Construction of Radiochemical Laboratory for RadWaste analysis in KRID

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1. Introduction

The permanent shutdown of commercial nuclear power plants (NPPs), such as Kori #1 and Wolsong #1, has drawn increasing attention to the importance of safe decommissioning and radioactive waste management. With the imminent commercial NPP decommissioning scheduled for 2027, the Korea Research Institute of Decommissioning (KRID) was established to support the safe decommissioning of NPPs and to foster the domestic nuclear decommissioning industry as a future growth engine.

KRID is currently constructing its headquarters in Busan for the Kori #1 decommissioning and the Decommissioning and Demonstration Center (D&D Center) for Wolsong #1 in Gyeongju. Each site is equipped with essential infrastructure for technology development and demonstration, including an office building, a mock-up building, a demonstration analysis building, and a research building.

This paper presents the establishment and current status of the radiochemical analysis laboratory for radioactive waste from decommissioning NPPs in the research building, which was launched as the first dedicated facility for the radiochemical analysis of decommissioning radioactive waste.

2. Construction of Radiochemical analysis Lab

2.1 Setup of Radiochemical analysis Lab

KRID successfully completed the 1st of construction in December 2024, establishing key facilities, including the office building, mock-up building, and research building. After this, we started building the radiochemical analysis laboratory.

Originally, the research building was designed as a general research facility and was not equipped with the necessary infrastructure for RI utilization. Therefore, additional infrastructure was installed to enable the operation of an RI laboratory. As a priority, the exhaust and drainage systems, which are critical for radiochemical experiments, were established. The exhaust system includes 6 fume hoods inside the laboratory and 3 independent blower systems dedicated to the operation of ICP analysis equipment. Additionally, to comply with RI facility emission standards, filter units and filter boxes were installed in each exhaust line.

Furthermore, a hot sink was designed and constructed to safely manage radioactive liquid waste generated during radionuclide separation processes. To enhance the secure storage and handling of radioactive samples, additional radioactive sample storage and holding roomswere incorporated into the laboratory, which were not originally included in the initial design phase. Moreover, to strengthen the security and safety of radiation-handling experiments, a dedicated physical protection facility was established, further reinforcing the laboratory's radiation safety management system.

2.2 Installation of Equipment and Operation Plan

The KRID's radiochemical analysis laboratory is structured into a physical protection room, a pretreatment room, a radioactive sample storage room, and an analysis room, considering the experimental propose and the analysis characteristics of radioactive samples.

The radioactive sample storag rooms are equipped with ten lead storage racks each, allowing for systematic storage of incoming samples as well as before and after analysis. Additionally, to safely store high-activity radioactive samples, lead-shielded containers have been installed to enhance radiation shielding.

The pretreatment room contains a total of 6 fume hoods, each equipped with facilities for sample crushing, liquefaction, and chemical separation for radionuclide extraction. This setup allows for the pretreatment of various types of radioactive solid waste, such as concrete, metal, and resin waste matrices.

The analysis room is equipped with various high-performance analytical instruments for the characterization of radioactive nuclides. For alpha, beta, and gamma radiation measurements, HPGe, LEGe , LSC, alpha/beta counter, and alpha spectrometer have been installed. Additionally, for the precise quantification of radionuclides, ICP-MS and ICP-OES are available.

The analysis proceduresfor radioactive samples are carried out in strict compliance with systematic management process. Upon arrival, the samples are first stored in the radioactive sample storage room, followed

by pretreatment and radionuclide separation based on the experimental objectives and procedures. Finally, each sample undergoes quantitative analysis according to its characteristics.

3. Conclusions

KRID has established a radiochemical analysis laboratory to conduct radionuclide analysis of radioactive waste generated during the decommissioning process of NPPs. The laboratory is equipped with dedicated spaces and safety facilities for handling and analyzing radioactive samples, with essential infrastructure, including exhaust and drainage systems, fully implemented.

In the pretreatment room, facilities for sample crushing, liquefaction, and separation have been installed to process radioactive waste, such as concrete, metal, and spent resin. The analysis room is equipped with high-precision instruments, including HPGe , LSC , alpha spectrometer, and ICP-MS, enabling systematic radionuclide analysis.

Radioactive samples undergo strict intake and storage procedures before pretreatment and radionuclide separation, followed by quantitative analysis. KRID plans to fully operate the radiochemical analysis laboratory starting in April 2025, supporting the analysis of radioactive waste and contributing to the establishment of a safe management system for decommissioning waste from nuclear power plants.