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THE DYNAMICS OF ENERGY RELEASE IN A HYBRID REACTOR OPERATING WITH GDT-FNS IN A PULSE-PERIODIC MODE

I.V. Shamanin[1], S.V. Bedenko[1], V.M. Shmakov[2], V.V. Knyshev[1], I.O. Lutsik[1], S.D. Polozkov[1]
[1]National Research Tomsk Polytechnic University,
Russia, Tomsk, Lenin st. 30, 634050
[2]FSUE «RFNC - VNIITF named after Academ. E.I. Zababakhin»,
Russi,a Snezhinsk, Vasilyeva Avenue, 13, 456770
E-mail: shiva@tpu.ru

Specific characteristics of a spatial hybrid thorium reactor with an extended neutron source based on the magnetic trap were studied in the work. The researched “fission–fusion” reactor facility is essentially a hybrid reactor with the reactor core which consists of the fuel blocks assembly of the unified construction of high temperature gas-cooled thorium reactor HTGR and a long magnetic trap (GDT-FNS) which permeates the near-axial reactor core region [1]. In the researched configuration of the hybrid unit the high-temperature plasma pinch is formed in the pulse-periodic mode. At certain pulse ratio (duty cycle) it should be expected that fission “wave” diverging from the axial region of the system and spreading over the fuel assembly volume is formed in correlation with the pulsed source of fast D-D neutrons by time. Thus, at such conditions it is essential to research the fission “wave” spreading process and, consequently, the formation of energy release distribution in the assembly volume.

The work studies the stationary and spatio-temporal characteristics of neutron fluxes and the energy dynamics of the stadied facility. The research result shows: (1) At the moment of the facility start-up for “cold” blanket GDT-FNS should provide steady intensity of D-D neutrons generation in the range from 1016 to 2×10^{18} neutrons per second from the total plasma column. (2) When the pulse duration is 1 ms and pulse ratio is 2, GDT-FNS, which operates in the required range of D-D neutrons generation, will provide warming of the blanket with the speed of 10 ($К \times h^{-1}$), that meets the requirements of thermal technical engineering reliability at cold start-up. (3) To maintain $k_{eff}(t)$ at constant level GDT-FNS should constantly power the reactor core with additional neutrons, while the intensity of D-D neutrons generation should grow continuously during the whole fuel campaign. The stationary neutron-physical characteristics and the spatio-temporal propagation of the fission wave were modeled using the PRIZMA software package developed at the Federal State Unitary Enterprise RFNC-VNIITF named after Academician E.I. Zababakhin. It can be stated that the obtained results proved the possibility of using the program software PRIZMA, developed in VNIITF to provide the whole list of full-scale computations of hybrid facility neutronic characteristics in various operation modes of the thermonuclear neutrons plasma source.

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