

## Principal Research Results

# Development of Inspection System for Clearance Level (CLALIS) and Proposal of Reasonable Methods to Judge Satisfaction of Clearance

## Background

In recent years, basic concepts for compliance with clearance level, that is distinction level to separate the solid material to be treated as radioactive, have been examined in Japanese regulatory authorities. The detail of methods for the verification of clearance level was described in a standard entitled “Monitoring for Compliance with Clearance level: 2005” and released in August 2005, by the Standard Committee (SC) in the Atomic Energy Society in Japan (AESJ). In drafting this standard, reasonable methods were requested, which can measure quite a low level radioactivity with high reliability and judge the satisfaction of the clearance level without setting an excess safety margin in the judgment.

## Objectives

To develop an automatic clearance level monitor which can measure radioactivity in metal wastes accurately without human factor. To propose a reasonable method to judge satisfaction of the clearance level appropriately considering uncertainties of measurement data for the objective nuclides such as Co-60 and Cs-137 and scattering of relation between the objective and the other nuclides.

## Principal Results

### 1. Development of clearance level automatic laser inspection system (CLALIS)

A new clearance monitor, CLALIS has been developed (Fig.1). CLALIS enables low level measurement with high accuracy. The full automatic measurement that could not be achieved by the former style, realizes the removal of human factor from the measurement results.

### 2. Verification of performance of CLALIS

As a result of the performance tests for approximately 260 patterns of mock metal wastes, it was made clear that the accuracy of the CLALIS is within +/- 20% (Fig.2). Using the result of the accuracy, detection limits for Co-60 and Cs-137 have been estimated 100 Bq and 240 Bq, respectively, which enables simultaneous judgment of Japanese legal criteria for surface density level in addition of the satisfaction of the clearance level.

### 3. Proposal of reasonable method to judge satisfaction of clearance level

Some nuclides, which are impossible to measure easily, are to be estimated using the previously prepared nuclide ratio to a key nuclide, for example Co-60. A new method has been proposed and adopted to the SC in the AESJ as follows; If the uncertainties of nuclide ratios are within the upper limits of the scattered nuclide ratios determined using a probabilistic approach, it would not be necessary to treat the clearance level as lower level considering some margin for uncertainties of measurement and nuclide ratio (Fig. 3). In addition, a probability distribution calculation system (PDCS), which is required for the application this method, has been developed and opened from our CRIEPI web site for free use.

## Future Developments

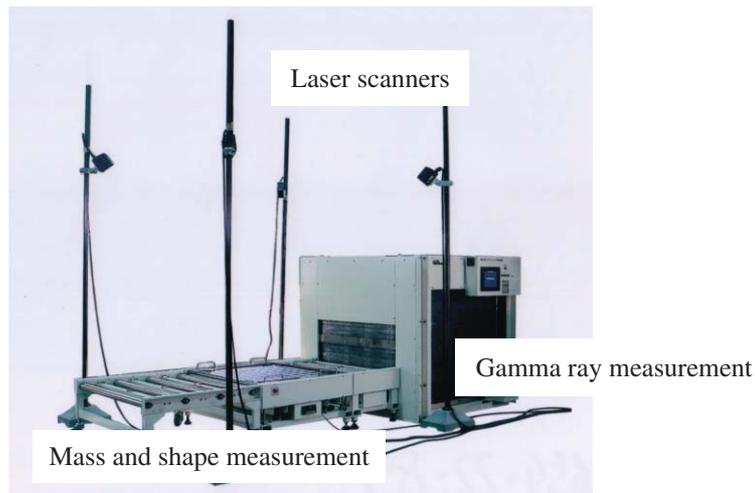
In the future, extension of the measurement target of CLALIS to concrete wastes in addition to metal wastes will be carried out after developing a method to remove the effects of natural radioactive nuclides.

### Main Researcher:

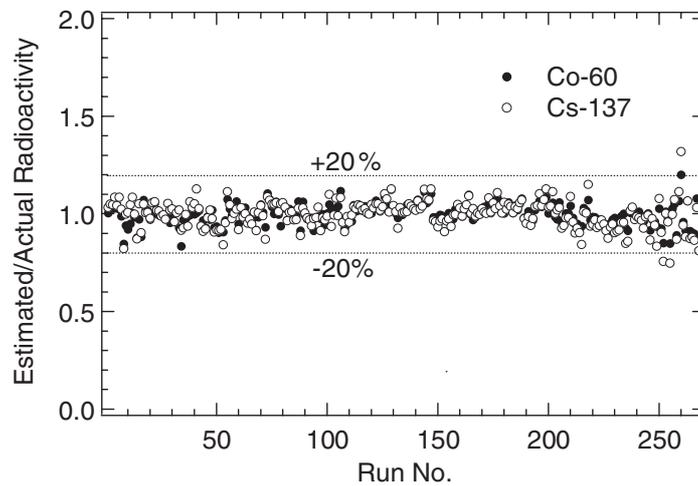
Takatoshi Hattori, Ph. D., Senior Research Scientist and Michiya Sasaki, Ph. D., Research Scientist,  
Radiation Safety Sector, Nuclear Technology Research Laboratory

### Reference

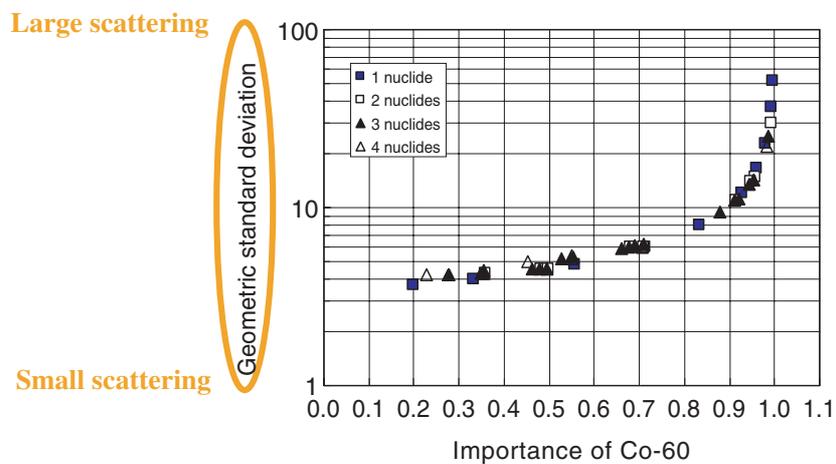
- M. Sasaki and T. Hattori, 2005, “Development of clearance level automatic inspection system, Nuclear Technology Research Rep. L01 (in Japanese)  
T. Hattori, 2004, “An Approach to Safety Margin for Measurement Error and Scattered Nuclide Spectrum on the Monitoring for Compliance with Clearance Level”, Transactions of the Atomic Energy Society of Japan, Vol.3, No.4, pp363-368 (in Japanese).



**Fig.1** Clearance level automatic laser inspection system (CLALIS)



**Fig.2** Accuracy of CLALIS Possible to measure within +/- 20%



**Fig.3** Concepts for upper limit for scattering of nuclide spectrum (an example of simple method)

Large scattering in nuclide spectrum is permissible in the case that Co-60 is dominant nuclide.