

Physical and Radiological Characterization Plan for Intermediate-Level Radioactive Waste at KRID

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1. Introduction

The Korea Research Institute of Decommissioning (KRID) was established to conduct radiological characterization and analysis of radioactive waste to ensure the successful and safe decommissioning of Kori Unit 1 and Wolsong Unit 1. Until now, only four countries—the United States, Germany, Japan, and Switzerland—have successfully carried out the decommissioning of nuclear power plants. However, essential waste data required for the decommissioning of nuclear power plants remains limited. Therefore, KRID aims to analyze the distribution and quantity of nuclides in decommissioning waste from nuclear power plants, with a focus on intermediate-level waste. Furthermore, the physical and radiochemical properties of these wastes will be analyzed, and the results will be compiled into a comprehensive database. To achieve this objective, a facility for the analysis of intermediate-level decommissioning waste is currently being constructed.



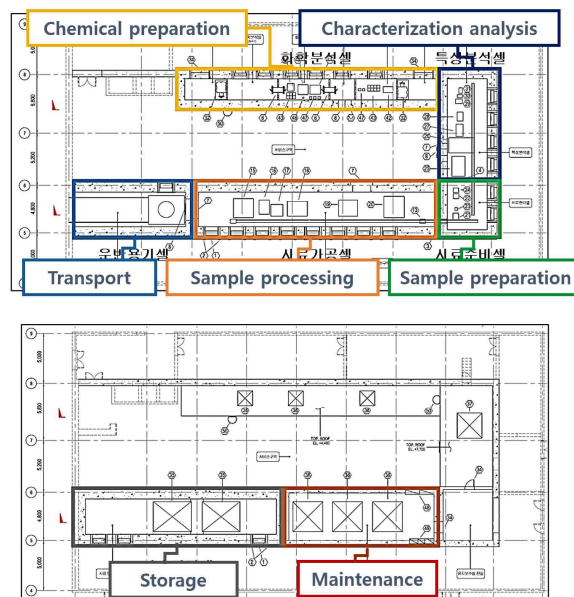
The headquarters of KRID, located in Busan-Gijang, has already constructed a radiochemistry laboratory and plans to start nuclide analysis research in April 2025. Additionally, a hot cell facility designed to perform comprehensive physical and radiochemical analyses of intermediate-level decommissioning waste is currently under construction, with the objective of being operational by 2027. Meanwhile, construction is ongoing in Ulsan for a branch of KRID, The PHWR D&D Center, to support the world's first decommissioning of a PHWR reactor. This facility is expected to be completed by 2026.

This paper introduces the hot cell facility and outlines its future operational plans.

2. Hot Cell

The configuration of the intermediate-level concrete hot cell under construction at KRID is described below.

It consists of a total of seven cells: ① Transport Cell, ② Sample Processing Cell, ③ Sample Preparation Cell, ④ Characterization Analysis Cell, ⑤ Chemical Preparation Cell, ⑥ Maintenance Cell, and ⑦ Storage Cell. The functions of each cell are as follows.



2.1 Transport cell

The Transport Cell is a cell designed to bring decommissioning waste into the hot cell. A special container is used to prevent the release of radiation to the outside, and due to its heavy weight, it is moved using an internal crane and a specialized cart.

2.2 Sample processing cell

The Sample Processing Cell is designed for primary cutting and processing required for the analysis of mechanical properties. It cuts large intermediate-level waste samples into appropriate sizes for analysis and performs sampling operations to extract cores through the thickness direction. To perform these tasks, the cell is equipped with circular and band saw cutters, a wire-cut discharge/wire-cut machine, and a CNC machine.

2.3 Sample preparation cell

This cell is used to process samples, which have been cut to appropriate sizes, into samples prepared for precise machining and analysis. It is designed for the preparation of loading and analysis of microstructure and hardness measurements. Several precision cutting machines, mounting machines, and polishing machines are scheduled to be installed.

2.4 Characterization analysis cell

This cell is designed to analyze the mechanical properties of irradiated materials from decommissioning waste. It performs analyses of the physical and surface properties of radioactive and irradiated materials and is equipped with a universal test machine, a Charpy impact tester, and a microscope.

2.5 Chemical preparation cell

The purpose of this cell is to prepare samples for intermediate-level radionuclide analysis. It is a cell designed to process fabricated samples through separation, liquefaction, and dilution steps to produce samples suitable for radiochemical analysis. The cell will be equipped with a furnace, an automatic melting machine, a microwave decomposition system, and a nuclide separation device.

2.6 Maintenance cell & Storage cell

These cells are designed to accept, handle, and temporarily store decommissioning waste, as well as to facilitate the maintenance of equipment inside the hot cells. In particular, the maintenance cells provide access to each cell through rear doors and/or hatches and will be utilized for the removal of radioactive contamination and maintenance of equipment within the cells.

Furthermore, a laboratory designed for the radiochemical analysis of samples processed in the Characterization Analysis Cell will be constructed. In this laboratory, various analytical instruments such as HPGe, ICP-MS, LSC, alpha spectrometer, and alpha-beta counter are planned to be installed to support comprehensive experimental analysis. KRID aim to secure data on the physical characteristics of decommissioning waste and identify 95% of nuclides to satisfy suitability for acquisition and disposal. [1] In

addition, advanced decommissioning-related research, including demonstration experiments on cutting large decommissioning waste, is planned.

3. Summary

KRID is currently constructing research facilities to analyze the physical and radiochemical properties of intermediate-level radioactive waste for the first time in Korea, supporting the decommissioning of nuclear power plants.

In particular, the hot cell facility being constructed at the headquarters is expected to serve as a central hub for future characterization and analysis tasks.

The facility is being constructed under thorough management and review to ensure the effective execution of the research tasks described in this paper.

In-progress activities include facility improvements through design modifications, the development of scenarios for receiving intermediate-level radioactive waste, and the continuous customization of research equipment inside the hot cell. Once all the facilities are completed, they will play a pivotal role in the analysis and database construction for nuclear power plant decommissioning waste.

REFERENCES

- [1] Junghyun Park, Seung-Ho Lee, Eunmi An, Seokhan Kim, Yeong Su Ha, KRID's physical/radiological characterization plan for intermediate-level decommissioning waste, Korean Radioactive Waste Society Spring Meeting, Busan, Korea, May 29~31.