Phase: **Preparation**

Decommissioning Process **"Transport/Storing/Storage (including Wastes containing Alpha Nuclides originating from Fuels)"**
Investigation Subject **"Characterization1"**
Issue **"Material accountancy"**

Needs

1. Establishing reasonable material accountancy and control policy for fuel debris and nuclear fuel materials

Characterization for rational waste management：【Mid】

Desired state and reasons for it

- Development of technologies necessary to analyze and estimate the properties of fuel debris is desirable for the purpose of contributing to the development of methods for removing fuel debris and in-core structures and technologies for fuel debris , transportation and storage, etc.
- It is not possible to apply normal material accountancy methods to fuel debris. Therefore, it is desirable to have material accountancy method suitable for fuel debris by referring to the examples of similar past accidents.
- It is desirable that guidelines, etc. for the legalization of management, processing and disposal of fuel debris and wastes are streamlined, which leads to the dissemination of information, etc.

Development of necessary technologies to understand the properties of fuel debris

- It is desirable to develop a technique to analyze fuel debris samples planned to be collected during experimental retrieval in Unit 2 and sediment samples collected during the investigation inside the PCV by the underwater ROV in Unit 1.
- It is desirable to reduce the burden of transporting samples to the hot laboratory facility when the amount of fuel debris to be removed increases in the future.

Development of non-destructive measurement technology for sorting

- It is important to target the amount of nuclear fuel in fuel debris because sample analysis of fuel debris can only determine the properties of a small portion of the fuel debris retrieved.
- As analysis involves the risk of contamination spread and internal exposure. it is necessary to measure the radiation emitted or transmitted from an object while it is sealed in a container, and to quickly determine the amount of nuclear fuel without destroying the object.

Current state against ideal

Development of necessary technologies to understand the properties of fuel debris

- The fuel debris samples that are planned to be collected during the experimental removal of the Unit 2 fuel debris and the sediment samples collected during the PCV internal investigation by the underwater ROV of Unit 1 will be analyzed in the hot laboratory facility, and the fuel debris generated by the accident at Three Mile Island Nuclear Power Plant Unit 2 will be used for structural analysis and X-ray CT imaging to confirm comparative data with the fuel debris of the Fukushima Daiichi Nuclear Power Plant.

- Accident progress analysis, material melting tests, and evaluation of melt migration behavior are being conducted focusing on RPV damage. Also, simple analytical techniques are being developed to quickly confirm the presence or absence of fuel components.

Development of non-destructive measurement technology for sorting

- Fuel debris contains a heterogeneous mixture of many nuclides and elements, including neutron absorbers, and these elements, including voids, may inhibit measurement. The effects of inhibition factors are being evaluated in extensive simulation analyses for fuel debris of various possible compositions. Important points are planned to be confirmed by testing using existing test equipment. Based on these results, conceptual design of equipment and sorting scenarios are being studied.

Issues to be resolved

- It is not practical to analyze the entire amount of fuel debris, nuclear fuel materials, and water treatment secondary waste. It is necessary to have models and policies to estimate the total inventory from the sampling results.
- It is also necessary to analyze, estimate and understand the inventory, etc. of low-concentration wastes, whose figures are basis for judgement on whether or not they should be subject to material accountancy.
- Since exposure to radiation during actual material accounting work becomes an important issue, it is essential to develop a policy judging on the safety and cost of the work.
- In investigating disposal methods, quantification of α-nuclides is a very important item to be implemented, and it is necessary to organize the basic technology to support it.

Measurement for sorting radioactive waste and fuel debris

- Measuring and estimating the amount of nuclear material and its concentration in the material retrieved from the PCV is difficult at present because of the heterogeneous mixture of various materials, including control rod components (neutron absorbers), and requires new technological development.

Understanding of measurement errors

- From FY2022 onward, it is important to continue and accelerate the development of measurement devices by concurrently conducting actual measurement of simulated fuel debris and fuel debris from the Three Mile Island Nuclear Power Plant Reactor No. 2 using currently available measurement devices, in addition to the development of measurement devices using an analytical approaches mainly based on numerical experiments.

Relevant Issues

- 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”