Evaluation of the Inventories Released from Liquid Radwaste Treatment Systems of Wolsung Nuclear Power Units 3 and 4 Using Linear Regression Method

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1. Introduction

In the preparing stage of Final Safety Analysis Report (FSAR), the expected inventories of radwaste treatment systems are estimated. The inventory calculation plays an important role in the estimation of environmental radiation as well as nuclear power plant (hereafter referred to NPP) integrity, and further improvement of the public perception for NPP or radiation. The inventory has been accumulated and periodically measured for every NPP during the whole operation in Korea. But, a detailed analysis and database construction for the inventory have not still been carried out.

For estimating the inventory change in this study, the radwaste treatment systems of Wolsung (hereafter referred to WS) nuclear power units 3 and 4 were selected as the reference systems. An analysis and prediction of the inventory change were performed for total activity released to environment during the whole operation. The linear regression analysis based on least squares method was applied to the estimation.

2. Methods and Results

2.1 Description of the liquid radwaste treatment system

The function of the liquid radwaste treatment system is to collect radioactive or potentially radioactive liquid wastes generated during plant operation, to process the liquid waste in order to remove radioactive isotopes, to accumulate radioactive isotopes for storage or disposal and to discharge the treated liquid to environment. Liquid radwaste contains boric acid as well as particulate and ionic radioactive materials, and the radioactive materials are removed through filter and evaporator. Liquid, whose activity is almost removed, can be reused in a plant or released to environment through radiation monitoring systems. Release to the environment of liquid radwaste is managed not to exceed the concentrations in water prescribed in the notice[1] of the Ministry of Science and Technology.

2.2 Application of linear regression analysis

The radwaste inventory generally increases linearly according to the operation history if there is no abnormal situation which resulted in a high activity in the radwaste treatment systems during operation[2]. Linear regression analysis using least squares method can provide a methodology for estimating the inventory change according to the operation history. Linear regression analysis[3] based on least squares method was thus employed to estimate the inventory change in the liquid radwaste treatment system of WS nuclear power units 3 and 4 in this study. Furthermore, future inventories of the radwaste were predicted using the relationship between inventories and operation histories.

The characteristics for the inventory data were firstly analyzed by nuclides contributing to the total activity prior to regression analysis. ^3H was turned out to be a major nuclide and its contribution was over 99 % for the total activity. Total activities, whose activities are much the same ^3H, were applied to estimation of the inventory change. These values which were within under the lower limit of detection (LLD) as well as beyond 95 % confidence interval were excluded for deducing the exact characteristics of the inventory changes.

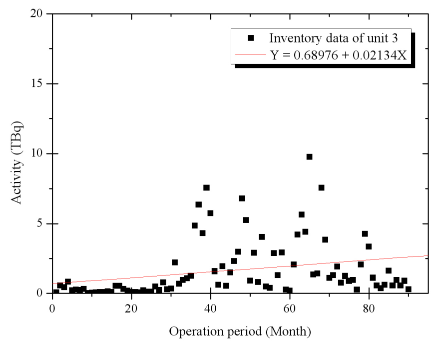

Figure 1. Inventory changes for total activity in liquid radwaste treatment system of WS nuclear power unit 3

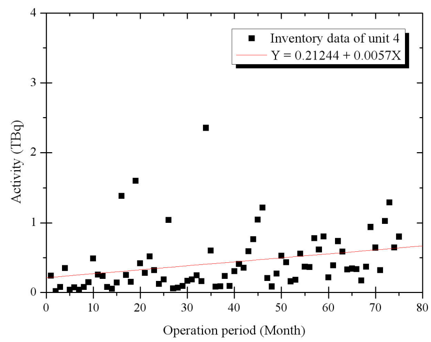

Figure 2. Inventory changes for total activity in liquid radwaste treatment system of WS nuclear power unit 4

From Figure 1 and Figure 2**,** it is noted that the inventory change of the radwaste show a linear increase for the operation histories in the units 3 and 4. The activity increase of unit 3 was higher than that of unit 4 due to the release of the defective fuels from unit 3 in 1998 year. These results mean that the future inventories can be predicted if WS nuclear power units 3 and 4 are continuously operated with the present pattern. Based on Figure 1 and Figure 2, the inventories for the operation histories of WS nuclear power units 3 and 4 were predicted and the values were shown in Table 1. It was also predicted that the activity of unit 3 would be higher than that of unit 4

Table 1. The predictive values according to the operation histories for WS nuclear power units 3 & 4 [TBq]

Unit	10 y	15 y	20 y	25 y	30 y
3	3.25	4.53	5.81	7.09	8.37
4	0.90	1.24	1.58	1.92	2.26

3. Conclusions

For estimating the characteristics of the inventory change in a nuclear power unit, the liquid radwaste treatment systems of WS nuclear power units 3 and 4 were selected as reference systems. The inventory data released to the environment from the systems were collected based on the whole operation histories and were then analyzed by the total activities with linear regression analysis based on least squares method. It is noted that the inventory change of the radwaste show a linear increase for the operation histories in units 3 and 4. These results mean that the future inventories can be predicted if WS nuclear power units 3 and 4 are continuously operated with the present pattern. It is summarized that the analysis about the inventory will be used in obtaining radiological integrity on NPP and establishing a criterion for an estimation of environmental radiation.

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