Development of 3D Visualization Technology for Medium-and Large-sized Radioactive Metal Wastes from Decommissioning Nuclear Facilities

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1. Introduction

The decommissioning market presents large liabilities for utilities and a huge amount of potential for contractors. Experts predict that the commercial market for decommissioning in Europe could, barring any changes, be as high as $81.5bn USD, according to the nuclear decommissioning market survey. [1] In case of the world, the market for decommissioning could be ₩500 trillion KRW on 2030 and reach ₩1000 trillion KRW until 2050. [2]

The most important point of decommissioning nuclear facilities and nuclear power plants is to spend less money and do this process safely.

In order to perform a better decommissioning nuclear facilities and nuclear power plants, a data base of radioactive waste from decontamination and decommissioning of nuclear facilities should be constructed. This data base is described herein, from the radioactive nuclide to the shape of component of nuclear facilities, and representative results of the status and analysis are presented.

2. Status and Analysis

The radioactive wastes from decontamination and decommissioning of nuclear facilities have specific shapes and can be categorized by radioactivity; relatively high level of radioactivity, machine or components of primary cooling system such as pumps, pipes, valves, tanks, and the low level of radioactivity (concrete from the surface of building).

It is reported that the radioactive metal wastes from decontamination and decommissioning of nuclear facilities amount to 0.50 billion ton for 1,100 MWe PWR (Pressurized Light Water Reactor) nuclear power plant. [3]

2.1 Status and Cause of the medium-and large-sized radioactive metal wastes

The radioactive metal wastes from decommissioning nuclear facilities can be generated in the case of the replacement of Atmosphere Cleanup System (ACS) and Cooling Water Pipe.

Some metal components placed in the Auxiliary Building (A/B) and Containment Vessel(C/V) are managed or replaced. Additionally, in the case of improving the work environment in the radiation control area and mending the old facilities, the radioactive metal wastes can be created.

2.1.1 Status of the radioactive metal wastes

There are representative components of the large-sized of radioactive metal wastes, such as steam generator, nuclear reactor head, and CCW Hx(component cooling water system). The 26 number of three kinds of the radioactive metal wastes from decommissioning nuclear facilities are decided to decommission; 16 steam generators, 4 number of the head part of nuclear reactor, and 6 CCW Hxs. In addition, there are 20 number of steam generators under the consideration to decommission. From Wolsong # 1 on 2013 to Hanul #6 on 2065, after decommissioning of nuclear facilities, the number of radioactive metal wastes is estimated that 54 steam generators, 20 nuclear reactor heads, and 79 CCW Hxs. In the case of Wolsong nuclear power plant, 16 steam generators, 4 nuclear reactor heads, 16 CCW Hxs will be generated.

Almost of all the large-sized of the radioactive metal wastes are in temporary storage sites in a nuclear power plant today, however, the wastes will go through appropriate processing, such as cutting, put them into the spent nuclear fuel disposal canister, and then be transferred to waste disposal sites for final disposition.

2.1.2 Characteristics of the radioactive metal wastes

The shapes of 70 percent of total radioactive metal wastes from decommissioning nuclear facilities are changed during the cutting process. The workers implement the cutting process and can make decisions on the shape of the wastes without cutting procedures. Most of the wastes have rectangular and cylinder form.

2.2 Development of the 3D visualization technology for the radioactive metal wastes using the 3D-SCAN

According to previous survey on the radioactive metal wastes from the decommissioning nuclear facilities, the estimated shapes of cutting radioactive metal wastes are mostly rectangular and cylinder form. Thus, the radioactive metal wastes that will be created from decommissioning facilities will be disposed with the shape of plate or cylinder as cutting shapes.

3D-SCAN output file has three component; x, y, z, and they can make coordinates, like dot (x, y, z). It can contain 1.5 milions-1.8milions of dots in the range of 10*10*10cm. inside of the surface is void and located on the visualized surface as space coordinates.

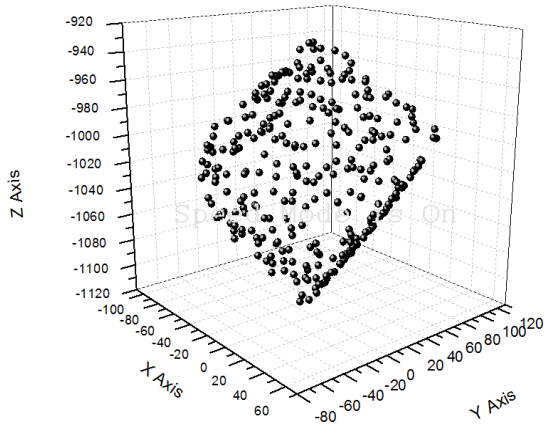

Fig. 3. The graph of scan data from 3D scanner

In order to transform the input texts for MCNP about the data from 3D-SCAN for simple diagram, there are some step; Create the file in each axis components, check 3D-SCAN file, Save into the each axis components files, Check the Maximum/Minimum values of the each three axis, Save the each components axis file, Change string variables into the real number, assort the Maximum/Minimum values and save into the different files, Save the Maximum/Minimum values differently, Choose the Maximum/Minimum values of each axis, Find out the length of x, y, z- axis between two dots, and Create the input texts for MCNP.

3. Conclusions

With the increase in number of nuclear facilities at the end of their useful life, the demand of decommissioning technologies will continue to grow for years to come. This analysis of medium-and large-sized radioactive metal wastes and 3D visualization technology of the radioactive metal wastes using the 3D-SCAN are planned to be used for constructing data bases. The data bases are expected to be used on development of the basic technologies for decommissioning nuclear facilities.

REFERENCES

[1] Nuclear Energy Insider, “UK & Europe Nuclear Decommissioning Market Survey”, 2012.
[2] IAEA, “Status of the Decommissioning of Nuclear Facilities around the World”, 2004.
[3] IAEA, “Methods for the Minimization of Radioactive Waste form Decontamination and Decommissioning of Nuclear Facilities”, Technical Report Series No. 401, Vienna , 2001.