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#04-37 Numerical and experimental characterization of the neutron flux and spectra in the core of the CNESTEN's TRIGA Mark II research reactor

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Education, training and isotopes production are the most important uses of the Moroccan 2 MW TRIGA Mark II reactor situated at the National Center for Energy Sciences and Nuclear Techniques (CNESTEN, Morocco). To develop new R&D projects in research reactors, the particular and advanced knowledge of neutron and photon flux distribution, within and around the reactor core, is crucial.

In order to precisely prepare the forthcoming experiments in the reactor, a detailed model of the reactor core was developed using the 3D continuous energy Monte Carlo code TRIPOLI-4 [1] and the continuous energy cross-section data from the JEFF3.1.1 nuclear data library. In particular, all the geometries and compositions of materials were described in the TRIPOLI-4 simulation model with good details. This new model was used to carry out preliminary neutron and photon calculations to estimate flux levels in the irradiation channels as well as to calculate kinetic parameters of the reactor, core excess reactivity, integral control rods worth and power peaking factors. As a first step of the validation of the model, the obtained results were compared with the experimental ones available in the Final Safety Analysis Report (FSAR) of the TRIGA reactor [2]. Fairly good agreement was found, which indicates that the Monte Carlo model is accurate enough to perform criticality calculations of TRIGA reactor.

Furthermore, this work aims at experimentally characterizing the neutron flux and energy spectra in various irradiation channels inside and outside the reactor core. Absolute flux measurements will be carried out using the neutron activation technique [3] [4]. To set up the experimental design for the activation experiments a series of preliminary calculations were performed using the TRIPOLI-4 model to calculate the expected gamma flux/intensity levels of various materials after irradiations in different positions in the core and reflector. Different activation foils with known characteristics will be then irradiated and the activity of several isotopes will be measured with the Gamma Spectrometry Method. During the irradiation process, the reactor power will be monitored via two fission chambers (FCs) adjacently fixed in the reactor cavity. The count rate is proportional to the neutron flux, which is proportional to the reactor power in the operation range. Sources of uncertainty in reactor power can therefore be either the calibration of the FCs, or the uncertainty in the count rate. Along with FCs, gold monitors will be irradiated in an ex-core position in order to monitor the neutron flux leading to estimate the reactor power during each irradiation. Experimental measurements will be compared with calculated neutron flux evaluated with the new TRIPOLI-4 model of the reactor, as well as against the reference calculation scheme using MCNP5 [5] and ENDFB-VII, developed by the CNESTEN [2] [6].

The final results of the above-mentioned experimental campaign will be presented in this study only after the betterment of the current situation of the Covid-19 pandemic. With the gradual opening of the airports and boundaries, we will be able to carry out our experiments with full concentration and in good conditions.

References

[1] E. Brun, F. Damian, C. Diop, E. Dumonteil, F. Hugot, C. Jouanne, Y. Lee, F. Malvagi, A. Mazzolo, O. Petit, J. Trama, T. Visonneau et A. Zoia, « TRIPOLI-4®, CEA, EDF and AREVA reference Monte Carlo code », Annals of Nuclear Energy , vol. 82, pp. 151-160 , 2015.
[2] B. El Bakkari et al., « Monte Carlo modelling of TRIGA research reactor », Radiation Physics and Chemistry, vol. 79, pp. 1022-1030, 2010.
[3] A. Borio di Tigliole et al., « TRIGA reactor absolute neutron flux measurement using activated isotopes », Progress in Nuclear Energy, vol. 70, pp. 249-255, 2014.
[4] V. Radulovic et al., « Validation of absolute axial neutron flux distribution calculations with MCNP with

z197Au (n,γ)198Au reaction rate distribution measurements at the JSI TRIGA Mark II reactor », Applied Radiation and Isotopes, vol. 84, pp. 57-65, 2014.
[5] « MCNP- A General Monte Carlo N-Particle Transport Code, Version 5 », X.-5. Monte Carlo Team, Los Alamos National Laboratory, 2003.
[6] E. Chham et al., « Neutronic and thermal–hydraulic analysis of new irradiation channels inside the Moroccan TRIGA Mark II research reactor core », Applied Radiation and Isotopes, vol. 116, p. 178-184, 2016.

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