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#5-220 Recommissioning, calibration and numerical simulation of a passive neutron counter

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CEA Valduc center produces nuclear waste that must be characterized before being discarded. The characterization is mainly done by gamma spectrometry. However, in the case of waste containing high-density metallic items, passive neutron measurements are necessary. To meet this need, and constrained by the difficulty of obtaining supplies of helium-3 tubes, the waste characterization unit had to reactivate an old "JCC-71" measuring station [MIRION-CANBERRA] that had been out of service for about ten years. The JCC-71 is a passive neutron system consisting of four rectangular counting blocks, each made of high-density polyethylene to allow thermalization of the fission neutrons. Each block contains six Helium-3 detectors connected to an fast AMPTEK amplifier. The four amplifiers are connected in series to a neutron coincidence analyzer JSR-15 [MIRION-CANBERRA], a computer and an analysis software. The first step in recommissioning the station was to determine its operating parameters: detector high voltage plateaus, preamplifier discrimination threshold, pre-delay value, mean neutron lifetime in the cell, coincidence window duration and station detection efficiency. These parameters are necessary to be able to perform experimental calibration. Unfortunately, a problem in characterizing nuclear waste is that there is no representative standard for each object. Therefore, it is necessary to use a computational code (in this case Monte Carlo N-Particle code "MCNP") to model the measuring station in order to numerically estimate the detection efficiency. Consequently, in a second step, the results obtained with the MCNP code were compared with experimental calibration coefficients obtained with several standard sources. This experiment also provided an opportunity to test the OpenMC Monte Carlo computational code, a community-developed Monte Carlo neutron and photon transport simulation code characterized by its Python programming interface. In this paper, the calibration method is presented. The results and uncertainties obtained experimentally are compared with MCNP and OPEN-MC results and discussed.

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