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Analysis of the poisoned uo2 lattice of creole experiment on the reactivity temperature coefficient using monte carlo transport calculations

S. El Ouahdani*[1], H. Boukhal[2], A. Gaga[1], E. Chakir[3], Y. Boulaich[4] and **M. Makhloul[2]**

[1]Sultan Moulay Slimane University, Morocco
[2]Abdelmalek Essaadi University, Morocco
[3]Ibn Tofail University, Morocco
[4]CNESTEN, Rabat, Morocco

The CREOLE experiment performed In the EOLE critical facility located In the Nuclear Center of CADARACHE - CEA have allowed us to get interesting and complete experimental information on the temperature effects in the light water reactor lattices.

To analyze these experiments with accuracy an elaborate calculation scheme using the Monte Carlo method implemented in the MCNP6.1 code and the ENDF/B-VII.1 cross section library has been developed. We have used the ENDF/B-VII.1 data provided with the MCNP6.1.1 version in ACE format and the Makxsf utility to handle the data in the specific temperatures not available in the MCNP6.1.1 original library. The main purpose of this analysis is the qualification of the ENDF/B-VII.1 nuclear data for the prediction of the Reactivity Temperature Coefficient while ensuring the ability of the MCNP6.1 system to model such a complex experiment as CREOLE.

We have analyzed the case of UO_2 lattice with 1166 ppm of boron in ordinary water moderator in specified temperatures. A detailed comparison of the calculated effective multiplication factors with the reference ones in room temperature presented in this work shows a good agreement demonstrating the validation of our 3D calculation model. The discrepancies between calculations and the differential measurements of the Reactivity Temperature Coefficient for the analyzed configuration are relatively small: the maximum discrepancy doesn't exceed 1,1 pcm/°C.

Key Words: CREOLE experiment, UO_2 borated lattices, Reactivity Temperature Coefficient, Monte Carlo Method, MCNP6.1.