

Analysis with JENDL-5 on TCA critical experiments of PWR-type fuel assembly loaded with B4C neutron absorber rods/B4C 中性子吸収棒を装荷した PWR 型 燃料集合体に関する TCA 臨界試験の JENDL-5 による 解析

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A series of critical experiments was implemented on a mockup PWR-type fuel assembly loaded with B4C neutron absorber rods (B4C rods) in a tank-type critical assembly (TCA) in 1983 [1]. The mockup assembly was a 15x15 lattice consisting of 204 UO₂ fuel rods with 3.2 wt% enrichment and 21 water holes. It was surrounded by a driver lattice region composed of 2.6 wt% enrichment UO₂ fuel rods. In the experiments, critical water levels were measured by varying the number of B4C rods inserted into the water holes of the mockup assembly. The core radial fission rate distributions in the mockup assembly and driver region were also measured by fuel rod gamma-scanning. In the present study, the experimental results were analyzed using a continuous-energy Monte Carlo code MVP3 [2] with a JENDL-5-based nuclear library. The analysis results were also compared with those with a JENDL-4.0-based nuclear library. The effective neutron multiplication factors (keffs) with JENDL-5 ranged from 0.9998 to 1.0006, exhibiting an increasing trend with the critical water levels, while those with JENDL-4.0 were around 0.9997. The reactivity effects by the updated neutron cross-sections of ¹H in H₂O, ¹⁶O in H₂O, ¹⁶O in the materials other than water, ²³⁵U, and ²³⁸U in JENDL-5 were estimated by derivative calculations with the cross-sections in JENDL-5 partly replaced by those in JENDL-4.0. As a result, the differences in the trends in keffs between JENDL-5 and JENDL-4.0 were mainly attributed to the updated cross-section of ¹H in water. The C/E-1s in the comparison between the calculated and measured relative fission rates of the fuel rods were obtained for the mockup assembly and driver region. The root-mean-squares (RMSs) of the C/E-1s with JENDL-5 and JENDL-4.0 for the mockup assembly increased with the number of B4C rods and ranged from 1.3% to 2.3%. Those for the driver region were almost independent of the number of B4C rods and ranged from 1.1% to 1.4%. The RMSs with JENDL-5 for the driver region were slightly larger than those with JENDL-4.0.

References

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Primary author: YAMAMOTO/山本, Toru/徹 (Former affiliation: Regulatory Standard and Research Department, Secretariat of Nuclear Regulation Authority (S/NRA/R)/元原子力規制庁長官官房技術基盤グループ)

Presenter: YAMAMOTO/山本, Toru/徹 (Former affiliation: Regulatory Standard and Research Department, Secretariat of Nuclear Regulation Authority (S/NRA/R)/元原子力規制庁長官官房技術基盤グループ)

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