

Development and Future Utilization of the KRID Concrete Hot Cell for Characterization of Intermediate-Level Decommissioning Waste

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1. Introduction

The decommissioning of nuclear power plants in Korea has been initiated in earnest with the approval of the final decommissioning plan for the Kori Unit 1 reactor. During this process, a significant volume of waste with diverse matrices and radioactivity levels is expected, of which approximately 5% will be classified as intermediate-level waste. Owing to its relatively high radiation intensity and heterogeneous composition, this category of waste requires stringent safety measures and detailed characterization. Yet, Korea currently lacks sufficient infrastructure to conduct systematic and reliable analysis of intermediate-level decommissioning waste, posing a major challenge to safe and effective decommissioning practices.

International organizations have also highlighted this issue. The IAEA stresses the need for comprehensive characterization and database development of radioactive waste to ensure safe management and disposal, while the OECD/NEA identifies such capabilities as a prerequisite for rational disposal strategies and regulatory compliance. These perspectives underscore that advanced analytical capabilities for intermediate-level waste are directly tied to enhancing national competitiveness in nuclear decommissioning.

In response, the Korea Research Institute of Decommissioning (KRID) is constructing a concrete hot cell, a dedicated facility for the analysis of intermediate-level radioactive materials. This facility will enable preprocessing and in-depth characterization—including physical, chemical, and radiological assessments—of decommissioning waste. Through this initiative, KRID seeks to strengthen domestic decommissioning capacity while establishing infrastructure aligned with international standards. Accordingly, this paper presents the background and current status of the hot cell project, and discusses its necessity and anticipated contributions to the advancement of waste management and analytical technologies.

2. Current Status

The Korea Research Institute of Decommissioning (KRID) is currently implementing a national research and development program aimed at establishing the infrastructure necessary for constructing a concrete hot

cell. The KRID hot cell is designed to enable the safe preprocessing and detailed characterization of intermediate-level radioactive waste generated during nuclear power plant decommissioning. The facility is composed of several specialized cells, including a transport cask cell, sample processing cell, sample preparation cell, characterization cell, chemical hot cell, receipt and storage cell, and maintenance cell.

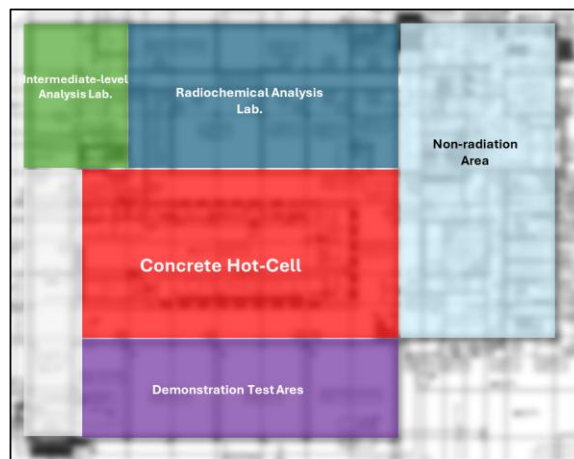


Figure1. Design drawing of demonstration analysis building



Figure2. Construction photograph of demonstration analysis building

At present, approximately 30% of the construction has been completed, as illustrated in the design

drawings and construction photographs (Figure 1 and Figure 2). The facility is scheduled for completion in the second half of 2026, with full-scale utilization expected to begin in 2027.

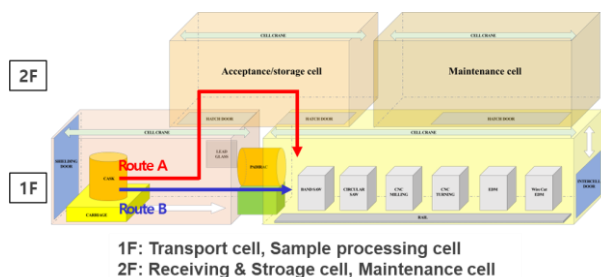


Figure 3. Sample incoming scenario of Hot-cell

To ensure immediate utilization upon commissioning, KRID is also developing operational scenarios and procedural guidelines in advance. These preparations are intended to facilitate efficient and safe operations from the very early stages of use. For example, a detailed scenario for the movement and handling of samples—from receipt and preprocessing to characterization and storage—has been established, as illustrated in Figure 3.

3. Future plans

Looking ahead, efforts will focus on ensuring the successful completion and stable operation of the concrete hot cell through a systematic review of both construction-related aspects and research equipment. With regard to construction, design reviews are being conducted for key components such as manipulators, shielding windows, penetrations, and doors. To strengthen the reliability of the design, benchmarking activities including visits to domestic and international hot cell facilities and expert seminars are being undertaken, enabling lessons learned and operational experiences to be incorporated. These reviews will be continued throughout the construction period in order to address potential issues in advance and to secure the safe and reliable completion of the facility.

In terms of research equipment, more than twenty instruments will be installed within the hot cell, requiring detailed consideration of radiation protection measures. In particular, control units and semiconductor-based components that are vulnerable to radiation are planned to be located outside the hot cell, while only the essential mechanical drive units will be installed inside. Each instrument is being carefully evaluated for suitability and specification, and technical discussions are ongoing to establish the separation between the drive and control units as part of the design process.

Furthermore, the establishment of operational procedures is recognized as a critical prerequisite for hot cell utilization. Draft procedures have already been prepared for each process, including sample transport,

processing, pretreatment, and characterization. These drafts will be refined and advanced to ensure practical applicability under real operating conditions. In addition, procedures for safety management and emergency response are also being prepared, thereby enabling immediate and systematic responses to a range of potential operational scenarios.

Through these integrated efforts across construction, equipment design, and procedural preparation, the project aims to ensure the successful commissioning and long-term stable operation of the hot cell. Ultimately, the facility is expected to function as a core national research infrastructure dedicated to the characterization of decommissioning waste, thereby reinforcing Korea's technical foundation in nuclear decommissioning.

4. Conclusion and future utilization

The concrete hot cell currently being developed by the Korea Research Institute of Decommissioning (KRID) represents the first domestic infrastructure dedicated to the preprocessing and detailed characterization of intermediate-level decommissioning waste. Considering the progress achieved and the planned future activities, the facility is expected to evolve beyond a conventional research space and serve as a core foundation supporting national decommissioning policies and regulatory compliance.

One of the primary contributions of the facility will be the systematic accumulation of physical, chemical, and radiological data on decommissioning waste, enabling the establishment of a comprehensive national database. Such data will support the development of safe management and disposal strategies while enhancing the reliability of regulatory assessments and licensing processes. Furthermore, by aligning with ISO/IEC 17025 and integrating with the KOLAS accreditation framework, analytical results produced within the hot cell will be recognized as certified testing data, thereby strengthening national credibility in waste characterization.

The facility is also envisioned as a platform for international collaboration and academic exchange. Through cooperative projects with organizations such as the IAEA and OECD/NEA, and joint research with leading foreign institutes, KRID aims to contribute to global standardization efforts while simultaneously enhancing the international competitiveness of Korean decommissioning technologies. In addition, the facility will provide a research foundation capable of addressing future demands, including the decommissioning of next-generation reactors, thereby extending its relevance and applicability.

In conclusion, the KRID concrete hot cell is expected to significantly reinforce national capabilities for managing and characterizing decommissioning waste. Upon commissioning, it will provide versatile benefits

across research, industry, and regulatory domains, establishing a robust basis for the safe and reliable decommissioning of nuclear power plants while elevating Korea's technical standing in the international arena.

REFERENCES

- [1] IAEA, Disposal Aspects of Low and Intermediate Level Decommissioning Waste, IAEA Technical Reports Series No. 389, Vienna (1998).
- [2] IAEA, Strategy and Methodology for Radioactive Waste Characterization, IAEA-TECDOC-1537, Vienna (2007).
- [3] OECD/NEA, Radiological Characterisation from a Waste and Materials End-State Perspective, NEA No. 7373, Paris (2017).
- [4] OECD/NEA, Optimising Management of Low-Level Radioactive Materials and Waste from Decommissioning, NEA No. 7425, Paris (2020).
- [5] World Nuclear Association (WNA), Radioactive Waste Management, Updated September 2022. Available at: <https://world-nuclear.org>
- [6] 원자력안전위원회, 「제 5 차 방사성폐기물 관리 기본계획(2021-2035)」, 서울 (2021).