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POWER CONTROL OF THE FAST NUCLEAR-BURNING-WAVE REACTOR

One of the most important problems in the further development of nuclear energy, from the point of view of its public acceptance, is the problem of safety. Thus, the development of new concepts for nuclear fission reactors with so-called "intrinsic safety" is a very urgent task. An equally important problem for the sustainable development of nuclear power is the need to expand the fuel base by involving uranium-238 and thorium-232.
The concept of a fast reactor (FR) operating in a self-sustaining nuclear burning wave (NBW) mode, proposed in [1], also known as the Traveling Wave Reactor and the CANDLE, if implemented, is capable to solve both of these problems, and in a very effective way. The "intrinsic safety" of the reactor is based on the specific mechanism of negative reactivity feedback inherent in the NBW mode, which ensures automatic maintenance of the critical state of the reactor even under external influences [2]. The use of depleted uranium and thorium as the main fuel with high burnup [3] makes it possible to use a "one-through"scheme instead of an expensive closed fuel cycle.
In our work, the possibility of controlling the NBW reactor power by changing the efficiency of a neutron reflector is investigated. Such a possibility is an important in the context of widespread use of weather-dependent wind and solar energy. The consideration was carried out on the basis of the approach developed in [4, 5], using the numerical solution of the multigroup nonstationary neutron diffusion equation together with the system of equations for fuel burnup and nuclear kinetics of delayed neutron precursors. A cylindrical multi-zone FR with U-Pu cycle fuel, in which NBW propagates in the axial direction, is considered. The calculations took into account the presence of a structural material Fe and a Pb-Bi coolant in the reactor core. The reflector consisted of 90% Pb-Bi and 10% Fe. Optimal algorithms are proposed for bringing the NBW reactor to a given power (both with decreasing and increasing) using a proportional-differential method for controlling the tantalum-181 content in a radial reflector.

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