Assessment on Reliability of Scaling Factor depending on the Size of the Database for the Activity of Radionuclides

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Final disposal of radioactive waste generated from Nuclear Power Plant (NPP) requires the information of the radionuclides inventories in waste package by national regulations and guidelines. However, the direct assessment through the destruction of the drummed radioactive waste for all stored drums is difficult economically and time-consuming. Thus it is well-known to rely on the indirect method by which the activities of the Difficult-To-Measure (DTM) nuclide are estimated using the correlations of the activities between the Easy-To-Measure (Key) nuclide and the DTM nuclide with the measured activities of the Key nuclide, so called the scaling factor method. Generally, the scaling factor is determined by the statistical process for the database for the each activity of the nuclides in waste stream sample. Therefore the reliability of the scaling factor determined depends on the size of the database for the activity of radionuclides. The assessment of the scaling factor depending on the size of the database is conducted by the blind test in which the number of data used for the calculation of scaling factor is increased as the number of 10, 20, 40, 80, 160. Figure I shows the procedure of the blind test. For the assessment, the data in EPRI-4037 is used, and ^{63}Ni is selected as DTM nuclide and ^{60}Co as Key nuclide. The assessment is conducted 5 times per each size of the database and the following formula is used the criterion of the assessment.

$$\text{Relative discrepancy (\%)} = \begin{cases} \dfrac{A_{predicted}}{A_{measured}} \times 100 & (\text{if } A_{predicted} > A_{measured}) \\ \dfrac{A_{measured}}{A_{predicted}} \times 100 & (\text{else}) \end{cases}$$

$A_{predicted}$: Predicted activities of DTM nuclides

$A_{measured}$: Measured activities of DTM nuclides

Figure II ~ VI show the box plot of the relative discrepancy depending the size of the database. As the size is larger, the value of the relative discrepancy is lower, and the deviation of it is shortened. It is concluded that the reliability of scaling factor is increased as the increase of the size of the database for the activity of radionclides.

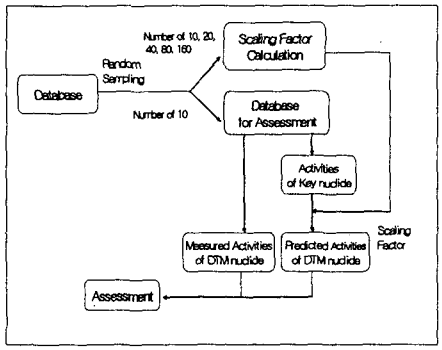

Figure I. Procedure of Blind Test

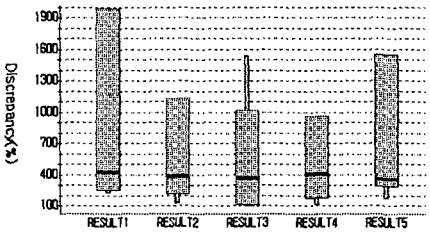

Figure II. Box Plot of Relative Discrepancy of Blind Test where Number of 10 Data are used for Scaling Factor Calculation

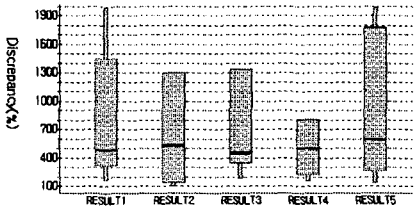

Figure III. Box Plot of Relative Discrepancy of Blind Test where Number of 20 Data are used for Scaling Factor Calculation

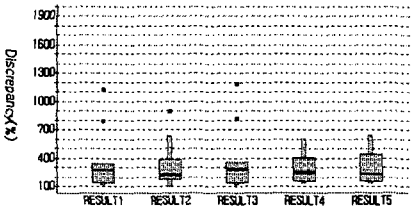

Figure IV. Box Plot of Relative Discrepancy of Blind Test where Number of 40 Data are used for Scaling Factor Calculation

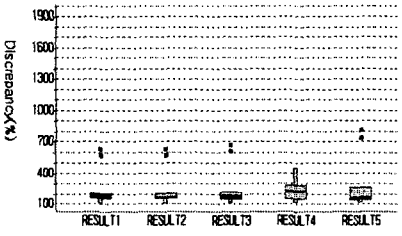

Figure V. Box Plot of Relative Discrepancy of Blind Test where Number of 80 Data are used for Scaling Factor Calculation

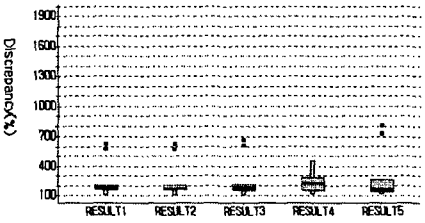

Figure VI. Box Plot of Relative Discrepancy of Blind Test where Number of 160 Data are used for Scaling Factor Calculation