Effect of ^{140}Ba Fission Yield on Fission Rate Distribution Measurements in UO2-MOX Mixed Core of REBUS Program

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1. Introduction

In core physics experiments a fission rate distribution is one of the essential data that is used to validate the core analysis methods. The measurements of this parameter have been adopting spectroscopy of specific gamma-rays from fission products, such as 1,596.5 keV gamma-rays from ^{140}Ba ($T_{1/2}$=12.752d) - ^{140}La (T1/2=1.6781d) after short period irradiation of experimental cores. When this method is applied to UO_2 - MOX fuel mixed cores, it is necessary to take into account the difference of the fission yield of ^{140}Ba in the UO_2 and the MOX fuel. For instance, the JNDC Nuclear Data Library of Fission Products[1)] shows that the cumulative fission yield of ^{140}Ba is 6.295 % for ^{235}U-thermal fission and 5.545 % for ^{239}Pu-thermal fission.

Japan Nuclear Energy Safety Organization (JNES) has been participating in the REBUS international program organized by Belgonucleaire and SCK/CEN. The aim of the participation is to obtain measured reactivity change with burn-up of MOX fuel and UO2 fuel and the fission rate and the flux distribution of the cores containing burned MOX and UO2 fuel and analyze these data in order to validate nuclear core analysis methodologies for burned MOX and UO2 cores. The program partly contains UO2 - MOX mixed cores and a fission rate distribution has been measured with the gamma-ray spectroscopy of 1,596.5 keV gamma-rays from ^{140}La.

We have studied an effect of the ^{140}Ba fission yield on the measured fission rate distribution through the analysis of a UO2 - MOX fuel mixed core of the REBUS program.

2. Summary of Study

(1) The ratio of fission rate of the MOX and the UO_2 fuel rods depends on the cumulative fission yields of ^{140}Ba that is used in the process of the experimental data, (2) The difference in the ^{140}Ba fission yield for the ^{239}Pu thermal fission among the nuclear libraries, JENDL-3.2, ENDF/B-VI and JEF-2.2, is up to 5 % and not negligible. (3) The fission yield data of ^{140}Ba used in the process of the experimental data should be precisely reviewed to evaluate the calculation errors for the ratio of the fission rate of the MOX and the UO_2 fuel rods in the UO2 - MOX mixed cores, (4) Effort to decrease uncertainty of the fission yield data of ^{140}Ba for ^{239}Pu (Thermal fission) is requested for the precise evaluation of the calculation errors of the fission rate distributions in UO2 - MOX mixed cores.