Rational Radiation Safety Technology

Background and Objective

Radiation safety in this country has been ensured through a deterministic approach to assessing individual dose with conservative parameters. On the other hand, a new methodology for dose assessment is being developed adopting probabilistic and risk-informed approaches toward optimization of resources (human, facility and performance of equipment) required for compliance with international safety standards.

In this project, we propose a methodology to reasonably ensure radiation safety standards such as exemption and clearance[1] of extremely low-level radioactive waste through enhancement of measurement and safety assessment techniques.

Main results

1. Evaluation of measurement performance for clearance of concrete materials

The methodology of metal waste measurement for compliance with clearance level has been already established in this country. On the other hand, in the case of concrete waste for clearance, there is a need to develop measurement techniques to appropriately subtract counts of radiation due to natural radioactive nuclides such as potassium-40 (K-40) from the total counts. From the above reason, detection limit was estimated as a function of scattering (relative standard deviation) of probability distribution of natural radioactivity, which was obtained from measurement results of representative samples from a nuclear power plant (Fig. 1). As a result, it was made clear that detection limit satisfies a target value (equivalent to one tenth of the clearance level for Co-60) when the measuring unit is beyond approximately 20 kg, even though there is large scattering (e.g. the relative standard deviation is 0.3). This shows that a reasonable measurement technique for clearance of concrete material was established and completed [L09003].

2. Proposal of rational exemption level for surface contamination

The current radiation safety standard for surface contamination was established through conservative parameters using two categories for alpha emitters and the others, based on past knowledge on radiation protection. In this study, the rational nuclide-specific exemption level for surface contamination was derived considering treatment types of contaminated objects (manually, closely and remotely handled), calculating the individual dose due to contamination and normalizing the individual dose to 0.01 mSv/y. As a result, it was clarified that the current standard has a remarkably large safety margin and therefore could be eased, although the current standard for Co-60 (most severe case) is almost the same as the derived exemption level[1)] (Fig. 2).

Other reports 1) Appl. Radiat. Isot, 67, 1283-1286 (2009)

1 Exemption is not to be considered under any radiological regulation since the radiation risks to individuals caused by the exempted practice or source are sufficiently low as to be of no regulatory concern. Clearance is to remove radiological regulation in the same way.

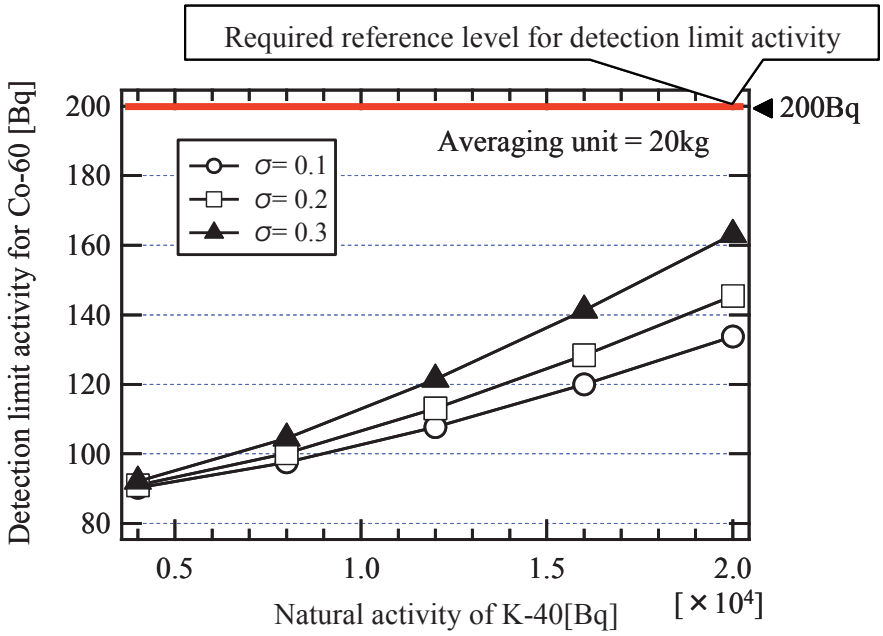

Fig. 1 Estimated results of the detection limit activity for Co-60 at a normal natural activity range of K-40

This indicates that the small amount of Co-60 is detectable even though natural radioactivity concentration is slightly high.

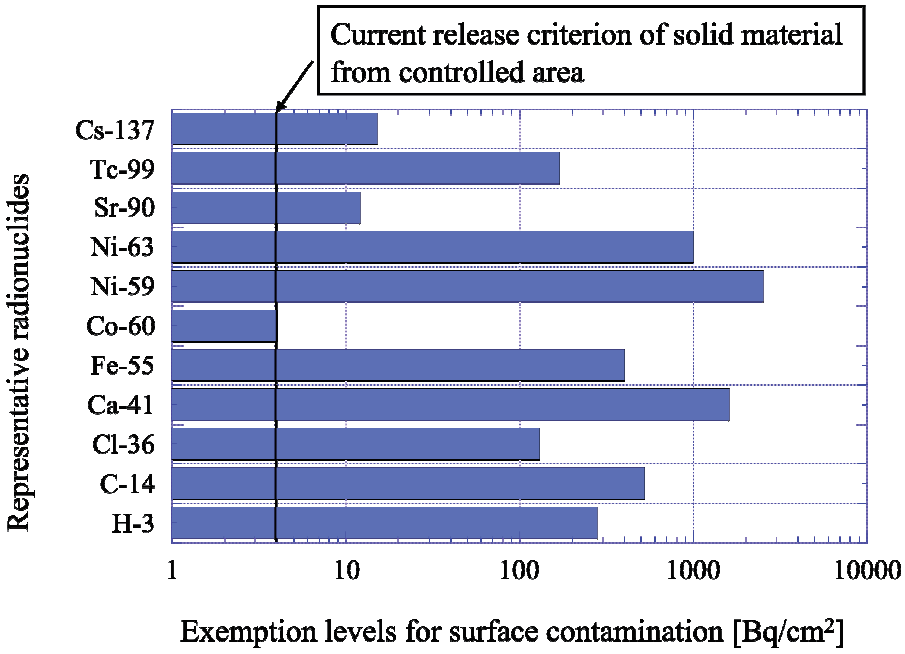

Fig. 2 Result of calculation of exemption levels for surface contamination

Exemption levels for surface contamination, which was derived based on the latest scientific knowledge, were found to be higher than current criterion, except for Co-60. The results suggest the possibility that current radiation protection standards for surface contamination could be eased.