Development of PHWR spent fuel transportation and dry storage management program

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1. Introduction

The management of the spent fuel DB basically begins with the manufacturing data of the nuclear fuel assembly, and in particular, the reactor operation history data is an important for evaluating the long-term integrity of the spent nuclear fuel. The operation history data in the nuclear reactor includes fuel assembly burn-up, EFPD, uranium content, enrichment, cooling time and power distribution that are important for evaluating the characteristics of spent nuclear. In this paper, the development of an automation program that evaluates the radioactivity of PHWR spent fuel is described based on operating history data.

2. Methodology and Program

The spent fuel generates various amounts of radioactivity and decay heat depending on the operation history, and gradually decreases over time. The analysis code used in this paper reflects the depletion history based on the express mode function of SCALE6.1's Origen-Arp system and evaluates the amount of radiation. ORIGEN 6.1 is used for the radioactivity evaluation and it is a module of the SCALE (Standardized Computer Analyses for Licensing Evaluation) [1]. Figure 1 shown below is a flow chart to evaluate the amount of radioactivity in PHWR SF.

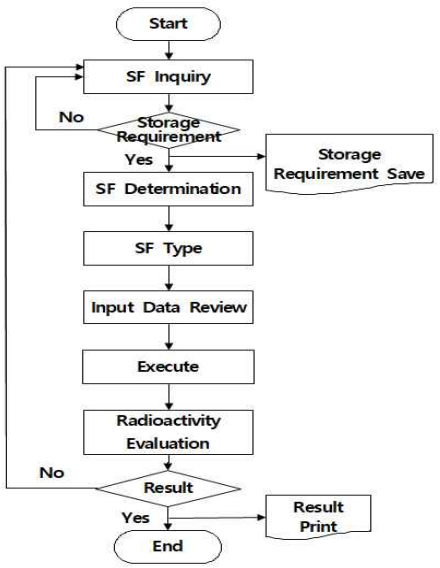

Fig. 1 Flow Chart of Radioactivity Evaluation

As shown in Figure 1, first, the SF stored in the spent fuel pool is inquired based on the discharge date and operation history of the PHWR SF. The SF is retrieved from the PHWR SF safety information system shown in Figure 2.

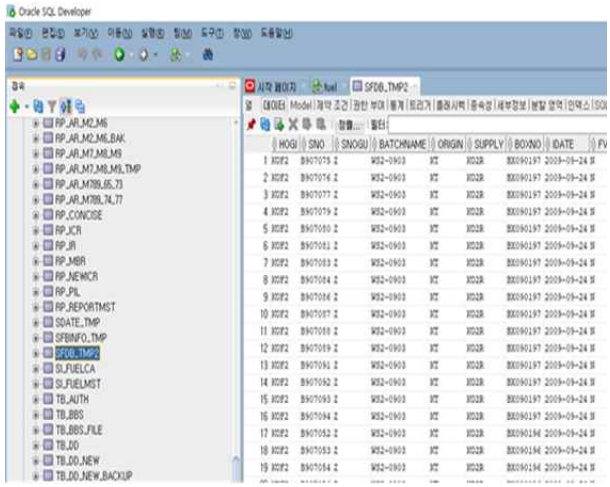

Fig. 2 PHWR SF Information Management System

The PHWR SF safety information includes various information such as initial concentration, combustion, specific power, and discharge date. The PHWR SF management system finally selects spent fuel for dry storage or transportation based on the design requirements of the PHWR SF transportation and dry storage system. These are shown in Figure 3

Fig. 3 Spent Fuel Selection of PHWR SF Management System

Figure 4 shows the configuration that code input data for evaluating the amount of radiation for fuel subject to transportation and dry storage.

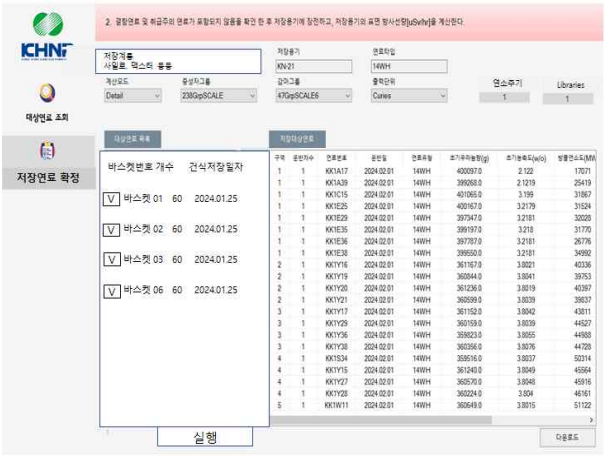

Fig. 4 Input Configuration for Radioactivity Evaluation of PHWR SF

Figure 5 is a configuration showing the results of radioactivity evaluation for the selected SF. The evaluation results will be prepared in accordance with the KHNP's standard procedure form, which will be submitted to the Nuclear Safety Commission.

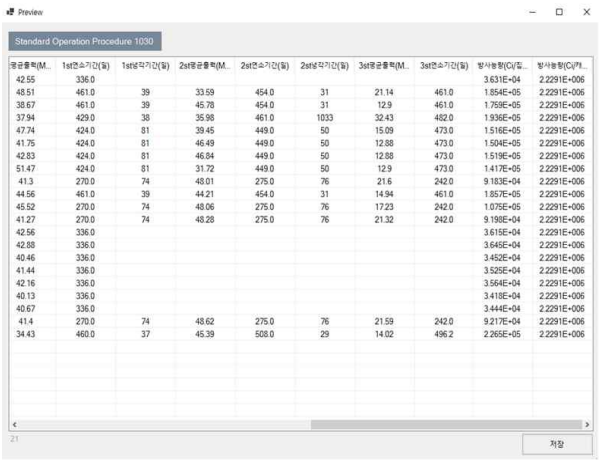

Fig. 4 Radiation Evaluation Result Form of PHWR SF Management System

3. Result and Conclusions

In this paper, A system was constructed to automate the evaluation of the amount of radioactivity performed during the transportation or dry storage of spent nuclear fuel in PHWR. This system basically fetches the manufacturing and output history of nuclear fuel used in heavy water from the heavy water reactor safety information system and is used to evaluate the amount of radioactivity. Therefore, it is expected that errors caused by human errors can be minimized and the time required for evaluating the amount of radiation can be significantly reduced.

REFERENCES

[1] Scale. A Comprehensive Modeling and Simulation Suite for Nuclear Safety Analysis and Design, Version 6.1.3, 2015.
[2] NUREG-2215, “Standard Review Plan for Spent Fuel Dry Storage Systems and Facilities”, Final Report, U.S. Nuclear Regulatory Commission, 2020.