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New proliferation-protected fuel cycle of nuclear reactors with ultra-high fuel burn-up based on Pa-231 and U-232 generated in thorium blanket of fusion neutron source

G G Kulikov, A N Shmelev, E G Kulikov and **V A Apse**
National Research Nuclear University MEPhI, Russia

Objectives: Are to solve important problems of nuclear power: Decreasing the scope and the number of technological operations, enhancing the proliferation resistance of fissile materials by minimal changes in the fuel cycle. Method is to use (D,T)-fusion neutron sources for 231Pa and 232U generation through (n,2n)- and (n,3n)-reactions.

Results: Admixture of 231Pa into fresh fuel composition can stabilize its neutron-multiplying properties. It can allow us to reach: The higher fuel burn-up up to 60% HM (the longer fuel lifetime); the smaller scope and number of technological operations in fuel cycle; uranium component will be strongly protected from unauthorized proliferation by the presence of light uranium isotope 232U up to several percent in U fuel fraction; shifting from 235U to 233U as more attractive fuel material for thermal nuclear reactors; generation of plutonium fraction in such uranium-based fuel will be suppressed because some part of fertile uranium isotope 238U is replaced by 231Pa; the use of well-mastered traditional uranium-based fuels in LWR will be preserved. The lower plutonium quantities can be incinerated in fast reactors placed at international centers; fresh fuel fabrication for LWR without applications of isotope separation technologies makes it possible to improve potential abilities of nuclear non-proliferation regime and simplify the existing technologies of fresh fuel fabrication and very moderate requirements for fusion neutron sources: Without plasma ignition and without energy generation. Share of the electricity produced by nuclear power plants and used to feed fusion neutron sources can be about 5-14%.

GGKulikov@mephi.ru