USE OF FISSION PRODUCT EXPERIMENTS FOR BURNUP CREDIT VALIDATION

Tatiana Ivanova*, Nicolas Leclaire, Eric Létang
IRSN, BP 17, 92262, Fontenay-aux-Roses, France

Jean-François Thro
AREVA NC, 1, place Jean Millier, 92084 Paris - La Défense, France

Criticality safety analyses traditionally assume the reactivity reduction in spent fuel due to production of actinide neutron absorbers but not fission products (FPs). To compensate for the lack of integral experiments with FPs, a series of 145 critical experiments, referred to as the FP experimental program, was conducted at Apparatus B research facility in Valduc (CEA, France). The experiments were performed with U(4.738 wt% $^{235}U)O_2$ or HTC rod arrays in moderating solution. The following key fission products encountered in the solutions either individually or as mixtures were studied: ^{103}Rh, ^{133}Cs, ^{nat}Nd, ^{149}Sm, ^{152}Sm, and ^{155}Gd.

A criticality validation tool based on generalized linear least-squares (GLLS) method (sometimes referred to as "adjustment") is under development in the IRSN. Modifications to the method have been recently implemented to differentiate bias due to the FPs from bias due to other materials. Two approaches can be used for the bias differentiation. One of them consists in applying the GLLSM not to k_{eff} but to reactivity of test material (FP). It is briefly described in Ref. 1. Another approach applies the method to k_{eff} in a few steps. In the first step, cross-section data for major actinides and moderator are corrected using results of replacing experiments without the FPs. Then, the "adjusted" major cross-section-covariance matrices and corrections to cross sections are involved in a procedure to "adjust" those for the FPs. A complete vector of corrections to cross sections and covariance matrix is then used to project to the application system bias due to the FPs available in the experiments. This paper presents performance of the second approach.

The FP experimental series provides unique data for this study because measurements were performed with and without the test FP on nearly the same array. This makes the experimental uncertainties strongly correlated for the pairs of experiments and allows magnifying the FP effect by applying the modified "adjustment" method.

References

1. N. Leclaire et al., Fission Product Experimental Program: Validation and Computational Analysis, NSE, Volume 161, Number 2, February 2009, pp. 188-215

* Corresponding author, e-mail: tatiana.ivanova@irsn.fr