Contribution ID: **160** Type: **Contributed Oral Presentation**

Modeling and calculation of reactivity feedback coefficients and neutron flux using Monte Carlo code OpenMC for SLOWPOKE-2 reactor

Thursday 18 September 2025 14:05 (15 minutes)

SLOWPOKE-2 is a pool-type research reactor whose accurate modeling is challenging due to its compact core and significant neutron leakage. In this study, a detailed three-dimensional continuous-energy model of the SLOWPOKE-2 reactor was developed using the Monte Carlo code OpenMC. The model was validated through criticality calculations, showing good agreement with measured excess reactivity values. Once validated, the model was used to compute key neutronic parameters, including the reactivity feedback coefficients associated with fuel temperature, moderator temperature, and void fraction. Each parameter was varied independently, with all others held constant. Temperature-dependent cross-section libraries were generated using the ENDF/B-VIII.0 nuclear data, processed with the NJOY2016 code at 313, 333, 353, and 373 K. The results show that all reactivity feedback coefficients are negative, in accordance with reactor safety requirements. Additionally, neutron flux distributions in both inner and outer irradiation sites are presented and analyzed. These findings demonstrate the capability of OpenMC to accurately simulate the neutronic behavior of the SLOWPOKE-2 reactor and to support safety evaluations.

Abstract Category

Nuclear Physics

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Session Classification: Contributed talks

Track Classification: Physics Research