About Reducing Radiation Exposure Dose Rates on the Refueling Floor of the Reactor Building for Unit 3

Kajima Corporation

1. Introduction

We have been working on the project for removing the fuel from the Unit 3 spent fuel pool. In October 2013, we completed the demolition and removal of the contaminated debris such as steel trusses and concrete debris that had fallen on the refueling floor as a result of the hydrogen explosion. In order to facilitate the fuel removal project, it was necessary to first reduce the air dose rates on the highly contaminated refueling floor.

2. Designing the Dose Rate Reduction Method

The measurement showed the high air dose rate on the refueling floor, especially in the area directly above the reactor well (756 mSv/h). Because manned work near the refueling floor would be unavoidable in the spent fuel removal project, it was necessary to design and implement a dose rate reduction method which combines decontamination and shielding.

The schedule constraints required us to plan the dose rate reduction of the refueling floor in parallel with the debris removal. Based on the damage condition around the Unit 4 reactor and other information, we developed a dose rate reduction plan for those areas that could not be sufficiently monitored and confirmed by camera images, assuming that the structures with a slab thickness exceeding 300 mm were sound and those with a slab thickness of 300 mm or less were damaged.

3. Decontamination Work

Taking into consideration the damage condition of the floor and the material composition of the surface, we developed the decontamination plan for the areas excluding the large openings such as the D/S pits and the northwestern area where the refueling floor had been severely damaged. Prior to the full-scale decontamination, the refueling floor surface was cleaned with several machines. “Dozer” collected debris with piece sizes of 300 mm or smaller and “Vacuum” sucked in debris with piece sizes of 100 mm or smaller and dust. The areas with a slab thickness of 600 mm or more, which were assumed to be sound, were decontaminated by using a chipper called “Scabbler” to scrape off the contaminated surface. All of these machines were developed for remote operation and were successfully used as planned.

4. Shielding Work

The objective of the shielding work was to reduce the air dose rates to the level at which manned work would be feasible. We planned the shielding work based on the load capacities of the structures and the dose condition after decontamination. The steel shields with thicknesses of 150 to 250 mm meeting the required shielding were used for the reactor building, the walls around the pool and the areas with thick slabs which can adequately withstand the load of the shield structures. The steel shields with a thickness of 65 mm were used for the areas of the structures with limited load capacities.

5. Effects of the Decontamination Work and Shielding Work

The air dose rate measurements conducted before and after the decontamination work and the shielding work showed that both reduced the dose rate. Based on the outcomes, we strongly believe that decontamination and shielding will significantly contribute to reducing radiation exposure in the case of manned work for the fuel removal.