Phase: **Preparation**

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

Needs

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

Characterization for rational waste management：【Long 2】

Desired state and reasons for it

- It is desirable to develop a technology necessary to analyze and estimate the properties of fuel debris, etc., with the aim of contributing to the development of methods for removing fuel debris and in-core structures, fuel debris storage, transfer, and storage technologies, etc.
- Since it is not possible to apply the usual material accountancy methods to fuel debris, it is desirable to have material accountancy methods suitable for fuel debris and waste, referring to past examples of similar accidents.
- It is desirable to investigate how the current methods and concepts can be rationalized, considering the data obtained from the fuel debris and waste management point of view.
- It is difficult to precisely identify and quantify all elements and isotopes in trace materials, by analysis because fuel debris contains difficult-to-measure nuclides, interfering elements, insoluble materials, etc., and there are issues during pretreatment and measurement, such as uniform dissolution of samples and sorting of isobaric substances. Improvement of the quality of analytical results is desired.
- 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 necessary to ascertain the extent to which these inhibitors 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, in order to expand fuel debris data, analysis of TMI-2 debris using the latest analytical techniques is being conducted among their Ibaraki area sites.
- To improve workability, technology development using laser-induced breakdown spectroscopy (LIBS) has been conducted as a simplified (in-situ) analysis technique.
- In order to confirm the degree of influence of inhibiting factors on measurement, technological development for on-site application is being conducted in Government-led R&D Program on Decommissioning and Contaminated Water Management through simulation analysis and actual measurement tests utilizing existing test equipment.

- 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.

Issues to be resolved

- Since it is not practical to analyze the entire amount of fuel debris, nuclear fuel materials and water treatment secondary wastes, it is necessary to have a models and measures for estimating the entire inventory, etc. from the sampling results.
- Since exposure to work during actual weighing is a critical problem, it is necessary to establish measures based on a rational judgment of safety and cost during the work.
- Quantification of α-nuclides is a very important item to be implemented when considering disposal methods, so it is necessary to develop a 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 for Government-led R&D Program on Decommissioning and Contaminated Water Management and TEPCO's investigations are based on conservative assumptions on the properties of fuel debris. In designing equipment and facilities for containing, transferring, and storing fuel debris in the case of further expansion of the scale of retrieval, it is important to advance rationalization using various measurement data such as the amount of hydrogen generation and fuel debris properties collected and accumulated in the test retrieval and retrieval of fuel debris on a gradually expanded scale, as well as knowledge and experience in handling fuel debris in operations from the transfer of fuel debris to storing.
- The number of samples to be analyzed will gradually increase due to fuel debris retrieval gradually expanded its scale, and in order to ensure reliable analysis, JAEA's Radioactive Material Analysis and Research Facility No. 2 should be steadily developed. For the scaling up 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.
- For determining the method of treatment and disposal of fuel debris, it is necessary to proceed with analysis of the properties of the fuel debris after its retrieval.

Relevant Issues

- SFP-301 "SF removal"
- FDR-201 "Sorting fuel debris and radioactive waste"
- DRB-301 "Removing in-core structures and dismantling buildings"
- PDR-205 "Verification and analysis method on waste body"
- BST-003 "Measurement and analysis technology"