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Criticality data of the modified STACY and evaluation results of nuclear data libraries/定常臨界実験装置 STACY 更新炉の臨界データと核データライブラリの評価結果

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To develop technologies for criticality safety management during the fuel debris retrieval at the Fukushima Daiichi Nuclear Power Plant, we conduct experiments under various core conditions assumed for fuel debris. JAEA modified the Static Experiment Critical Facility (STACY) from a solution fuel system to a light-water moderated heterogeneous system for critical experiments to study the criticality characteristics of fuel debris. After the modification, STACY was operated to inspect its designed performance on reactor operation, and the first criticality was achieved on April 22, 2024.

In this study, we performed criticality calculations of STACY's critical cores using several nuclear data libraries and compared their results. The five core patterns in a series of performance testing were calculated neutron multiplication factor with the measured critical water levels: (1) 277 fuel rods with a water level of about 70 cm, (2) 253 fuel rods with a water level of about 110 cm, (3) 253 fuel rods with an irradiation sample in the center of the core for thermal power calibration with a water level of about 120 cm, (4) 241 fuel rods with a water level of about 70 cm, and (5) 213 fuel rods with a water level of about 110 cm. Fuel rods are cylindrically loaded on a grid plate with grid intervals of 1.50 cm for cores (1), (2) and (3), and of 1.27 cm with skipping one by one to achieve fuel intervals of 2.54 cm for cores (4) and (5).

We calculated neutron effective multiplication factors of each core using MVP2 with JENDL-4.0, JENDL-5, and ENDF/B-VII.1. Furthermore, in order to analyze the differences between libraries, a comparison was made for representative nuclides by replacing the nuclear data of each nuclide with JENDL-5 in the calculations using JENDL-4.0.

The result using JENDL-4.0 showed that the effective neutron multiplication factor correspond within 3σ for cases of (1), (2), and (3). However, it overestimated about 69 pcm for case (4) and about 33 pcm for case (5). JENDL-5 overestimated all patterns, 195 pcm in maximum.

In this presentation, detailed critical data for all pattern cores and evaluated trends for each nuclide will be presented.

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