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#04-224 Optimization of Next-Generation Fast-Spectrum Self-Powered Neutron Detectors using Geant4

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Self-powered neutron detectors (SPND) have been a common diagnostic tool for intra-core neutron flux mapping in thermal nuclear reactors for more than 45 years. They are attractive flux monitors as they are compact, simple, and produce a signal proportional to local neutron flux without the need for an external source of power. Signal in these detectors is driven by electrons generated from nuclear reactions within the emitter in the detector. As the next-generation reactors are on the horizon and some of them are designed to be operating with harder neutron spectra, it is imperative to develop diagnostic tools tuned to their neutron spectrum, peaking around 0.5 MeV. However, the current state-of-the-art for SPNDs is optimized for thermal neutron interactions. We will be discussing our efforts to develop fast-spectrum SPNDs (FS-SPND) that are sensitive to neutrons with energies ranging from thermal up to 1 MeV. We have performed an in-depth analysis of ENDF VII.1 neutron-capture cross sections and have identified 4 novel materials that are suitable emitter candidate materials to measure fast neutrons, all are stable mid-shell nuclei in the region between doubly-magic 132Sn and 208Pb. We will be discussing the results of Geant4 simulations for each emitter candidate with detector parameters optimized to maximize overall detector efficiency as well as an exploration of complex detector geometries.ocess.

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