Radioactive Wastes Assay Techniques and Equipment for the Waste Drums Stocked in KAERI

Kang Moo Lee, Dae Suk Hong, Il Sik Kang, Jong Sik Shon, Kwon Pyo Hong

Nuclear Fuel Cycle Test Team, Korea Atomic Energy Research Institute,
P.O Box 105, Yusong, Daejeon , 305-600, nkmlee@kaeri.re.kr

1. Introduction

The radioactive waste inventory records should be submitted together with the radioactive waste packages for the final disposal. Therefore the radioactive wastes of nearly around 10,000 drums stocked in KAERI should be assayed to get those records. As a part of that preparation, the wastes drum assay techniques and equipment which are commercially utilized at present are investigated and the most suitable and practicable method and equipment for the KAERI-waste assay are presented.

2. Regulations, Techniques and Equipment

In this section the necessity of wastes assay and the investigation results of the practical techniques and equipment for the wastes assay are described.

2.1 Legal Requirements for Disposal

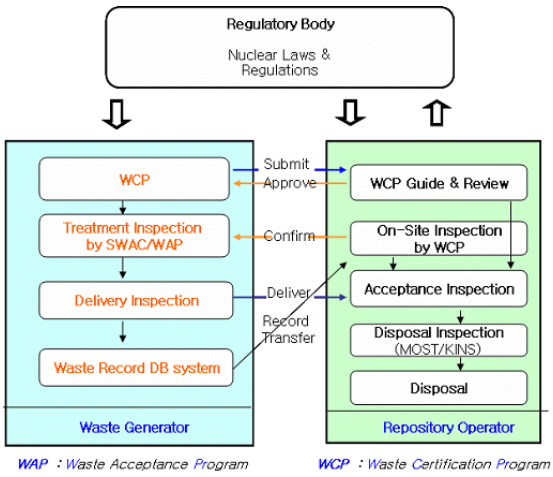

Fig.1 Wastes Package Delivery Procedure for Disposal

According to the regulations [1], [2], the radioactive wastes producer must deliver the waste packages with the waste records including the radioactive nuclides and those radio activities, the gross activity[3](cf. Table 1) and the waste form of each waste package. The records are used as the basic data for WCP(Waste Certificate Program) and WAP (Waste Acceptance Program) by which the waste packages are delivered to the repository. The delivery procedure of wastes for final disposal is as like Fig.1.

Table 1. Concentration Limits of Major Nuclides & Identification Required 18 Nuclides by Law

Concentration Limits (Bq/g per Drum)	Designated 18-Nuclides
H-3(1.11E6), C-14(2.22E5), Co-60(3.7E7),Ni-59(7.4E4), Ni-63(1.11E7),Sr-90(7.4E4), Nb-94(1.11E2),Tc-99(1.11E3) I-129(3.7E1),Cs-137(1.11E6), Gross α(3.7E3)	H-3, C-14, -59, Co-60, Ni-63, Sr-90, Nb-94, Tc-99, I-129, Cs-135 Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cm-242, Cm-244, Grossα

2.2 Wastes Package Assay Techniques

The major waste assay techniques in current use are as followings;

2.2.1Direct Assay Method

Every drum of waste packages is assayed destructtively using such as the radiochemical assay technique or nondestructively by the gamma techniques and the neutron techniques. The destructive-direct method produces the accurate results but needs much cost and man-hour. On the contrary, as the nondestructive-direct method needs not to open or destruct the waste packages, it is more practicable especially for the routine assay.

2.2.2 Indirect Assay Method

The representative sample of waste packages are assayed by the experimental or theoretical method, such as the scaling factor method, the mean activity concentration method, the representative spectrum method and the activation method, which is very advantageous in saving the time and cost for assay. The reasonableness of representing sample should be approved but it is not easy for the wastes of having no regular waste stream.

2.3 Assay Equipment

Presently the most practicable non-destructive waste assay equipment for the waste drums are the SGS(Segmented Gamma Scanner) system and the TGS(Tomographic Gamma Scanner) system.

2.3.1 SGS

SGS has been generally used for wastes assay. The wastes drum is broken into several segments for scanning and then one or multiple HPGe or NaI(Tl) detectors measure the gamma-ray peaks from each segment. Attenuation characteristics of the γ-ray from each segment is measured by the transmission source installed on the opposite side. SGS is known as suitable for the low density wastes assay. (Fig. 2)

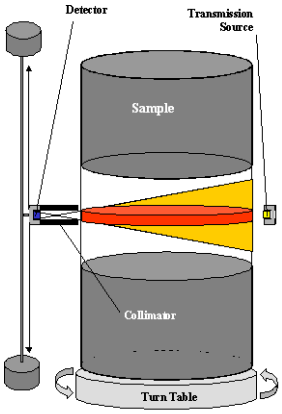

Fig.2 Principal Features of SGS

2.3.2 TGS

As TGS is developed relatively in recent, it is the more quality and convenient wastes assay system, i.e., it gives accurate, quantitative, non-destructive estimate of the 3-D distribution of γ-emitting radionuclides filled with the heterogeneous matrix with non-uniform radionuclide distribution using the low spatial resolution transmission and emission imaging.(Fig. 3)

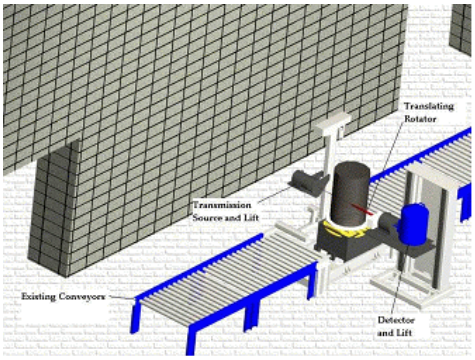

Fig.3 Automatic Wastes Assay System with TGS[4]

2.4 Some Considerations for KAERI- Wastes Assay

2.4.1 Characteristics of KAERI-Wastes

The characteristics of radioactive wastes [5] generated at KAERI, as shown in Table 2, are different from those of nuclear power plants. Because of the various types of waste, non-homogeneity and many kinds of nuclides contained in the wastes and furthermore the small quantity of each waste and the irregularity of the generating time and period, KAERI wastes are not kept up the uniform waste streams. It gives rise to get out so many scaling factors independently from each of the various waste streams for using the indirect waste assay technique.

Table 2. Characteristics of KAERI-Wastes

Item	Characteristic
1.Waste stream	No uniform streams
2. Waste form	Various kinds of wastes
3. Nuclides	Many kinds of nuclides
4. Quantity	Small quantity of each lump
5. Generation	Irregularity of time & period

2.4.2 In Case of Nuclear Power Plants

In case of the domestic nuclear power plants, SGS has been used tentatively in some sites. Based on the results of experimental operation, TGS is decided finally as the wastes assay equipment for all of the NPP sites and those are to be installed on sites in this year. Therefore it is anticipated that the repository and the regulatory body may adopt TGS as their own verification equipment also.

3. Conclusion

As KAERI-wastes have no regular waste streams and the characteristics are unique, very differently from NPP's, application of the in-direct wastes assay technique using the scaling factors are neither effective nor economic for the KAERI-wastes. Considering for the versal conveniency including the accuracy over the wide range of waste forms and the combination of assay time and sensitivity, TGS is appropriate as for the KAERI-stocked radioactive wastes assay equipment. Also, using the same kind of equipment, i.e., TGS which both NPP;the major wastes generator (and perhaps the repository and the regulatory body too) will use, may give us much conveniences for the harmonious mutual communication through the database network such as WACID and etc.

REFERENCES

[1] MOST Enforcement Notice No. 2001-32 ; 'The Criteria for the Delivery of Intermediate and Low Level Radioactive Wastes',
[2] MOST Enforcement Regulation No.98; 'Transportation of the Wastes Package'
[3] Revision of MOST Notice No. 2001-32 (Draft)
[4] Canberra Product Catalogue , 12th Edition(2004)
[5] K. M. Lee et al., 'Radioactive Waste Assay Technique & Equipment - KAERI Wastes Assay Plan', pp.31-34, KAERI/ TR -2879/2004