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The demand for TRU nuclide cross-sections from the view point of TRU production and radiotoxicity

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The environmental load reduction of nuclear energy is required in Japan, from the view point of public acceptance due to the increasing of safety demand to the nuclear energy utilization. This environmental load consists of the mass and radiotoxicity of radioactive wastes. The long-term radiotoxicity of the radioactive wastes is dominated by trans-uranium (TRU) nuclides. Additionally, most of the TRU nuclides, which are large part of environmental loads, are generated from light water reactor. Therefore, the evaluation of TRU nuclide production in the light water reactor is important to estimate the environmental load of nuclear energy.

As well known, the amount of TRU nuclide is evaluated through burn-up calculations. Additionally, these burn-up calculations rely on the cross section data of a nuclear data library. However, these cross section data have a different value between libraries due to its uncertainty.

We evaluated the effects of heavy-metal-nuclide cross-section between libraries on the TRU production and radiotoxicity based on the light water reactor. In this study, MVP-BURN and JENDL-4.0u were used as a burn-up calculation code and a reference nuclear data library, moreover, each heavy metal cross section was independently changed to JEFF-3.2 or ENDF/B-VII.1 to evaluate the cross section effect in each nuclide between libraries.

The calculation results revealed that the productions of Pu-238, Am-241 and Cm-244 with JEFF-3.2 were different from more than 8% those with JENDL-4.0u and ENDF/B-VII.1 as shown in Fig.1˜Fig.3. The thermal energy capture reaction of Pu-238 and 1.356eV resonance capture reaction of Am-243 have a large impact on the radiotoxicity of Pu-238 and Cm-244. These nuclides don't have a large impact on the criticality of nuclear reactor core; hence, the precision of these nuclide cross sections is not a significant problem for core design. However, Pu-238 and Cm-244 contribute to the decay heat and radiotoxicity of TRU within 100 years after spent fuel discharge, therefore, the precision of these nuclide cross sections should be improved from the view point of TRU production and radiotoxicity.

For present results, we extracted TRU nuclides which capture cross sections should be improved. In the future work, more accurate evaluation of the TRU production and radiotoxicity will be examined quantitatively.

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