Experimental determination of the neutron source for the Argonauta Reactor subcritical assembly

C. A. C. Renke[1], R. C. Furieri[1], J. C. S. Pereira[1], D. L. Voi[1] and A. L. N. Barbosa[1]
e-mail: renke@ien.gov.br

[1] *Division of Nuclear Engineering - IEN*

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The purpose of building a subcritical assembly to be attached to the upper region of the Argonauta reactor core was reported in 1971 [1]. The main function was to provide the greatest flexibility for reactor physics studies, to develop and to refine new methodologies, allowing experimental measurements of nuclear parameters of fuel elements, particularly rods elements, and to validate data obtained with other methods and calculation models existing at that time. Further development and improvement of this project was taken up in the nineties [2] and when its construction began. The utilization of a subcritical assembly for the determination of nuclear parameters in a multiplier medium requires a well defined neutron source to carry out the experiments necessary for the acquisition of the desired data [3]. The Argonauta research reactor installed at the Instituto de Engenharia Nuclear has a subcritical assembly, under development, to be coupled at the upper part of the reactor core that will provide the needed neutrons emerging from its internal thermal column made of graphite. In order to perform neutronic calculations to compare with the experimental results, it is necessary a precise knowledge of the emergent neutron flux that will be used as neutron source in the subcritical assembly. In this work, we present the thermal neutron flux profile determined experimentally via the technique of neutron activation analysis, using disprosium wires uniformly distributed at the top of the internal thermal neutron column of the Argonauta reactor and later submitted to a detection system using Geiger-Müller detector [4]. These experimental data were then compared with those obtained through neutronic calculation using HAMMER [5], [6] and CITATION [7] codes, in order to validate this calculation system and to define a correct neutron source distribution to be used in the subcritical assembly. This procedure avoids a coupled neutronic calculation of the subcritical assembly and the reactor core. It has been also determined the dimension of the graphite pedestal to be used in the bottom of the subcritical assembly tank in order to smooth the emergent neutron flux at the reactor top. Finally, it is estimated the thermal neutron flux inside the assembly tank when filled with water.

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