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Development of a Fast-Spectrum Self-Powered Neutron Detector for use in Sodium-Cooled Fast Reactors KATHLEEN GOETZ, University of Tennessee, SACIT CETINER, Oak Ridge National Laboratory — Self-powered neutron detectors (SPND) have been an essential diagnostic tool for intra-core neutron flux mapping in thermal nuclear reactors for more than 45 years [1]. As next-generation reactors are on the horizon, it is imperative to develop diagnostic tools tuned to their faster neutron spectra [2]. For example, the neutron spectrum in sodium-cooled fast reactors peaks around 0.5 MeV [2]. SPNDs are transistor-like detectors that produce an electrical current as a result of neutron-capture reactions within the neutron-sensitive portion of the detector [1]. The current state-of-the-art for SPNDs is optimized for thermal neutron interactions. We will therefore be discussing our efforts to develop fast-spectrum SPNDs sensitive to neutrons with energies approaching 1 MeV. We have performed an in-depth analysis of ENDF neutron-capture cross sections and have identified 5 novel materials that are suitable to make up the neutron-sensitive portion of our detector, all are stable mid-shell nuclei in the region between doubly-magic ^{132}Sn and ^{208}Pb. We will also be discussing the results of Geant4 simulations with the chosen materials as well as detector optimization and the exploration of complex detector geometries. [1] Todt, W. H. "Characteristics of self-powered neutron detectors used in power reactors." *Core Instrumentation and Core Assessment, Nuclear Energy Agency, Boulogne-Billancourt, France* (1996). [2] Verma, Vasudha, et al. "Self powered neutron detectors as in-core detectors for Sodium-cooled Fast Reactors." *NIM A:* 860 (2017): 6-12.

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