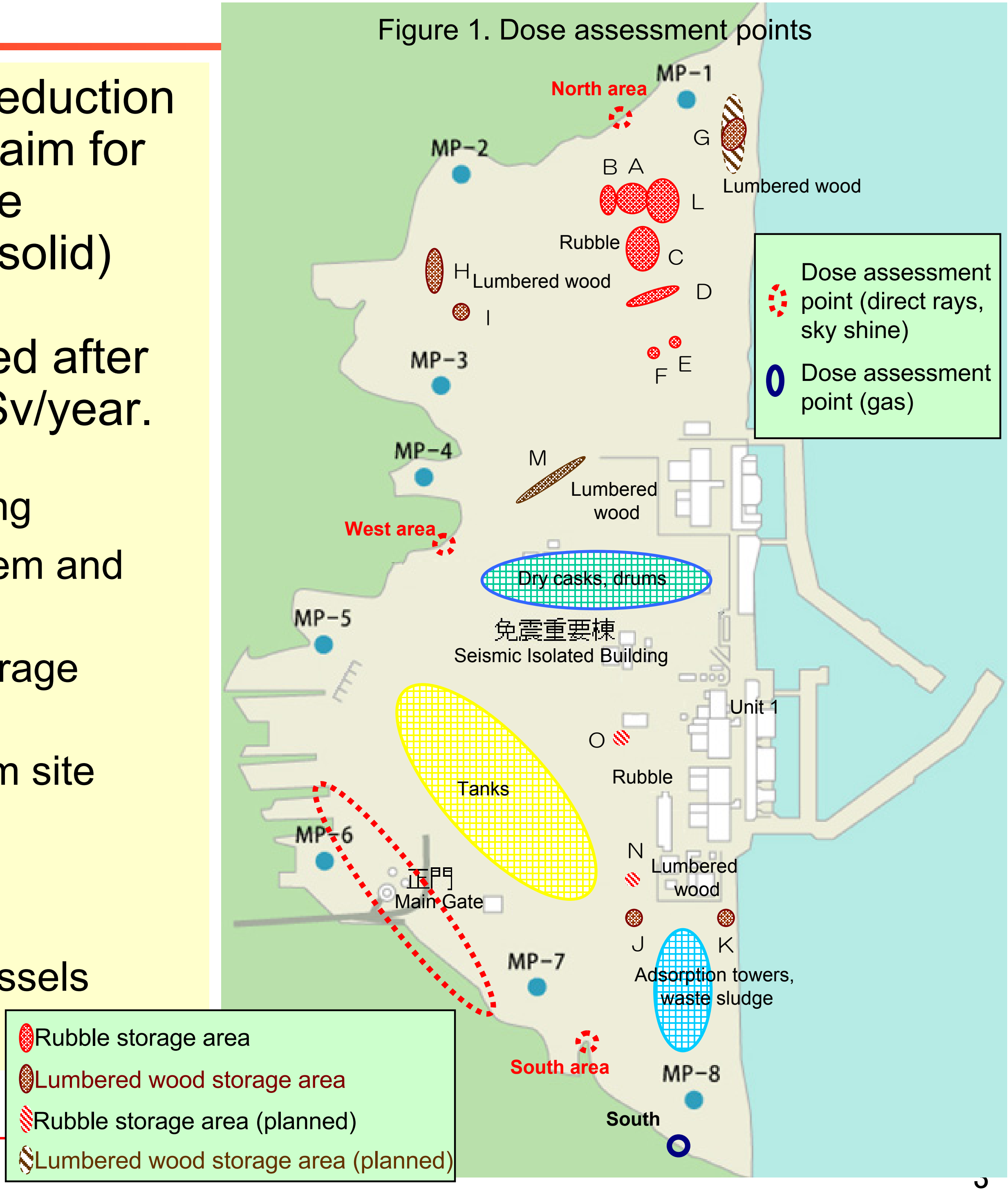
→ **R&D consider these characteristics**

# 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.

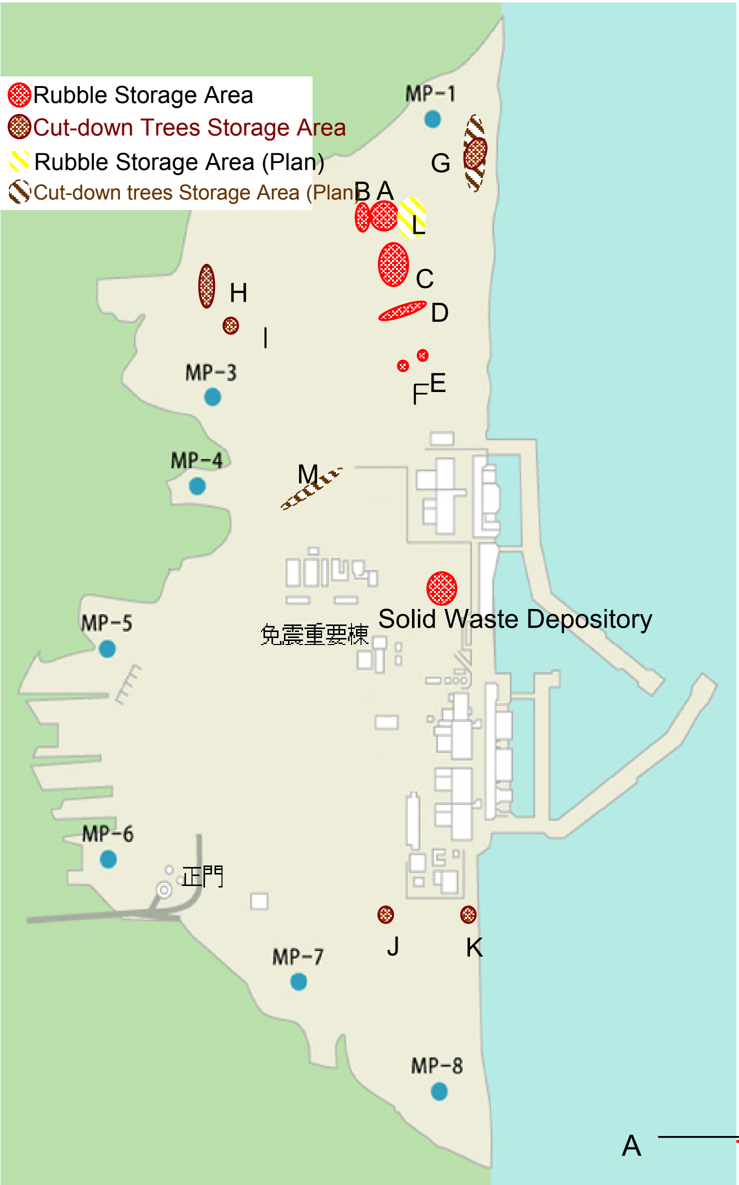
- Closing Unit 2 blow out panel opening
- Installing multi-nuclide removal system and related shielding
- Installing soil covered temporary storage facility and move rubble to the facility
- Moving rubble to locations away from site boundary
- Covering lumbered trees with soil
- Installing shielding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

Figure 1. Dose assessment points



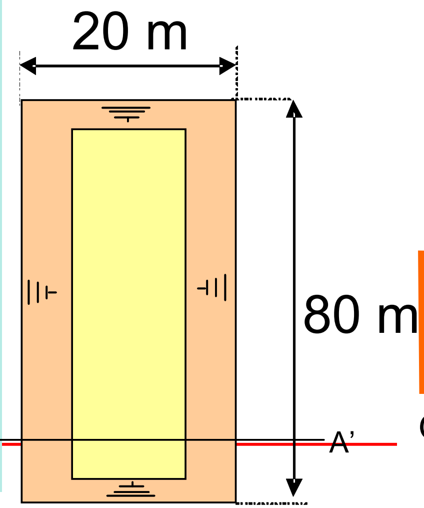
# Processing and Disposal of Waste

- ✓ 49,000 $m^3$ of concrete/metal and 61,000 $m^3$ 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.

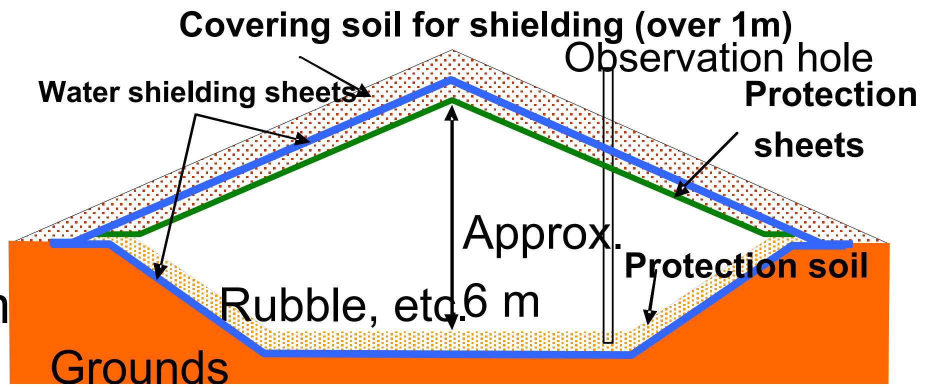



| Storage Area | Type | Storage Method | Amount | | Area Occupancy |
|---|---|---|---|---|---|
| Solid Waste Depository | Concrete,Metal | Container | 2,000 | $m^3$ | 35% |
| A: Northern Site | Concrete,Metal | Temporary Storage Facility | 11,000 | $m^3$ | 96% |
| B: Northern Site | Concrete,Metal | Container | 4,000 | $m^3$ | 86% |
| C: Northern Site | Concrete,Metal | Outdoor Yard | 20,000 | $m^3$ | 00% |
| D: Northern Site | Concrete,Metal | Outdoor Yard | 2,000 | $m^3$ | 66% |
| E: Northern Site | Concrete,Metal | Outdoor Yard | 3,000 | $m^3$ | 90% |
| F: Northern Site | Concrete,Metal | Container | 1,000 | $m^3$ | 99% |
| L: Northern Site | Concrete,Metal | Covering Soil Type Temporary Storage Facility | 2,000 | $m^3$ | 25% |
| Total(Corcrete,Metal) | | | 49,000 | $m^3$ | 76% |
| G: Northern Site | Cut-down trees | Outdoor Yard | 18,000 | $m^3$ | 63% |
| H: Northern Site | Cut-down trees | Outdoor Yard | 16,000 | $m^3$ | 93% |
| I: Northern Site | Cut-down trees | Outdoor Yard | 11,000 | $m^3$ | 100% |
| J: Southern Site | Cut-down trees | Outdoor Yard | 12,000 | $m^3$ | 77% |
| K: Southern Site | Cut-down trees | Outdoor Yard | 5,000 | $m^3$ | 100% |
| M: Western Site | Cut-down trees | Outdoor Yard | 6,000 | $m^3$ | 29% |
| Total(Cut-down trees) | | | 71,000 | $m^3$ | 74% |

Plain View




A-A' Cross-section View



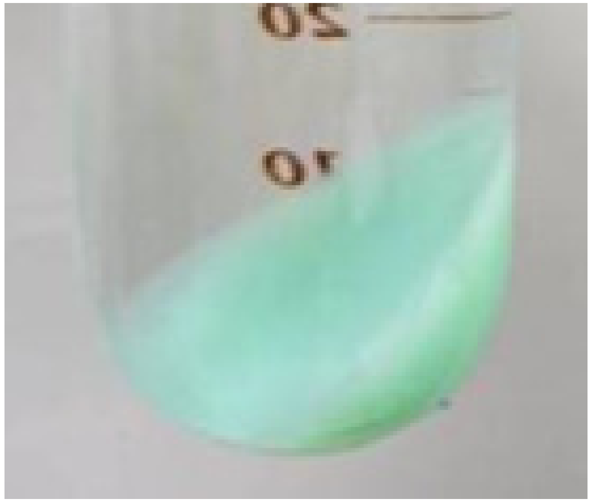

Overview of Covering Soil Type Temporary Storage Facility

# Example of radioactive waste

| Scene | Waste | Dose rate [mSv/h] | Volume of the waste |
|---|---|---|---|
| Treatment for contaminated water | Sludge | Approx $10^3$ | 597 $m^3$ |
| | Zeolite | Approx $10^4$ at vessel surface | 460 vessel |
| | Concentrated liquid waste | Approx $10^4$ beta ray | Approx 200,000 $m^3$ |
| Actives for plant restoration | Debris | Approx from $10^{-3}$ to $10^3$ | Approx 54,000 $m^3$ |
| | Logged tree, Soil | Approx from $10^{-3}$ to $10^3$ | Approx 69,000 $m^3$ |
| | 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）

Cesium adsorption vessel

Zeolite

Tank for concentration liquid waste

# Examples of Debris

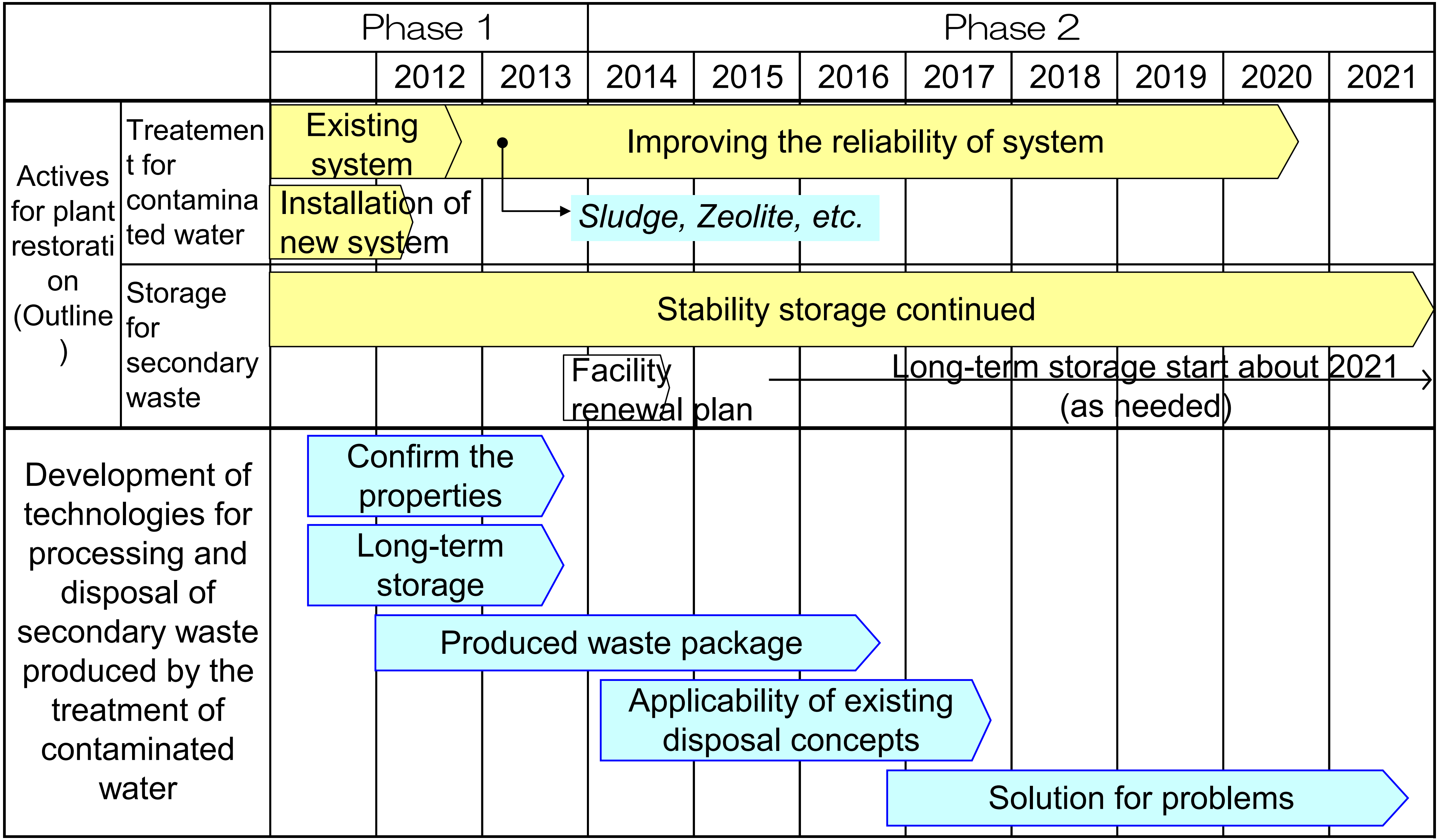
removal

Between Unit 2 and 3

Inside of tent

Area of accumulated debris

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



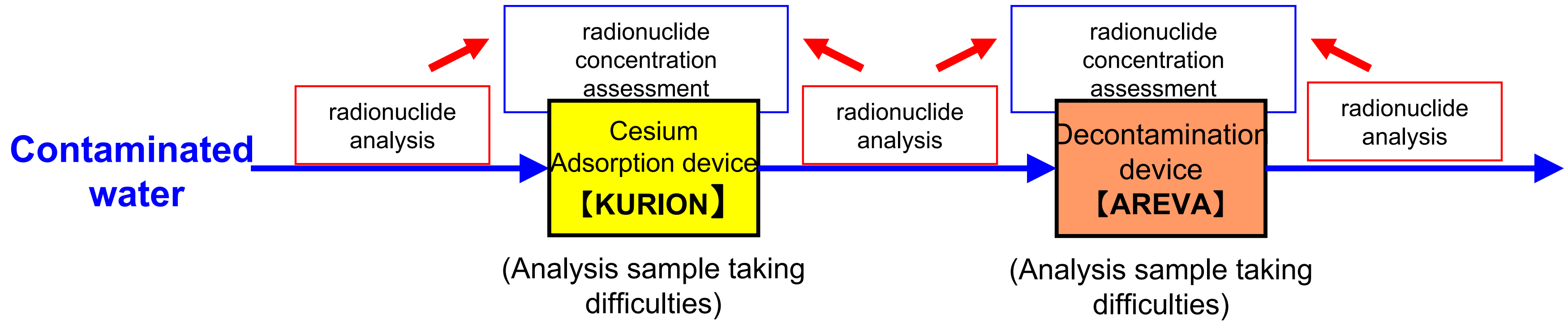
# Contaminated water treatment system / Sampling points for radioactive analysis

## 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

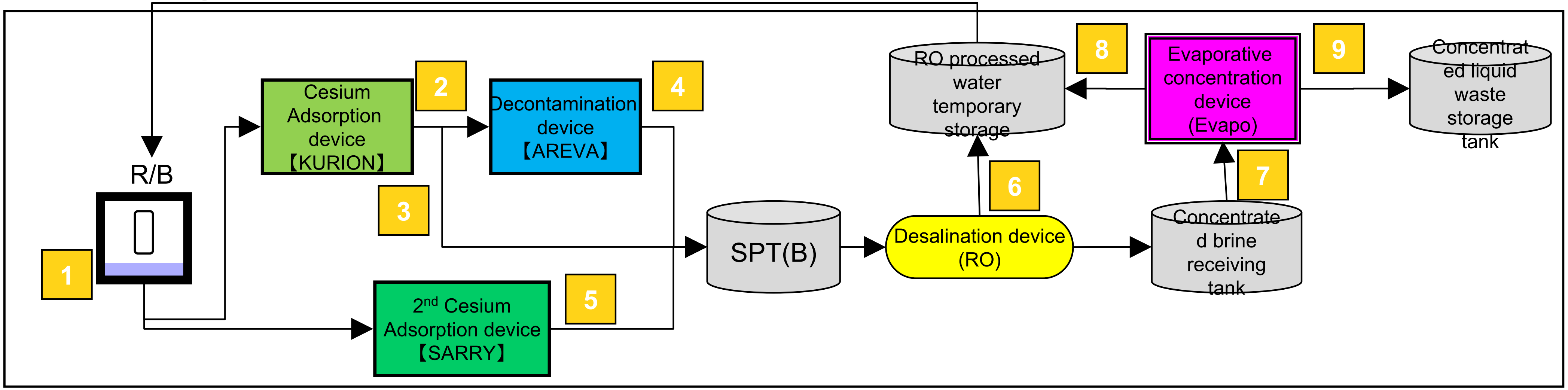
$\beta$ nuclide : H-3, C-14, Cl-36, Ca-41, Ni-59, Ni-63, Se-79, Sr-90, Zr-93*, Mo-93*, Tc-99, Pd-107*, Sn-126*, I-129, Cs-135*, Sm-151*, Pu-241

$\alpha$ 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 2nd 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

**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 waste2**

# Examples of Lessons learned from Foreign Organization

## 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 indispensible.