SIMULATION OF THE NEUTRON-PHYSICAL CHARACTERISTICS OF THE SUBCRITICAL ASSEMBLY YALINA-BOOSTER WITH LOW ENRICHMENT URANIUM FUEL

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The non-proliferation issues caused by the civilian use of highly enriched uranium (HEU) were solved by using of several international agreements, for example, Reduced Enrichment for Research and Test Reactors (RERTR) program [1], supported by the International Atomic Energy Agency (IAEA). Accordingly, efforts were made to reconstruct existing research reactors for using of low enriched uranium (LEU) and to encourage the usage of LEU in the development of new research reactors and other nuclear facilities, such as subcritical systems driving by external source (Accelerator driven system or ADS). ADS systems are considered as promising for energy production and transmutation of long-lived fission products and minor actinides. The study of the processes occurring in ADS systems with low enrichment uranium fuel is of high interest in the development of projects for innovative installations.

The controlled by external sources subcritical assembly Yalina-Booster [2] (Scientific Institution JIPNR-Sosny) makes it possible to study the neutron-physical characteristics and parameters of breeding media with fast and thermal neutron spectra with subcriticality levels of keff ≤ 0.975. Neutron-physical characteristics that can be measured in the ADS system can also be calculated by using modern simulation programs based on the Monte Carlo method.

In this paper a methodology for simulation of the neutron-physical characteristics of the subcritical assembly Yalina-Booster with low enrichment uranium fuel is developed by using the MCNP4B program implementing the Monte-Carlo method. The following characteristics of the Yalina-Booster with low enrichment uranium fuel and controlled by a neutron generator were calculated: an effective neutron multiplication factor at different stages of assembly loading, neutron spectra in experimental channels, reaction rates on a set of neutron activation detectors of various sizes, reaction rates of radiation capture of neutron on Np^{237}, Am^{243} and I^{129}.

It was conducted a comparison of characteristics that were both calculated and obtained experimentally.

It is planned a further refine of the model and determination of the influencing factors in order to reduce the difference between the calculated and experimental values, which will improve the experiment planning procedure.

[1] The Reduced Enrichment for Research and Test Reactors (RERTR) Program [Electronic resource]. – Mode of access: https://www.rertr.anl.gov/. – Date of access: 30.01.2019.

[2] Gohar, Y. Smith, D. L. et al., YALINA Facility A Sub-Critical Accelerator-Driven System (ADS) for Nuclear-Energy Research Facility Description and an Overview of the Research Program (1997-2008), Report of Argonne National Laboratory (United States). Funding organisation: USDOE Office of Nuclear Energy, Science and Technology (United States).