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Measurement of neutron fluence in the High-Flux Test Module of the Early Neutron Source by an activation foils method

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The neutron fluence is an important normalization parameter for the material specimens to be irradiated in the Early Neutron Source (ENS). The activation foil method appears suitable for this purpose considering cost, low technical requirements and invasiveness.

Small packages of thin activation foils can be placed in several locations: on the outer surface of the HFTM, on the outside of specimen capsules inside the HFTM or inside the specimen capsules. The latter would provide measurements very close to the specimens while the other two options require more corrections to determine the neutron fluence in the place of the specimen. Each location has a different access time after completion of the irradiation cycle. If the activation foils are mounted on the outer surface of the HFTM the estimated earliest access to them for measurement of the induced gamma activity would be approximately one week after shut-down. An activation foils package on the surface of a specimen capsule would be accessible about three weeks after shut-down while an activation foil package inside the specimen capsule becomes available two to three months after shut-down.

In this work we will present a set of activation foils which is suitable for application in the HFTM. The set consists of iron, cobalt, nickel, yttrium, and gold. The selected dosimetry reactions lead to radioisotopes with half-lives of several months up to a few years so that they preserve neutron flux information over the full irradiation time, and they cover the entire ENS neutron energy range. Tests of the measurement method were performed with the cyclotron neutron source at NPI Řež which provides a fast neutron spectrum similar to ENS. We will present the analysis of these tests together with a review of state-of-the-art evaluated cross sections of the dosimetry reactions of interest.

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