THE STUDY OF THE PROBABILITY OF INCREASING THE OPERATING TIME OF THE NUCLEAR REACTOR KLT-40 S THROUGH THE USE OF PERSPECTIVE NUCLEAR FUEL CYCLES

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The low-power reactor KLT-40 S is one of the most promising projects of nuclear power generation industry in the Russian Federation. Mobility and perspectivity of energy supply for isolated northern areas define the need to study probability of increasing the operating time to improve the economic feasibility of the nuclear reactor [1].

The purpose of the research is to determine the best nuclear fuel used in the core of the reactor KLT-40 S to enhance self-sufficiency of the nuclear reactor.

The fuel for KLT-40 S is uranium dioxide particles in the matrix made of aluminum-silicon alloy. In the study, this alloy consists of 90 % of aluminum and 10 % of silicon [2].

The density of fuel pellets is constant during the research. The following types of fuel are: $(U^{238}\text{-}U^{235})O_2$, $(Th^{232}\text{-}U^{235})O_2$, $(U^{238}\text{-}Pu^{239})O_2$ and $(Th^{232}\text{-}U^{233})O_2$. For all types of fuel, the percentage of fissionable nuclide is 18.6 %.

To determine the neutron flux and to calculate a value of the effective neutron multiplication factor, the iterative process of calculating the system of the neutron diffusion equations in a 26-group approximation was completed [3].

The calculation of the change of the nuclide composition in the reactor core was conducted using the finite difference method for solving differential equations with a step of 50 effective full power days. The software was developed to make calculations, which allows determining the dynamics of changes in the nuclide composition, the neutron flux, the effective neutron multiplication factor and other parameters in the reactor core.

The dependences of the changes of the effective neutron multiplication factor in the core of the reactor KLT-40 S on the operating time for different fuels are given in fig.1.

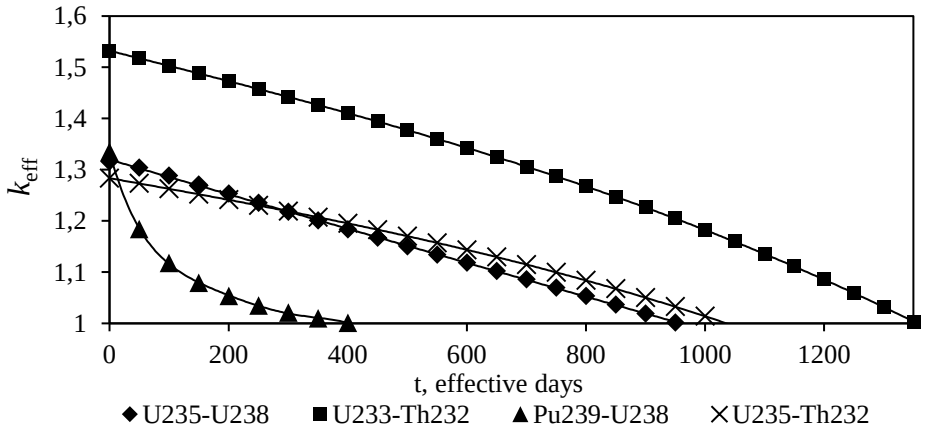

Fig. 1. Dependences of the effective neutron multiplication factor in the core of the reactor KLT-40 S on the operating time without refueling

Accordingly, the thorium-uranium nuclear fuel cycle can increase the operating time of the reactor KLT-40 S by 400 effective days in comparison with the conventional fuel load if the fuel composition $(Th^{232}\text{-}U^{233})O_2$ is used.

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