Phase: **Design**

Decommissioning Process **"Fuel Debris Retrieval"**
Investigation Subject **"Improving working environment"**
Issue **"Controlling worker exposure inside the building"**

# Needs

## 1. Controlling and monitoring worker exposure

**Fuel Debris Retrieval：【Short】**

### Desired state and reasons for it

- In order to reduce external and internal exposure of workers, it is desirable to monitor radionuclide information and doses in the work environment.
- It is desirable to understand, in a timely manner, the properties and concentrations of radioactive particles dispersed in the air during fuel debris retrieval.
- In addition to the monitoring of the work environment, it is desirable to monitor the location of workers in the building timely, in order to ensure safe work.

### Current state against ideal

- To prepare against the risk of internal intake of alpha- and beta-emitting nuclides, it is required to build a comprehensive internal exposure dose assessment system using bioassays and in vitro measurement (including lung monitoring). The current bioassays are time-consuming in analysis. Also, in decommissioning work, it is necessary to monitor many workers for a variety of nuclides. Therefore, Government-led R&D Program on Decommissioning and Contaminated Water Management "Development of Safety System (Technology Development of Analytical Methods for Assessing Exposure Doses)" is underway.
- TEPCO is working to strengthen its risk management practices implemented prior to starting on-site work, based on common analysis of four incidents: physical contamination during ALPS pipe cleaning work (October 2023), leakage of water containing radioactive materials from HTI (February 2024), fire alarm caused by steam from the waste storage pit of the miscellaneous solid incineration facility (February 2024), and shutdown of power supply system A and injuries at the plant (April 2024).

### Issues to be resolved

- It is necessary to evaluate and identify the nuclides to be focused on in the management of external and internal exposure.
- In the same view as above, real-time monitoring technologies should be required.

## 2. Developing a safe and efficient work plan

**Fuel Debris Retrieval：【Short】**

### Desired state and reasons for it

- It is desirable to consider and set work methods, work hours, and the number of workers so that they are kept below the radiation dose limits (50 mSv／year and 100 mSv／5 years) set by laws

and regulations. It is necessary to prevent exposure of workers to certain individuals, to reduce overall worker exposure, and to secure human resources from a long-term perspective.

- In order to carry out efficient work, it is desirable to reduce the burden on workers by simplifying the work equipment (full face mask, Tyvek, Anorak wear) in the building.
- In order to carry out safe work, it is desirable to collect the location information of workers in the building in a timely manner.

## Current state against ideal

- In accordance with the Mid- to Long-term Roadmap and TEPCO's Mid-and-Long-Term Decommissioning Action Plan, removal of interfering materials and dose reduction inside the reactor building are underway to improve the work environment in the work area and access routes.
- As part of preparations for the test retrieval, on-site dose reduction work is underway and the dose in the corridor on the west side of the first floor of the Unit 2 reactor building and around the X-6 penetration in the northwest area has been reduced to approximately 5 mSv／h or less (average 2 to 3 mSv／h or so).
- Regarding internal exposure protection, taking other measures on the facility such as controlling the dispersion of radioactive dust and preventing contamination spread, appropriate protection measures should be selected based on the target nuclide, airborne concentration, and surface density in the work area and efforts should be made to prevent inhalation intake and physical contamination leading to internal exposure. When an internal uptake event occurs, it is necessary to properly evaluate the deposited effective dose by in vitro measurement methods (lung monitors) and bioassay methods. Therefore, it is important to select significant alpha nuclides in the exposure assessment in advance and reflect them in the control of airborne concentrations, wearing standards for protection equipment, and equipment calibration control.
- In addition, control of surface density in the work environment and the bodies of workers entering and exiting the area is important for early detection of the spread of contamination beyond the classified area and for preventing internal uptake by dust resuspended from free contaminants. Considering these, research and development started in FY2021 under Government-led R&D Program on Decommissioning, Contaminated Water and Treated Water Management for internal uptake protection and dose assessment at the time of uptake.
- To reduce exposure in long-term decommissioning, it is important to accumulate experience and knowledge such as lessons learned at the on-site work and pass on know-how. In order to further expand the scale of retrieval, it is necessary to share information on handling techniques for alpha nuclides in the test retrieval and promptly provide feedback to the next work plan. Since May 2021, guidance from JAEA, which has relevant know-how, has started for the test retrieval because there are concerns about the risk of physical contamination and internal exposure in the work of handling alpha nuclides.

## Issues to be resolved

- Priority should be given to the investigation on reducing exposure by combining the use of remote technology and decontamination, followed by planning for work exposure control based on "time, distance, and shielding".
- In areas with extremely high radiation levels, such as inside the PCV and torus room, work should be carried out without human access using remote technology.
- In the reactor building excluding the above areas, the optimal combination of decontamination, shielding, removal of disused items, remote technology, and reduction of work time should be investigated enabling to keep the accumulated dose for the entire work at low level.

- Even when remote technology is utilized, the evaluation and investigation should take into account the accompanying need for work to install the equipment, maintenance, and trouble-shooting.
- For decontamination work, whether to use remote technology or to perform the work manually shall be determined by evaluating the dose rate of the target area, contamination type, work space, frequency of use, applicability and development trend of the remote technology, process, cost, etc.
- Priority should be given to the investigation for areas with clear needs, rather than for areas where the needs are unclear or the betterment-oriented such as reducing the overall radiation dose.
- Furthermore, in preparation for internal initiatives events of alpha-ray emitting nuclides, important alpha-ray emitting nuclides should be identified in advance in the exposure assessment and these nuclides should be reflected in the management of airborne concentrations, wearing standards for protective equipment, and equipment calibration management.
- In addition, surface density in the work environment and on the bodies of workers entering and exiting the area should be controlled in order to detect the spread of contamination beyond the zone classification at an early stage and to prevent internal uptake by dust resuspended from free contaminants.

## Relevant Issues

- CWM-101 “Understanding current status of contamination source”
- FDR-103 “Understanding status of FP”
- FDR-104 “Understanding doses inside PCV and RPV”
- FDR-106 “Understanding contamination status inside buildings”
- BST-002 “Visualization technology (including 3D)”