

DESIGN OF NEW RADIOCHEMICAL ANALYSIS LABORATORY FOR NUCLEAR WASTE MANAGEMENT AND DISPOSAL OF KHNP

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The new radiochemical analysis laboratory is designed for the construction at KHNP CRI. The laboratory consists of 8 rooms in the total area of 558 m². The construction of the laboratory is expected to finish in 2017, and the installation of most of measuring instruments and apparatus for preparation and nuclide separation are expected to be complete until December 2018. This laboratory supports the management and disposal of the nuclear wastes produced during the operation of nuclear power plants and the decommissioning of K-1 unit in Korea.

I. INTRODUCTION

It is confidently expected that the demand of radiochemical analysis will be increased as starting operation of nuclear waste disposal facility and decommissioning of K-1 unit. The requests of the cross analysis and re-analysis by regulatory body and radioactive waste agency will also be frequent to reduce the uncertainty of measurement. It is postulated that the required quantities of radiochemical analysis will be increased more than two times than normal. In order to respond preemptively and properly to this situation, the new radiochemical analysis laboratory is intended to be constructed. In this study, the design of new radiochemical analysis laboratory, the employment of measuring instruments and the future plan are introduced.

II. DESIGN

II.A. Objectives

We should analyze the nuclide species and inventory in radioactive wastes produced from nuclear power plants prior to disposal. Main nuclides described in Table I should be investigated and analyzed for the disposal. At least 31 nuclides in Table I are analyzed in the new radiochemical analysis laboratory.

TABLE I. Main Radionuclides in the Nuclear Waste Investigated for the Disposal

Category	Nuclides
Mandatory for Disposal	³ H, ¹⁴ C, ⁵⁵ Fe, ⁵⁸ Co, ⁶⁰ Co, ⁵⁹ Ni, ⁶³ Ni, ⁹⁰ Sr, ⁹⁴ Nb, ⁹⁹ Tc, ¹²⁹ I, ¹³⁷ Cs, ¹⁴⁴ Ce, total alpha
Gamma Nuclides	²³⁸ Pu, ²³⁹ Pu, ²⁴⁰ Pu, ²⁴¹ Pu, ²⁴¹ Am, ²⁴² Cm, ²⁴⁴ Cm ⁵¹ Cr, ⁵⁷ Co, ⁵⁴ Mn, ⁵⁹ Fe, ⁶⁵ Zn, ⁹⁵ Zr, ⁹⁵ Nb, ^{110m} Ag, ¹²⁵ Sb, ¹³⁴ Cs

As shown in Table II, it is confidently expected that the demand of radiochemical analysis will be increased as starting operation of nuclear waste disposal facility and decommissioning of K-1 and W-1 in the near future. The target of measuring capacity of new radiochemical analysis laboratory is over 7,500 a year.

TABLE II. Demand of Radiochemical Analysis for Operating and Decommissioning NPPs

Year	2019	2020	2021	2022	2023	2024	2025
Operating NPPs	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Decommissioning	K-1 500	500	500	500	4,000	4,000	4,000
	W-1 -	-	-	-	-	500	500
Total	3,500	3,500	3,500	3,500	7,000	7,500	7,500

II.B. Layout

The laboratory consists of one room on the second floor and 7 rooms on the third floor. The total area of the laboratory is 558 m². A room on the second floor is for general chemical experiments. The third floor is divided into 7 rooms as shown in Figure I, which are designated radiation areas as handling open radioactive material except health physics room and hall. The rooms are placed in the order of the analytical steps i.e. receiving, preparation, separation and measurement. Most of rooms are located on both sides of main corridor, which plays role in reducing the propagation of radioactive materials, toxic chemicals and debris generated during the sample preparation. Radioactive storage room is designed for the safe and secure storage of all radioactive material such as samples and wastes. Preparation room is for decomposing and liquefying samples easy to separate nuclides and then analyze them. Separation room is for purifying and separating each nuclide from the pretreated samples. Three measuring rooms are for counting alpha, beta and gamma, measuring physical-chemical properties and characterizing samples. These rooms are compartmentalized in order to be free from intervention.

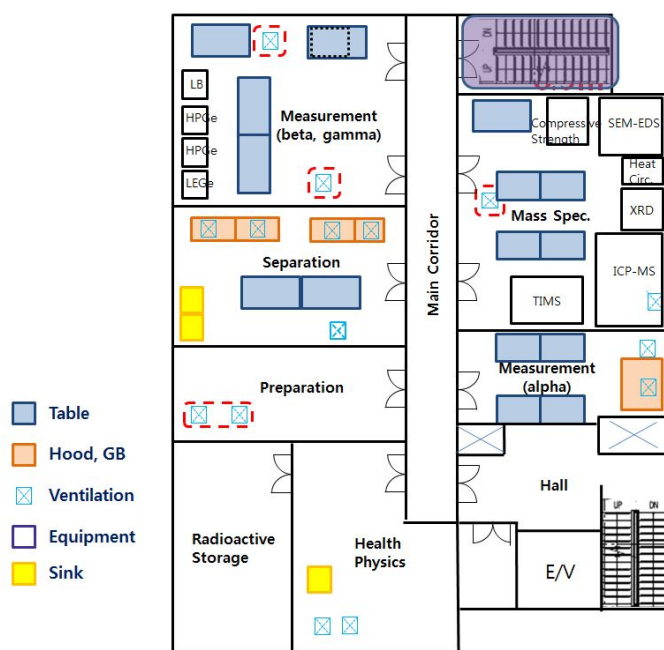


Fig.1. Layout on the Third Floor of Radiochemical Analysis Laboratory at KHNP CRI

II.C. Measuring Instruments

A pyrolyser, a fusion machine, a microwave digestion, centrifugal separators, milling machines and etc. are installed in the preparation room and they are used for the fusion, melting, acid extraction and chemical solution in the steps of sample preparation. Various separators and resins are used for nuclide separation. Alpha spectrometers, LSCs, LBs, two of HPGe, an LEGe and other instruments for measuring alpha, beta and gamma are installed in the measuring rooms. ICP-MS, TIMS, SEM-EDS, XRD and other equipment for measuring physical properties are also installed in the measuring room. Some hoods and gloveboxes for dealing with toxic chemicals are employed.

III. CONCLUSIONS AND FUTURE PLAN

The new radiochemical analysis laboratory is designed for supporting the management and disposal of the nuclear wastes produced during the operation of NPPs and the decommissioning of K-1 unit in Korea. The construction of the laboratory is started December in 2016 and expected to finish in 2017. The equipment for the sample pretreatment and nuclide separation, the measuring instruments and the apparatus for investigating physical properties are installed until December in 2018.

REFERENCES

1. EPA, NUREG, DOE, DOD, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (2000).
2. X. HOU, "Radiochemical Analysis for Decommissioning of Nuclear Facilities", KRS workshop, Jeju, Korea (2016).
3. C. S. FARMERY, *Design of Radiochemical Laboratories*, the University of Edinburgh (2006).