

Decommissioning Process “Fuel Debris Retrieval”Investigation Subject **“Retrieval”**Issue **“Retrieving fuel debris inside RPV”****Needs****1. Retrieving fuel debris from the core and the bottom of the RPV****Desired state and reasons for it**

- The Basic Policy for the Decommissioning of Fukushima Daiichi NPS, a strategic plan of the Nuclear Damage Compensation Facilitation Corporation, mandates the continuous and rapid reduction of risks caused by radioactive material generated by the accident, which is not normally found in ordinary NPS.
- In order to reduce risks at Fukushima Daiichi NPS, it is desirable to remove fuel debris inside the RPV, which has been identified as a risk source.
- As part of the fuel debris retrieval policy, it is desirable to establish a method for retrieving fuel debris inside the RPV, in consideration of giving priority to side entry to the bottom of the PCV by the partial submersion method.

Current state against ideal

- According to the current risk assessment for each unit, Unit 1 has no upper part of reactor building, and Unit 3 has only a fuel retrieval cover instead of the upper part of reactor building. On the other hand, in Unit 2, the reactor building remains as it used to be and most of the fuel debris is presumed to stay inside the RPV. Therefore, the degree of damage to the RPV in Unit 2 is small. Thus, there is a difference between the three units in terms of the importance of management importance. The fuel debris, which may affect the potential impact, may take various forms, ranging from near-powder to solid, but the form has not been specified at this time. Especially for Unit 2, most fuel debris is presumed to remain inside the RPV, and it is thought that the proportion of concrete reaction products in the molten core is smaller than that in Unit 1 and Unit 3, and that it maintains a stable form. Therefore, the potential impact on Unit 2 may be relatively low.
- The partial submersion method is emphasized in the R&D. Side entry to the PCV bottom is prioritized in the fuel debris retrieval policy. Based on this policy, R&D of various technologies has been accelerated and emphasized, especially on the confinement function and the water level management technology in the PCV, assuming the presence of alpha nuclides. Since the selection of a method requires specialized and intensive study, the “Subcommittee for Evaluation of Fuel Debris Extraction Methods” was established under the NDF’s Technical Committee on Decommissioning, etc., with a resolution of the Committee in February 2023. The Subcommittee reported its findings to the Technical Committee on Decommissioning in March 2024. For Unit 3, TEPCO conducted design studies of the fuel debris retrieval method since FY2024 in accordance with the contents of the Subcommittee Report, and compiled the results of examinations on the retrieval scenario, equipment planning, layout planning, and work schedule.
- Investigations on the PCV internal investigations that have been conducted so far have provided various useful information for understanding the situation inside the PCV. On the other hand, the

information about the situation inside the PCV is still limited, partly because further RPV internal investigations have not been conducted yet. PCV internal investigation is being planned to obtain more detailed information such as deposit and fuel debris distribution inside the PCV. RPV internal investigation is also planned to obtain information inside the RPV.

- Since FY2024, full-scale design studies of the airborne method for Unit 3 have been underway, emphasizing the following policies: (i) access through small openings, (ii) standardization and simplification of fuel debris handling (such as processing and collection), and (iii) a combination of top and side access. Through comparative examinations of the east–west gantry configuration and the north–south platform configuration, studies are underway to assess the feasibility of top-access support structures in accordance with the damage conditions of the reactor building, as well as on layout planning for auxiliary systems (gas and liquid systems, etc.) within the additional building.
- Examples of the methods identified to date include the airborne method, the optional airborne method (RPV filling and solidification method), and the submerged method (ship hull method). As the submerged method is technically challenging at present, future efforts will focus primarily on the more feasible airborne method.
- The proposed airborne method is a method to retrieve fuel debris by pouring water inside the RPV while the fuel debris is exposed in the air or immersed at a low water level.
- The optional airborne method is a method in which the bottom of the pedestal, RPV, reactor well, etc. are physically stabilized by solidifying them with filling material and fuel debris is excavated and removed together with the filling material.
- The submerged method (ship hull method) is a method of enclosing the entire reactor building with a new structure called a ship hull structure as a confinement barrier, thus flooding the reactor building to remove fuel debris.

Issues to be resolved

- Towards expanding the scale of fuel debris retrieval, it is important to understand the situation in the PCV and the RPV and develop technologies to improve the efficiency of fuel debris retrieval including removal of interfering obstacles, for reducing the dispersion of radioactive particles during fuel debris retrieval, for sorting fuel debris from waste as well as developing analytical and estimation technologies for characterization of fuel debris. In addition, it is important to develop the technology for fuel debris retrieval by access from above.
- It is also necessary to strengthen the management of R&D on a project basis by clarifying necessary R&D issues through engineering investigations and solving these issues in a timely and accurate manner.
- In the retrieval scenario, information obtained through future internal investigations may reveal, for example, that the distribution of fuel debris differs significantly from the conditions assumed in the studies, thereby identifying new challenges. In such cases, it may become necessary to revise the retrieval scenario, and in some instances, to reconsider the retrieval method itself from an earlier stage.

Relevant Issues

- FDR-201 “Sorting fuel debris and radioactive waste”
- FDR-208 “Understanding status of fuels for maintaining stable conditions”
- FDR-214 “Establishing debris collection strategy”
- FDR-217 “Establishing access route to fuel debris”
- FDR-218 “Developing fuel debris retrieval equipment and devices”
- FDR-219 “Ensuring safety in processing fuel debris”

- TSR-101 "Characterization"
- TSR-103 "Material accountancy"
- PDR-101 "Characterization"
- PDR-102 "Waste strategy"