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COMPARATIVE ANALYSIS OF REACTOR RITM-200 AND KLT-40S BY DURATION OF NUCLEAR FUEL CAMPAIGNS*

S. ALHASSAN[1], *S.V BELIAVSKII*[1], *V.N NESTEROV*[1]

[1]*NATIONAL RESEARCH TOMSK POLYTECHNIC UNIVERSITY, TOMSK, RUSSIA.*

ABSTRACT

An essential parameter that justifies the interest in nuclear power reactors is the length of the fuel campaign. Floating nuclear power plants (FNPP) have proven to be a solution to bridging the developmental gap between urban and remote areas in terms of providing electricity and district heating. This article seeks to compare the reactors RITM-200 and KLT-40S in terms of their fuel performance. The Th - U fuel cycle is considered in the calculations. A spectra of neutron flux densities of both reactors was analyzed for (U^{238} + U^{235})O_2 and (Th^{232} + U^{233})O_2 fuel dispersion. The calculation of the fuel lifetime of both reactors revealed RITM-200 as superior reactor with about 1,100 effective days in fuel lifetime. From the calculations, the optimal diameter of the KLT-40S is 6.2 mm which is the same as the design value. For RITM-200 however, the optimal diameter of 7.5 mm is higher than the design value of 6.9 mm.

INTRODUCTION

For a variety of reasons, the Russians begun the research and development of a range of small power reactors from the late 1950's [1]. After about 30 years, the focus changed to the provision of electricity and district heating to remote and hard-to reach areas. The multipurpose and co-generational activities of these floating nuclear power plants (FNPP) have generated enormous attention.

USING THE ITERATIVE ALGORITHM IN SOLVING THE MULTIGROUP NEUTRON DIFFUSION EQUATION

The spectra of neutron flux were evaluated for both RITM-200 and KLT-40S reactors with the aid of the diffusion equation below in an iterative manner [7, 8]:

$$-D^i B_i^2 \phi^i - \Sigma_a^i \phi^i - \sum_{k=i+1}^{I} \Sigma_R^{i\to k} \phi^i + \sum_{k=1}^{i-1} \Sigma_R^{k\to i} \phi^k + \varepsilon^i \sum_{k=1}^{I} \nu_f^k \Sigma_f^k \phi^k = 0 \qquad (1)$$

$$\sigma_n = \sigma_n(293.6) \cdot \frac{\sqrt{\pi}}{2} \cdot \sqrt{\frac{293.6}{T_{\text{n.g.}}}} \cdot f_n \qquad (2)$$

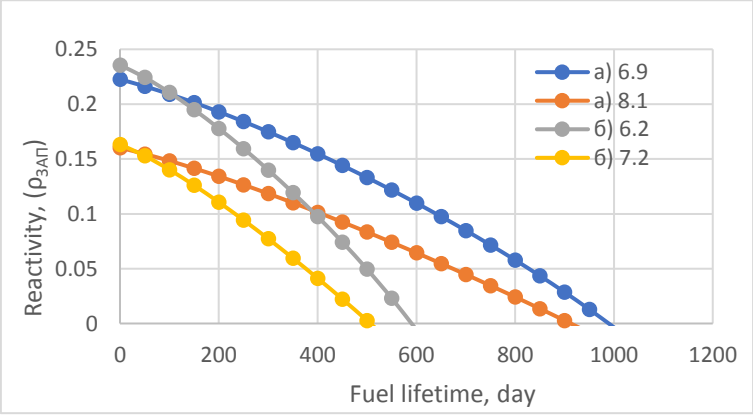

Fig. 2. Change in K_{eff} with time for $^{235}U+^{238}U$ at radii а) 6.9 & а) 8.1 for RITM-200 and б) 6.2 б) 7.2 for KLT-40S.

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