The International Forum on the
Decommissioning of the Fukushima Daiichi NPS

Analysis Strategy for Promoting Decommissioning

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Kazuyuki Kato
Managing Director

Nuclear Damage Compensation and Decommissioning Facilitation Corporation
（NDF)

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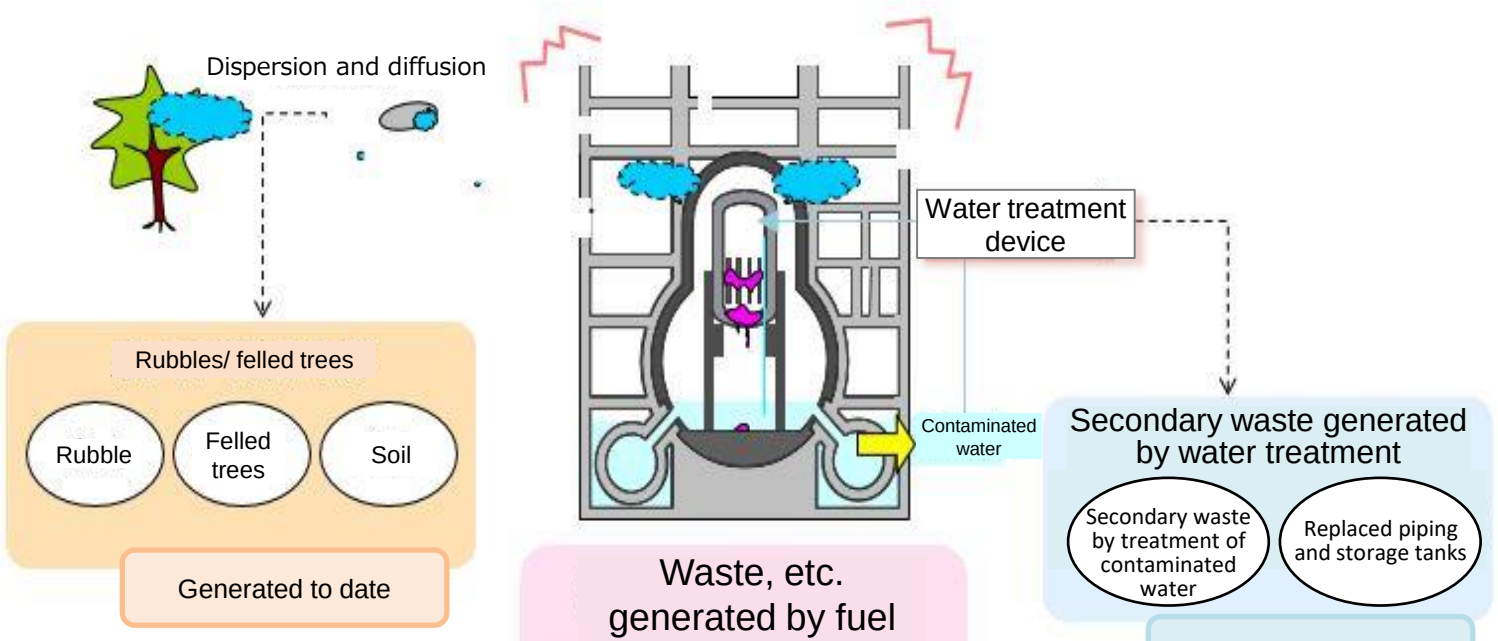
Overview of contaminant sources of solid waste and waste characteristics



- Large amount of material and widely distributed.
- Trees and soil have a limited record of processing/disposal
- Surface contamination by dispersion and diffusion mainly
- Permeation contamination through partially stagnant water
- Expecting scaling with Cs

- Large amount and high-does of material (high-βγ, high-α)
- Difficult to collect raw waste

- Limited record of processing/disposal
- Difficult to collect raw waste
- Some amount of generation and nuclides can be estimated depending on the characteristics of the device.

- Contaminated by seawater from tsunami, boron contained in boric acid solution, and chemical substances such as anti-dispersion agents, etc.

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Points on waste management at 1F for smooth decommissioning

Time-consuming and laborious due to diverse and a large physical volume of unconventional nuclide compositions.

- Volume reduction is important.
  → Introducing the waste hierarchy concept
- Time-consuming to characterize
  → Development of efficient analytical/evaluation methods
- Time-consuming to classify waste (How do they fit into the conventional categories? Or more reasonable to create a new classification?)
  → Considering optimization methods with uncertainty in mind through to disposal (without reworking)
- Identifying which existing technologies can be applied to which waste and to what extent
  → Consideration/improvement of the scope of application in various processing technologies

- It's not as difficult as to be get stuck, but it's taking long.
- It is necessary to revise the targets based on results as appropriate to address a large volume of waste in parallel with efforts to reduce the volume.

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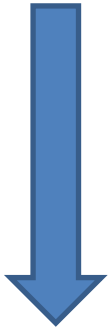
Current Situation of Characterization

Reconnaissance survey

Start Characterization
analyze the sample which we were able to gather

Detailed characterization



Inventory Estimation for R&D
- ✓ Integrated waste management strategy
- ✓ Propose rational regulatory system early

We are here

Confirmation monitoring

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Challenge of 1F Waste Characterization

After the accident (Start preliminary characterization)

✓ Regardless of priority, we carried out analysis from the sample which we were able to gather

No regulatory requirement

Integrated R&D for waste management

✓ Establishment of waste management strategy for 1F waste is required early (around FY2021) → **Regulatory System**

✓ Estimation of total inventory is basis for study disposal concept, processing technology and WAC etc.

✓ Some waste streams are difficult to sample

✓ Considering the limit of storage area, HVLAW is a critical issue

Because of huge volume of waste, time for analysis may be bottleneck of decommissioning

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Key Issues in Characterization

- Historical knowledge is lost
- Some waste streams are difficult to sample
- Needs to estimate total inventory of waste
- No regulatory requirement and WAC

- ✓ What is the priority of measurements (dose rate, gamma spectrometry, total alpha, concentration for each nuclide)?
- ✓ How to determine nuclides to be analyzed?
- ✓ How much analysis is enough?
- ✓ How to determine the priority of waste streams to be analyzed?

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Towards Efficient Characterization

How to accelerate the characterization on the condition that the number of data is limited

- **How to group waste streams**
  - ✓ Make small number of waste groups to lower the burden of processing/disposal
  - ✓ In case of lack of analysis data
  - ✓ New streams are expected to be generated by decommissioning activities
- **How to use analytical modelling**
  - ✓ Experiences (to what kind of waste?)
  - ✓ Statistical approach
- **No destructive analyses**
  - ✓ Possible method, experience
- **Conservative evaluation against uncertainty**
  - ✓ To avoid analysis, set enough conservatism is feasible?

To examine necessary analysis and evaluation with clear objectives efficiently is important

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Efficient Confirmation Monitoring

Especially for HVLAW, we will have options of clearance, limited use in the site etc. for the waste minimization. **In the confirmation monitoring phase (regulatory phase)**, efficiency of characterization is still important to achieve smooth decommissioning because of high volume of waste.

- **How to decrease the number of analysis**
  - ✓ Using analytical modelling (experience)
  - ✓ Conservative evaluation of nuclide concentration
  - ✓ Statistical approach
- **Experience of applying efficient analyzing method**
  - ✓ Simple and easy analyzing method
  - ✓ Automatic
- **What others?**

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Major targets and progress for solid waste

Major targets

- In a processing/disposal effort, processing/disposal strategies for solid waste and technical prospects on their safety should be made clear by around FY 2021.

Progress

Providing processing/disposal strategies for solid waste and technical prospects on their safety

a. **Present how to proceed with volume reduction** of solid waste

b. **Develop analytical/evaluation methods** for efficient characterization

c. **Establish a method for rationally selecting** safe **processing/disposal methods** for solid waste once necessary information including characterization is obtained

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Processing/disposal strategies for solid waste and technical prospects on their safety

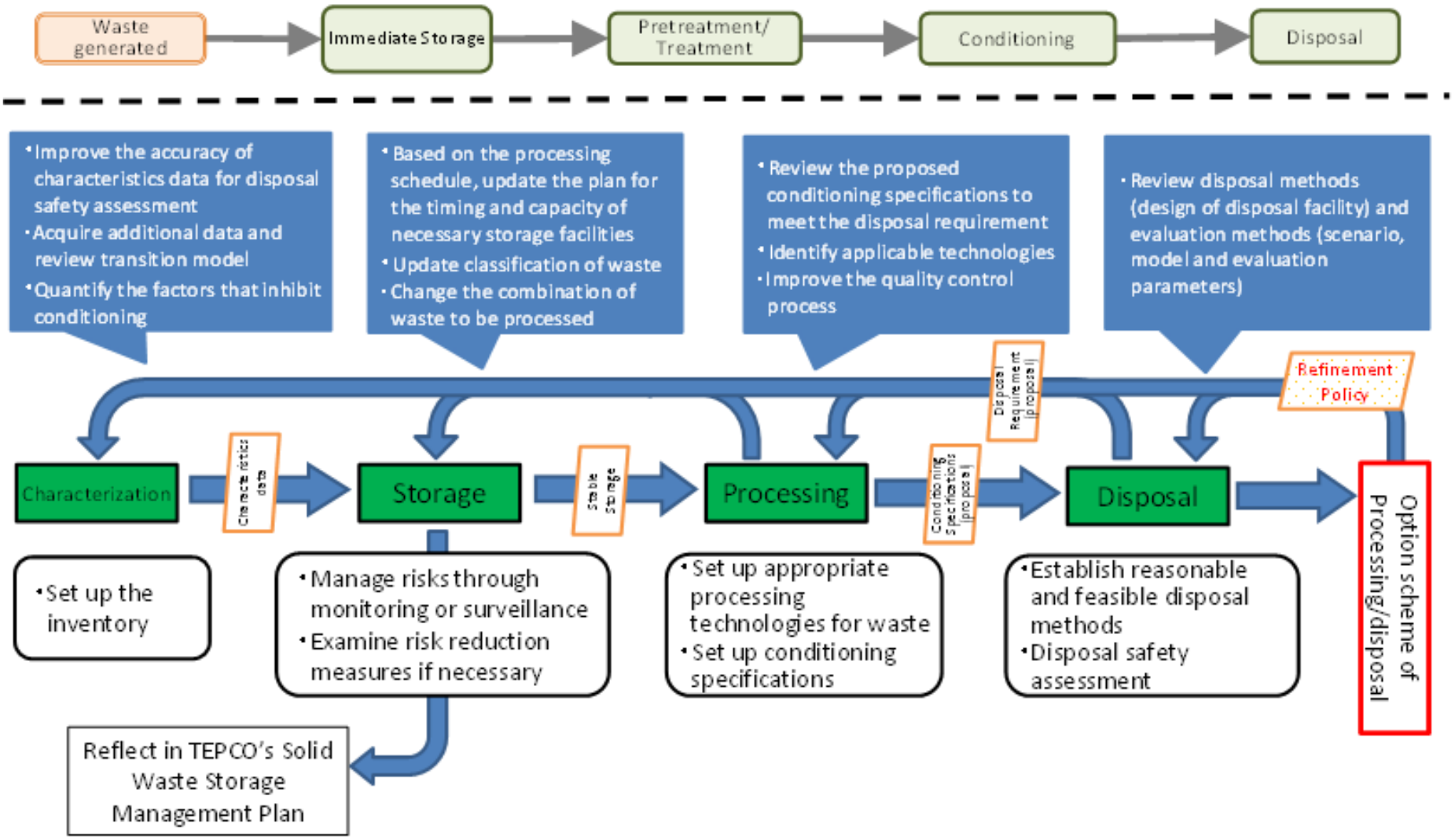

Fig. Development of methods to rationally select safe processing/disposal methods

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Result of major technology development : Characterization

1. Examining efficient analytical methods for characterization (mainly on hardware)

Simplify/accelerate analytical methods.

① The types of waste subject to characterization and nuclides to be evaluated were selected.

② Technology development for automating and accelerating characterization

③ Development of high-radiation dose sampling technologies

2. Consideration of characterization using statistical methods (mainly on software)

Enable efficient characterization using limited analytical data.

① Establishment of an analysis database management system (FRAnDLi)

② Establishment of statistical inventory estimation methods

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Technical strategy by sectors for waste management in the future

Characterization

- It is important to develop a medium-to-long-term analysis strategy that defines the solid waste to be analyzed, its priority, and quantitative targets for analysis, etc., and to proceed with analysis/evaluation accordingly.
- **Reasonable number of analyses for large volume low and medium activity waste**
- **Characterization strategy for high activity waste that is difficult to sample.**

Storage

- Thorough safe and rational storage.
- Secure storage capacity under the limitation of space (volume reduction、limited scope of dismantling ）

Processing/disposal

- In order to establish safe and reasonable processing/disposal methods, and to widely obtain knowledge for optimizing each individual waste stream, it is necessary to continue development/research of processing/disposal technologies required for the series of studies.
- Secure safety assurance measures for entire waste streams under large uncertainty.

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Diversifying Analysis methods against the requirements for the management of retrieved materials

Criticality

- Shape management or substance quantity management of storage package based on contents of nuclear material

Safeguards and Nuclear Material Protection

- Evaluate needs of safeguard and protection based on contents of nuclear material

Processing/disposal

- Evaluate needs of processing
- Allocate to the suitable disposal option

Fuel debris contains difficult-to-measure nuclides, interfering elements, immiscible materials, etc.

- Analytical Capability (Facility and Human Resource)
- Remote sampling technology
- In-situ analysis and non-destructive measurement methods to improve analytical results
- Statistical inventory estimation method

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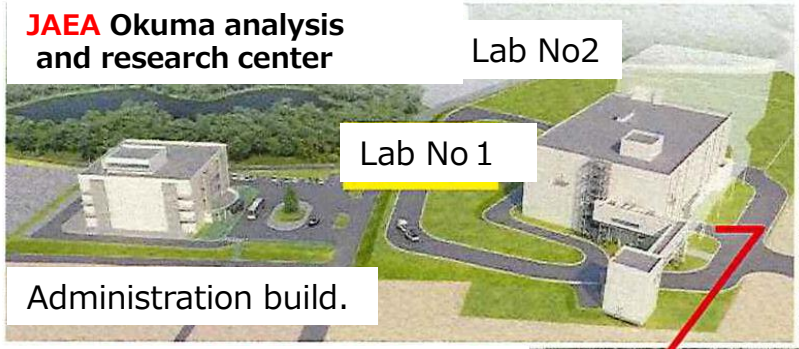
On Site Analysis Laboratories

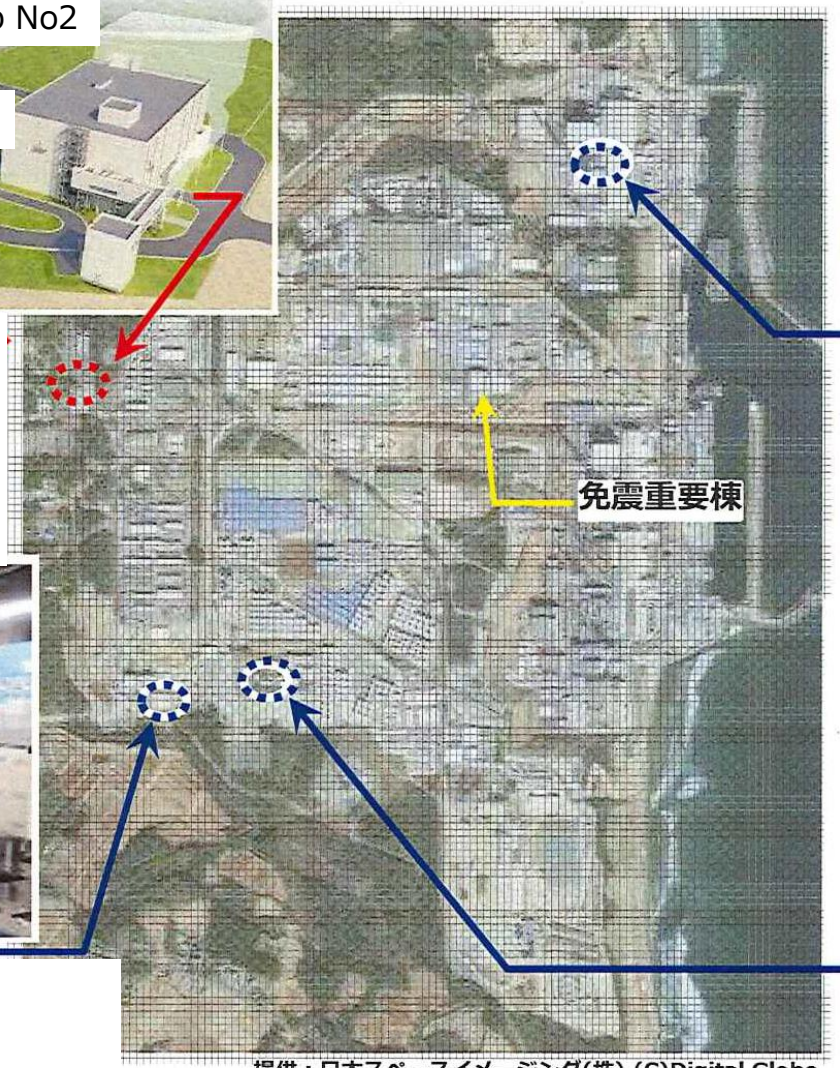
JAEA Okuma analysis and research center



Objectivas:
・For R&D of Processing, Disposal and Fuel Debris characterization
etc

TEPCO Hot Lab in unit5,6

Objectivas:
・Contaminated water,
・Processed water
etc



提供：日本スペースイメージング(株),(C)Digital Globe

TEPCO Chemical Lab

Objectivas:
・Discharge water
・Sea Water,Fish etc

TEPCO Environmental Lab

Objectivas:
・Ground Water
・Soil
etc

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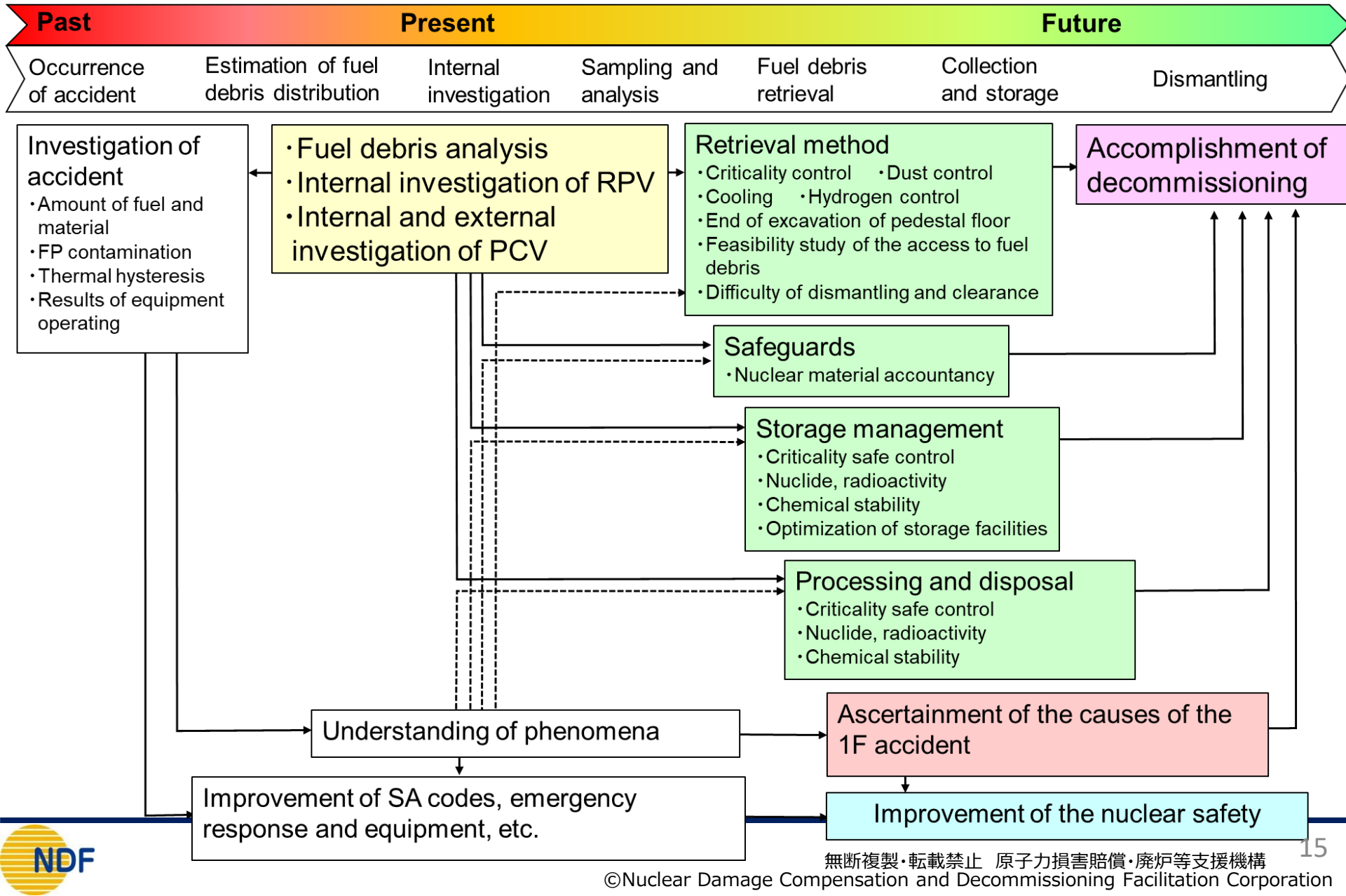
Role of Analyses and Investigation results in the Decommissioning Work



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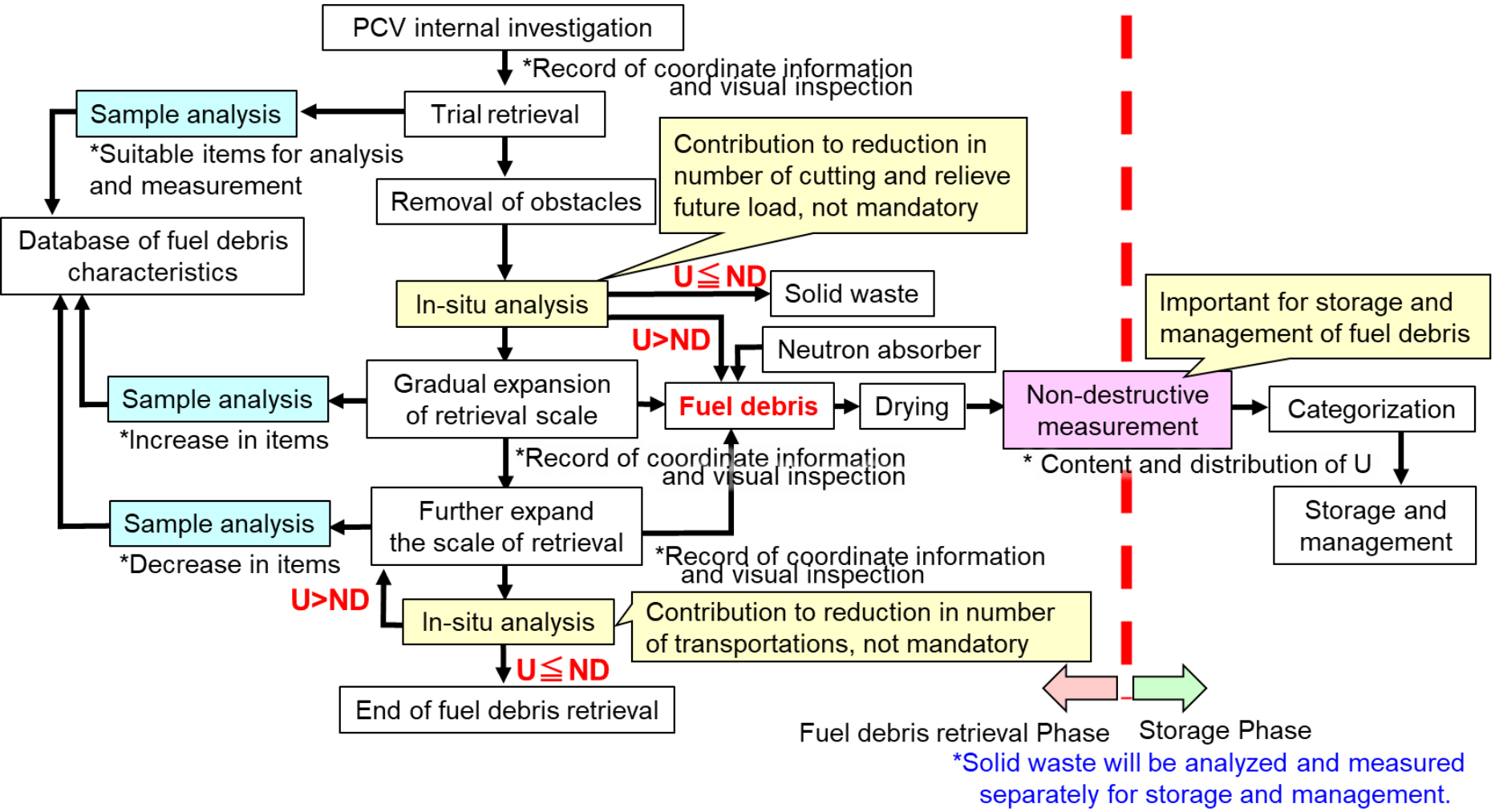
Example timing of in-site analysis and non-destructive measurement in the process of fuel debris retrieval to storage phase



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Concluding Remarks

- About the 1F solid waste, challenges are the analysis and evaluation strategy for the high activity waste that is difficult to sample and the rationalization of the number of analyses for the large quantities of low/middle activity waste. A rational characterization method not to be seized with a conventional method is necessary.
- In consideration of needs of analyses and the ability of each analysis facility, to characterize under the clear the role-sharing of related organizations as All Japan is essential for the smooth decommissioning promotion.
- It is necessary each facility secures ability (facilities and person) necessary for a role, and to cope with the change of needs accompanied with the progress of the decommissioning.
- The novel technology development with universities very much expected.

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Thank you for your attention!

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