Phase: **Action**

Decommissioning Process **“Fuel Debris Retrieval”**
Investigation Subject **“Retrieval”**
Issue **“Retrieving fuel debris inside PCV”**

Needs

1. Retrieving fuel debris from the lower PCV

Fuel Debris Retrieval：【Mid】

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 nuclear power plants.
- In order to reduce risks at Fukushima Daiichi NPS, it is desirable to remove fuel debris in the lower part of PCV, which has been identified as a risk source.
- In addition, data obtained in proceeding with retrieving fuel debris is expected to be used successively and in a ripple effect as data for research and development (research and development related to retrieval, analysis, storage, storing, etc.) and as evidence data for regulations.
- Meanwhile, the fuel debris retrieval policy involves the prior use of side entry to the bottom of the PCV by the airborne method. However, since the plan is not to retrieve all the fuel debris, the retrieval method should be investigated considering the knowledge obtained and the results of the investigation of the method in the preceding Unit 3.

Current state against ideal

- According to the current status 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 is still retaining its integrity, most of the fuel debris is estimated to be inside the RPV. Therefore, the degree of damage to the RPV of Unit 2 is small. Thus, there is a difference among the three units in terms 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 in Unit 2, most fuel debris is presumed to remain inside the RPV, and the ratio of molten core-concrete reaction products is smaller than in Unit 1 or Unit 3, and it is thought to maintain a stable form. Therefore, the potential impact on Unit 2 may be relatively low. The estimated fuel debris distribution, situation of access routes, and surrounding structures for Unit 1-3 are referred in Figure 8 of NDF’s “Technical Strategic Plan 2024 for the Decommissioning of Fukushima Daiichi Nuclear Power Station, TEPCO Holdings Consignment Operations”.
- Regarding research and development, based on the decision of the fuel debris retrieval policy to focus on the airborne method and precede the lateral access to the bottom of the PCV, we are accelerating and focusing on research and development, including the construction of confinement function assuming the presence of alpha nuclides and water level management technology in the PCV.

- Although the construction method has not been finalized, the airborne method, airborne method option (filling and solidification method) and the flooding method (vessel shell method) are mentioned as examples.
- The airborne method intends to retrieve the 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 airborne method option (filling and solidification method) involves physically stabilizing the bottom of the pedestal, RPV, and reactor well with filling material, and then excavating and removing the fuel debris together with the filling material.
- The flooding 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, flooding the reactor building, and removing the fuel debris.

Issues to be resolved

- Towards expanding the scale of the fuel debris retrieval, it is important to understand the situation in the PCV and the RPV, develop technologies to improve the efficiency of fuel debris retrieval including retrieval of interfering obstacles, technologies to reduce the dispersion of radioactive particles during fuel debris retrieval, technologies to sort fuel debris from waste, and analysis and estimation technologies for characterizing fuel debris. In addition, it is important to develop technology for fuel debris retrieval by the top access.
- It is also important to proceed R&D on the fuel debris retrieval assuming the status that the PCV is partially submerged.
- 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 those issues in a timely and accurate manner.
- In engineering, it is important to investigate the optimization of processes such as drying, sorting, and discharging, as well as whether it is possible to secure and maintain an area for debris retrieval facilities outside the reactor building (yard area) to implement the processes, considering interference with the same facilities in other Units.
- In particular, if water accompanies the fuel debris, hydrogen will be generated by radiolysis. Technology is required to take measures against hydrogen generation (e.g., drying, hydrogen recombination／absorption, and confirmation／evaluation that the hydrogen concentration can be kept below the flammable limit concentration of 4 vol%) as a measure for hydrogen during storing of fuel debris.

Relevant Issues

- FDR-201 “Sorting fuel debris and radioactive waste”
- 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”