Study of a sampling method for a Very Low-level scrap metal recycling

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1. Introduction

Radioactive metal waste generated at nuclear power plants or related facilities has been disposed of and recycled by each of them since 2000 in Korea. Especially, disposal limitations are 10 μ Sv as personal radiation dose per year and 1 man· Sv as group radiation dose per year, and less waste than the disposal limitation is allowed to be disposed by each facility [1]. Foreign countries offer limitation about metal wastes generated at nuclear power facilities by introducing deregulation concept. For example, DOE (Department of Energy) of USA offered a procedure for emitting radioactive metal waste in 1993; since then, the procedure has been applied [2].

Disposal procedure performed by each facility in Korea includes waste classification regarding its system and class, cutting, decontamination, nuclide analysis, and dose evaluation in order. However, the regulating organization has offered neither a method for sampling a representative test material in the self-disposal procedure nor concrete nuclide deregulation limits [3]. Therefore, this research is to apply a sampling method based on the method offered by DOE guide to recycle radioactive metal waste.

2. Methods and Results

DOE offered the guide for distinguishing and releasing a background level of reference metals from waste generated at each nuclear power facility so as to make it possible to reuse radioactive metal waste [4].

2.1 Proposed method

The method offered by DOE to dispose of radioactive metal waste is based on the methodology of MARSSIM. The following figure is organized with a procedure for releasing scrap metal.

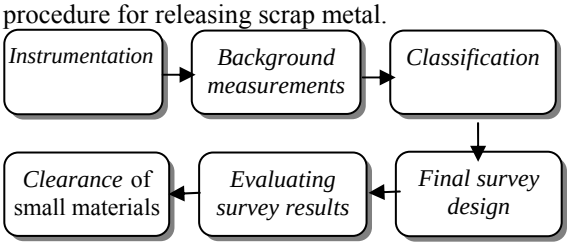

Figure 1. Scrap metal release procedure

Instrumentation is a step for checking reliability of result values after measurement. At this step, backgrounds of measuring equipments are detected and IMC (Individual Measurement Comparison) levels of the equipments are found and compared with each other. Because the equipments have different characteristics, a value offered by DOE 5400.5 is used.

Background measurement is a step for measuring substances made of the same material in the same method to judge contamination of scrap metal. According to the DOE guide, such step is performed to make a comparison level used in releasing a background level of metals from radioactive metal waste.

Classification is a step for dividing the level into class 1, 2, and 3 through historical assessment of metal waste. However, all wastes to be released are determined on the basis of class-3 metal having contaminated surface.

Final survey is a step for measuring scrap metal, and statistically analyzing and evaluating result values and background values. This statistical analysis uses the Wilcoxon rank-sum method.

2.2 Applied the method

The above methodology is applied to an active carbon filter case generated at the Uljin division of Korea Hydro and Nuclear Power Co. Ltd. The active carbon filter case is to be disposed by the division, and has been cut and stored.

Figure 2. Stored active carbon filter case

A smear method is used to measure surface contamination of metal waste, and the smear uses a method offered by ASTM [5]. Calibrated gross α and β counters are used as measuring equipments. Background of the equipment is 50 cpm, and the measurement result is reliable because the value is not over 99 cpm which is the IMC level offered by DOE 5400.5.

The active carbon filter case is made of EGI by coating a steel plate with zinc. Substances made of the same material are tested by the smear method to determine the background value. Result values of the same material substances are obtained from 20 and 30 locations. Table 1 given below shows measurement

results and statistical analysis data about substances made of the same material with the active carbon filter case.

Table 1. Survey & Reference data

	Survey data	Reference data	Adjusted Reference data	Reference Rank
1	50	52	58	20.5
2	61	54	60	36
3	61	54	60	36
4	71	52	58	20.5
5	55	54	60	36
6	63	53	59	30.5
7	57	54	60	36
8	61	52	58	20.5
9	78	53	59	30.5
10	58	57	63	45.5
11	53	52	58	20.5
12	68	52	58	20.5
13	52	52	58	20.5
14	60	52	58	20.5
15	79	51	57	10.5
16	56	53	59	30.5
17	75	52	58	20.5
18	51	52	58	20.5
19	56	56	62	43
20	72	57	63	45.5
21	88	51	57	10.5
22	63	52	58	20.5
23	60	52	58	20.5
24	73	53	59	30.5
25	52	51	57	10.5
26		52	58	20.5
27		52	58	20.5
28		52	58	20.5
29		52	58	20.5
30		54	60	36
			Wr	775

Each data resulting from statistical analysis is calculated by the Wilcoxon rank-sum method. This method compares a critical value with a sum value of each ranked data to evaluate data.

Wr value obtained by summing ranked data is 775. The compared critical value of data is 896.2. Confidence level of statistical results is 95%. Because Wr is lower than the critical value, the active carbon filter case cannot be determined to show the same level of radioactivity with the same material substances.

3. Conclusions

In this research, the guide offered by DOE to release scrap metal is applied to radioactive metal waste which is to be disposed by each facility. This shows contamination or not of radioactive metal waste through data statistically demonstrated by comparing with data of the same material substances.

In comparison with the same material substances, the active carbon filter case does not show the same level of radioactivity. However, this is obtained by comparison of only gross α and β , and gamma analysis is additionally needed to release the scrap metal.

Through this methodology, contamination of radioactive metal waste can be determined. It is to judge contamination by statistically comparing data of radioactive metal waste with data of the same material substances. If this methodology is applied into radioactive metal waste to be disposed of from now on, it might increase working efficiency by reducing time and cost for self-disposal and change public awareness about radioactive metal waste.

The future research needs to establish an organized method for recycling radioactive metal waste by increasing the number of samples and by studying more reference substances.

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