AN IMPROVED METHOD OF DETECTOR MATERIAL SELECTION FOR MULTIPLE

FOIL ACTIVATION MEASUREMENTS IN THE TBMS

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The neutronics measurements in the TBMs aim the determination of several physical quantities like tritium production rate, heat load, neutron spectrum etc., which are hard to measure inside the hermetic zone by active detectors. For this reason activation detectors (foils) are planned to be used. The detector materials have to be selected in a way to provide the best possible neutron spectrum reconstruction by the unfolding technique. The measurement conditions, like the irradiation time and the accessibility of the foils highly depend on the detailed design of the TBMs and are not yet determined. Therefore several foil sets have to be investigated and compared to help the design of the measurement. This task requires the setting up of an objective qualification process to select the optimal foils for an actual experiment.

The qualification process presented in this paper assigns a so called qualification number to each foil-set. This qualification number depends on the orthogonality of the cross sections, the energy range covered by the foils and the discreteness of the energy range. It is proved, that a better foil-set gets a larger qualification number. A new concept has been set up to determine the energy range covered by a foil, which is called "sensitivity range" to distinguish from the generally used "response range". This new definition is more sensitive to the energy range, where the cross section of the detector material is high. The detection limit [1] of the activity of a foil was also taken into account in determination of the sensitivity range. The materials differ from each other in half-lives and in reaction rates, therefore the irradiation time and the cooling time are also important in composing a foil-set.

A computer code has been developed to perform the qualification process based on a detailed neutron spectrum calculated by a Monte Carlo code and cross-section data available in the nuclear data libraries.

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