TRANSPOSITION STUDIES WITH A HYBRID EXPERIMENTAL BASE COMBINING ZPR AND PWR MEASUREMENTS

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Abstract

Quantifying uncertainties plays a crucial role in demonstrating the safety of nuclear reactors. It enables the safety margins to be established, which are essential if they are to operate safely under the intended design conditions. Uncertainties in neutronics are generally estimated by comparison of calculations and measurements. The lack of experimental data in certain cases (new fuel management, new reactors, accident situations, etc.) leads to the exploration of new techniques. The transposition methods, in addition to offering the possibility of extending the conclusions of the validation of a scientific calculation tool to a wider field of use, are of great interest for this purpose. The aim of this paper is to apply a transposition method to a third generation (Gen-III) benchmark core based on a combination of measurements from both critical mock-ups and industrial reactors, thus distinguishing ourselves from most of the studies carried out on the subject. The studies carried out focus mainly on highlighting the main nuclear data requirements for reducing the uncertainties propagated in the EDF industrial core code COCAGNE. A general overview of the advantages of using transposition for integral quantities requiring significant improvements in nuclear data, inaccessible only from fleet observation, is also given. Two observables are analysed in this context, one is global: the critical boron concentration, rarely studied in the literature. The second is local: the center/periphery fission rate ratio. It is an indicative measure of the centre/periphery power bulge inside a reactor core and has received particular attention. As a results, it is shown that the hybrid experimental base enables a wide range of sensitivity profiles to be covered and thus a very large number of nuclear data to be constrained, which ultimately leads to significant reductions in the uncertainties after adjustment (about 70% in the case of the fission rate ratio and 80% in the case of the critical boron concentration). The main nuclear data contributors are identified in each case. Finally, the study details the current limitations of the available integral information and proposes some perspectives, both computational and experimental.

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