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

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.
- As for solid wastes during fuel debris retrieval, since molten fuel and structural materials are mixed in the solid wastes, it is expected to improve workability if it is possible to quickly confirm whether or not uranium is contained in the adhered materials to damaged supports and pipes, etc.
- Since fuel debris contains factors that inhibit nondestructive measurement, it is desirable to determine the extent to which these factors affect the measurement.

Current state against ideal

- In order to improve the quality of analysis results, JAEA, NFD, NDC, and Tohoku University have cooperated to conduct chemical analysis and structural analysis using common samples since FY2020. Currently, to expand the fuel debris data, analysis of TMI-2 debris using the latest analytical technology is being conducted among the Ibaraki area sites.
- In order to improve workability, technology development using laser-induced breakdown spectroscopy (LIBS) has been conducted as a simplified (in-situ) analysis technology development.
- In order to confirm the degree of influence of inhibiting factors on measurement, technology development for on-site application is being conducted in Government-led R&D Program on Decommissioning, Contaminated and Treated Water Management through simulation analysis and actual measurement tests utilizing existing test equipment.
- As a method to evaluate the amount of uranium in fuel debris, technology development is focused on active neutron methods that detect neutrons emitted by fission in nuclear fuel, as well as methods that utilize scattering of cosmic-ray muons.

- In order to speed up and improve efficiency in the analysis of nuclear fuel materials and difficult-to-measure nuclides, development of technologies for the simultaneous automatic quantity determination of these materials is being conducted.
- Since material accountancy of retrieved fuel debris is unprecedented, TEPCO is to face technological challenges in investigating and applying it on site. Therefore, NDF is preparing to provide technological support to TEPCO by conducting a broad survey of existing technologies related to material accountancy.

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.
- Currently, due to the limited information and knowledge on the properties of fuel debris, the design of equipment and facilities is based on conservative assumptions on the properties of fuel debris in the investigation of Government-led R&D Program on Decommissioning, Contaminated and Treated Water Management and TEPCO. In the design of equipment and facilities for packaging, transferring, and storing fuel debris in the further expansion of the scale of retrieval, it is important to promote rationalization by utilizing various measurement data such as the amount of hydrogen generation and fuel debris properties that are collected and accumulated during the test retrieval and the gradual expansion of the scale of retrieval, as well as knowledge and experience on the handling of fuel debris in the work from transfer to storing.
- The number of samples to be analyzed will gradually increase due to the gradual expansion of the scale of retrieval, and in order to ensure reliable analysis, JAEA's Radioactive Material Analysis and Research Facility Laboratory 2 should be steadily developed. For the further expansion of the scale of retrieval to be followed, it is also important to investigate a comprehensive analysis facility and to work with the development of non-destructive measurement systems and simplified analysis technologies. In addition, since the method of treatment and disposal of fuel debris will be determined in the third phase, it is necessary to investigate the acquisition of data related to treatment and disposal, such as measurement of thermophysical properties and hydrogen generation by water radiolysis, using the collected fuel debris.
- In order to determine the treatment and disposal method of fuel debris, it is necessary to proceed with analysis of the properties of the fuel debris after it the fuel debris retrieval.

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"