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BORON-LINED NaI DETECTOR AS AN EFFICIENT ALTERNATIVE TO He-3 NEUTRON DETECTORS

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Abstract

He-3 detectors are considered as the main component of most neutron detection systems in various nuclear fields because of their high thermal neutron cross section. Due to the worldwide shortage of He-3 gas after 2009, which led to a huge price increase, many researchers directed their efforts to find alternative efficient replacements. One of the proposed cost-effective alternatives is using an existing NaI detector covered with a thin layer of ^{10}B to detect the gamma ray resulting from the $^{10}\text{B}(n, \alpha)^7\text{Li}$ reaction. In this work a simulation MCNP model is developed for the He-3, BF3 and boron-lined NaI detectors to calculate the response of each detector. Experimental measurements were made for the three detectors and compared to the simulation results for validation. The results show that the boron-lined NaI detector has a good sensitivity when exposed to various neutron flux distributions and a higher efficiency compared to the He-3 and BF3 detectors used. In addition, the boron-lined NaI detector has the ability to detect gamma rays from the surrounding medium. The simulation and experimental results clearly demonstrate that boron-lined NaI detectors are an efficient alternative for replacing He-3 detectors and can be used in multiple real-world applications.

Keywords: Neutron detectors, boron lined detectors, MCNP, He-3 alternatives.