Phase: **Design**

Decommissioning Process **"Fuel Debris Retrieval"**
Investigation Subject **"Improving working environment"**
Issue **"Shielding and decontamination measures"**

Needs

1. Establishing decontamination and shielding methods in the building

Desired state and reasons for it

- In order to secure a work area for fuel debris retrieval and to reduce workers' exposure, it is desirable that the work environment in the building is appropriately decontaminated or shielded to minimize radiation doses.
- In order to reduce worker exposure during decontamination work, it is also desirable to minimize exposure dose as much as possible by taking such measures as work in a short time, work in shielded area and work remotely.

Current state against ideal

- Regarding decontamination technology in the reactor building, technology development is being carried under Government-led R&D Program on Decommissioning and Contaminated Water Management "Development of Remote Decontamination Technology in the Nuclear Reactor Building (FY2014)", and as decontamination technology at lower and higher areas, suction／blasting and decontamination equipment, dry ice blasting decontamination equipment and high pressure water jet decontamination equipment were developed.
- In addition, regarding technology to decontaminate remote equipment, Government-led R&D Program on Decommissioning and Contaminated Water Management "Development of Remote Equipment Maintenance Technology"(FY2021~2022) is being carried out and the technology development of remote maintenance of the equipment, which is necessary for ensuring safe and reliable operation continuity over a long period of time in the further expansion of the scale of fuel debris and in-core structure retrieval, and is also necessary from the viewpoint of a rational design of remote equipment related to the retrieval method and volume reduction of waste generated.
- Furthermore, in order to make it possible to investigate where decontamination would be most effective, Government-led R&D Program on Decommissioning and Contaminated Water Management "Development of technology for improving the environment inside the reactor buildings (functionality-upgrading development of digitizing technology for environment and source distribution to reduce exposure)," is underway.
- Possible measures to reduce radiation doses in the building include removal of high-dose piping, etc. and decontamination of the inside of the piping. Even in the case of removal, it may be desirable to decontaminate the inside of the pipes in advance from the viewpoint of controlling the scattering of radioactive materials contained in the pipes. However, there are various types of piping, and decontamination technology that can be applied to each type of piping is required. In particular, decontamination of small-diameter piping is difficult. Generally, chemical decontamination is considered for decontamination of inside of small-diameter piping, but in the case of chemical decontamination, there is an issue of how to handle the liquid waste. On the

other hand, if equipment is placed inside, a compact device is required. In addition, since there are valves and blockages in the piping, technology to break through the valves and blockages in the piping is necessary in addition to the technology to decontaminate by the equipment placed inside the piping. In the future, as work in the reactor building will increase due to the retrieval of fuel debris, etc., it is desirable to be able to reduce the radiation dose in the work environment as much as possible. Therefore, chemical decontamination technology (pH adjustment, etc.) and physical decontamination technology (collection and quantity of cutting materials, etc.) that can also take into account issues such as water treatment after decontamination of inside of the piping are necessary.

- Since FY2024, technological development has been underway on remote monitoring technologies and removal work systems for the dismantling of PCV penetration pipes and related components, and progress is being made in the development of technologies for monitoring pipe contamination levels and for remotely removing such piping.

Issues to be resolved

- Units 1 and 3 have higher radiation doses at the work site than Unit 2, and the issue is to investigate a remote method of reducing the dose (removal or decontamination) of highly contaminated piping. It should be noted that it is necessary to handle nuclear fuel materials, etc. that contain alpha-ray emitting nuclides, which have a large dose contribution to internal exposure.
- In order to formulate an appropriate decontamination and radiation shielding plan, it is necessary to establish a method for evaluating the work effectiveness of decontamination and radiation shielding (how much decontamination and radiation shielding will reduce radiation dose), based on the current contamination condition.
- In doing so, it is necessary to take into account the measures for decontamination and radiation shielding work (using remote technology or manual work) and decontamination and shielding technologies to be taken (what kind of technology can be used and how much dose can be reduced), adequate for the area where radiation doses should be reduced (including highly contaminated piping).
- In addition, it is necessary to develop efficient and effective decontamination and shielding technologies adequate for the area where radiation doses should be reduced. For example, there is a case in which, in the decontamination of the building, the radiation dose cannot be reduced by mopping, and the only way to reduce the dose is to peel off the surface.
- When applying decontamination and radiation shielding technologies, the quantity and quality of secondary waste to be generated should be also considered.

Relevant Issues

- 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)”