Phase: **Preparation**

Decommissioning Process **"Processing/Disposal/Environment Remediation (including Wastes containing Alpha Nuclides originating from Fuels)"**
Investigation Subject **"Characterization2"**
Issue **"Characterization"**

Needs

1. Understanding the properties of secondary waste generated from contaminated water treatment

Characterization for rational waste management：【Short】

Desired state and reasons for it

- Secondary waste generated from contaminated water treatment has not been treated so much in the past. In preparation for processing and disposal, it is desirable to understand the types, chemical forms, and quantities of contaminating nuclides.
- It should be noted that secondary waste generated from contaminated water treatment that contains moisture and is stored outdoors under ventilated conditions may be subject to microbial growth, which may make analysis and subsequent solidification difficult. Therefore, it is desirable to evaluate the impact of microorganisms, etc. under high radiation doses and to have a countermeasure technology if necessary.
- Dewatering and stabilization may be implemented for slurries with high moisture content. In anticipation of storage, management, and even treatment and disposal, it is desirable to have a detailed understanding of the changes in properties and volume before and after dewatering.

Current state against ideal

- It is at the stage of collecting and analyzing samples that are important in measures for waste from the stage of analyzing those that are easy to collect.
- In addition to existing analysis facilities such as the analysis facility at the JAEA Ibaraki site, construction of the first radioactive material analysis and research facility (Okuma Analysis and Research Center) was completed in June 2022, and analysis work using radioactive materials began in October of the same year. Demonstration of the simplified and expedited analytical techniques that had been promoted so far as standard analytical methods was completed in FY2023, with full-scale operations beginning in FY2024. In addition, a new analysis facility by TEPCO is scheduled to begin operation in the late 2020s.
- In order to obtain analytical data on high-dose wastes, adsorbent material from cesium adsorption vessel (KURION and SARRY) collected at the Fukushima Daiichi Nuclear Power Plant site was transported to the analysis facility at the JAEA Ibaraki site, and analytical methods are being investigated.

Issues to be resolved

- While it is not easy to sample the contents of secondary waste generated from contaminated water treatment since they are stored in adsorption towers, etc., and high dose, it is necessary to understand and evaluate their properties.

- Since their properties vary widely, it is necessary to investigate a processing and disposal method for each waste specifications. In addition, it is necessary to carefully consider the concept of representativeness of sampling and analysis results, since there is likely to be variations in properties both among and within the same wastes.
- It is important to formulate a medium- to long-term analysis strategy that defines the target wastes and their priority, analysis objectives and quantitative targets, etc., and to analyze and evaluate them based on the strategy.
- Since the target nuclides, items, precision, the number of samples, etc. required for analysis differ depending on the target waste, it is necessary to establish a system based on the appropriate division of roles according to the characteristics of the facility and the purpose of analysis.

2. Facilitating management of waste generated from dismantling of the PCV/RPV/building

Characterization for rational waste management：【Long 1】

Desired state and reasons for it

- In preparation for the processing and disposal of waste, it is desirable that the properties of the equipment, etc. in the PCV／RPV／building are understood and that the method of dismantling work is investigated.
- For this purpose, it is desirable that the processing／disposal side should present requirements and notes to the dismantling side of the PCV／RPV／building.

Current state against ideal

- At the bottom of the torus room in the reactor building, there is stagnant water in which α-nuclides derived from fuel debris exist in particulate form (α-sludge) and ionic form, and relatively high total α concentrations have been detected.
- The situation of α contamination in the Unit 3 reactor building and the presence of α sludge associated with the treatment of residual water at the bottom of the tank are becoming clear.

Issues to be resolved

- The wastes generated by dismantling of the PCV／RPV／building are very large in volume and wide in range from high to low contamination and may contain alpha-nuclides. Taking these factors into consideration, it is necessary to have technologies for understanding the properties of the waste more quickly, easily, reliably, and at a lower cost.
- Among the above-mentioned technologies, the technology that enables on-site characterization prior to dismantling is particularly important. Once the on-site characterization becomes possible, the findings can be fed back to the dismantling method and waste classification. Considering the results of the feedback, it will be possible to estimate the quantity and properties of waste to be generated before dismantling.

3. Evaluating the inventory and properties of solid wastes

Desired state and reasons for it

- In order to contribute to investigation on waste processing and disposal, it is necessary to evaluate the amount of radioactivity contained in the waste (inventory) and the properties of the waste (including the presence／absence of metal components to be removed in advance).
- Since the collection of waste samples is limited, it is necessary to estimate and evaluate the inventory and properties of the waste by using analytical methods, etc.
- In estimating the inventory, it is desirable to take into account the overall picture of the migration and behavior of radioactive elements.
- With respect to analytical models for estimating and evaluating inventories and properties, it is desirable to develop and advance it to obtain more detailed and rapid results.
- With regard to low-dose waste, although the analytical work itself is not highly difficult, the amount of material is enormous, and therefore, the implementation of the total measurement requires an enormous amount of time. Efficient analysis and analysis planning methods are needed as well as a reduction in the volume of material.
- For high-dose waste, sampling and analysis themselves are difficult, and the number of analytical data to be obtained is limited, so statistical inventory estimation based on a migration model is important.
- It is desirable to analyze each waste material to determine its radioactivity concentration, with a view to promoting its reuse on the premises, as well as to its treatment and disposal.

Current state against ideal

- Investigations are underway to establish a methodology for developing a medium- to long-term analytical strategy that will define the solid wastes to be targeted, their priority, and quantitative targets for analysis.
- In the Radioactive Material Analysis and Research Facility Laboratory 1 (completed in June 2022), demonstration was initiated to use the outcomes of analytical methods established so far for simple and rapid data acquisition as standard analytical methods, and full-scale operation has been conducted since FY2024.
- Efforts are underway to establish an efficient analytical planning method that combines the DQO process (a method developed by the U.S. Environmental Protection Agency to plan sampling of analytical samples for decision making) with a statistical method, based on the characteristics of both low-dose and high-dose wastes.
- In the storage and management of waste to date, management has been based on classification using surface dose rate as an indicator, since debris, etc. generated in large quantities were fallout-induced contamination. From now on, in order to ensure more appropriate storage and management, the radioactivity concentration of each waste material is to be determined by analysis with a view to promoting its reuse on the premises and to its treatment and disposal.

Issues to be resolved

- There are many different types of wastes, and even if they are of the same type (e.g., “rubble”), their individual inventories differ. Even for a single type of waste, the inventory varies depending on the location (surface vs. interior) and shape (pores vs. smooth areas). In such a situation, it is not practical to measure the inventory of all wastes. It is necessary to conduct sampling measurements and then evaluate the overall inventory. In this respect, analytical and estimation

technologies are required that can evaluate the inventory more quickly, easily, reliably, at low cost, and with high accuracy.

- From the viewpoint of processing and disposal, it is necessary to confirm in advance whether metals and other substances that should be removed (undesirable components for processing and disposal) are included in the waste. In this respect, too, analytical and estimation technologies are required that can evaluate the properties of waste more quickly, easily, reliably, at low cost, and with high accuracy.

Relevant Issues

- CWM-301 "Efficient and effective water treatment"
- SFP-301 "SF removal"
- FDR-301 "Fuel debris retrieval inside PCV"
- FDR-302 "Fuel debris retrieval inside RPV"
- DRB-301 "Removing in-core structures and dismantling buildings"
- PDR-202 "Waste conditioning method"
- PDR-203 "Establishing disposal concept"
- PDR-204 "Performance assessment"
- BST-003 "Measurement and analysis technology"