Development of Integrated Decommissioning Information Management System for Korea Research Reactor-1&2

Sung-Kyun Kim, Dong-Gyu Lee, Chong-Hun Jung
Korea Atomic Energy Research Institute, 150, Dukjin-dong, Yusong-gu, Daejeon, 305-353
sungkyun@kaeri.re.kr

In a stage of a decommissioning planning, it is one of the most important jobs to establish the proper dismantling scenarios among the overall D&D project because according to the selection of dismantling scenarios, not only the dismantling schedule and the dismantling cost but also the radiation exposure for workers are determined. If a wrong scenario is selected, it leads to the extension of the dismantling schedule, waste of dismantling cost, and unnecessary worker's exposure. On that reason many foreign countries have been developing the programs that can provide the information needed to setup the dismantling scenarios. Some of them were applied to dismantle research reactors and nuclear facilities and they have been used to design dismantling scenarios and to train workers. However, the current programs have only the functions producing dismantling information to be helpful to estimate dismantling scenarios but they do not evaluate the dismantling scenarios.

Therefore, KAERI developed "IDIMS(Integrated Decommissioning Information Management System)" that can manage dismantling information and integrate dismantling information producing modules and also can evaluate dismantling scenarios on the basis of the information from the information producing modules.

- Functional specification of IDIMS

IDIMS is composed of a DB system, a simulation system, and a data-computing system and their detailed functions are as follows.

1) Decommissioning DB system

Basically various decommissioning information is needed to evaluate decommissioning scenarios. When the facility is dismantled, large amounts of information like dismantling work data, worker's exposure data, radioactive inventory data, etc. are generated. These enormous amounts of information are very essential to evaluate the scenarios so a decommissioning DB system is needed in order to keep and maintain the information systematically.

2) Dismantling simulation

Dismantling simulation is very useful to establish and estimate the problems that may happen in the real work. In other words, it is able to prevent a waste of time and cost in the real dismantling work by establishing the problems of the dismantling processes and the design errors of the dismantling equipment that inevitably happen while changing and modifying the decommissioning plans. Besides, it can be useful to help understand all the dismantling scenarios and to educate the workers. Therefore, a dismantling simulation is a necessary function.

3) Data-computing modules

In order to calculate the quantitative figures for comparing the decommissioning scenarios, data-computing modules are necessary. Following modules are the key factors to evaluate the scenarios and the description of these modules are as follows;

(1) Calculation module of the dismantling work time

The dismantling work time is different according to each dismantling scenario because the working position, work method, number of workers, etc. differ from scenario to scenario. It is used as basic information to calculate a decommissioning cost and to make a decommissioning schedule. Therefore

this module is needed to provide basic information.

(2) Calculation module of the waste volume

Many different kinds of wastes are accumulated during the decommissioning of a nuclear facility and the volume of them varies with a change of the dismantling methods. These variations of the wastes are also connected to the decommissioning cost. Namely, the variation of the waste greatly affects the calculated cost of a physical and a chemical waste treatment for reducing the waste volume and the cost of a waste transportation. Therefore a calculation of the waste volume for the dismantling scenarios is needed for estimating the cost of a waste treatment.

(3) Calculation module of the decommissioning cost

Since the decommissioning schedule, the waste volume, the dismantling methods, etc. are changed for each decommissioning scenario, the decommissioning cost is also varied. This estimation of the decommissioning cost can be used to judge whether the planned cost may be enough to accomplish the dismantling work. If it is not enough, a planner will have to develop a new decommissioning scenario or request more funds from the government. Therefore the appropriate items for the decommissioning cost have to be selected and the equations for them have to be developed. Finally an estimation of the decommissioning cost for the scenarios has to be executed.

(4) 3D radioactivity visualization module

3D radioactivity visualization is very useful in the case of removing only highly activated parts from a whole object. Namely, the highly activated parts can be removed by using this module and then classified into the appropriate radioactive waste category and the other parts are treated as the common waste. This means that the volume of waste that has to be treated is lessened. So this module greatly contributes to reducing the cost of a waste treatment. Besides, it can also help to decrease a worker's risk by visually displaying the highly activated areas to the workers. Therefore this module has an essential function to reduce the waste and the cost.

4) Scenario evaluation module

Decommissioning scenarios have to be evaluated by considering both quantitative items (cost, worker exposure, waste volume, etc.) and qualitative items (Contribution of technology development, safety, influential effect, etc.). So a logical evaluation procedure which can specify and quantify the qualitative parts has to be developed. Therefore a logical evaluation process like the analytic hierarchy process (AHP) is necessary in order to present the best decommissioning scenarios.

- CONCLUSION

In this paper, we developed the virtual environment of KRR-1 by using computer graphic technology and simulating the dismantling processes. The data-computing modules were also developed for quantitatively comparing the decommissioning scenarios. The decommissioning DMU system was integrated with both the virtual environment system and the data-computing modules. In addition, we presented a decision-making method for selecting the best decommissioning scenario through the AHP. So the scenarios can be evaluated logically and quantitatively through the decommissioning DMU.

References

1. Sullivan, T.M. and. Suen, C.J. "Low-level Waste Source Term Model Development and Testing," NUREG/CR-5681, BNL-NUREG-52280,U.S. Nuclear Regulatory Commission, 1991.
2. IAEA, Safety Assessment Methodologies for Near Surface Disposal Facilities, Results of a Coordinated Research Project, Volume 2: Test Cases, IAEA-ISAM, International Atomic Energy Agency, 2004.