

Controlled thermonuclear fusion: potential role of a joint (Th-U-Pu) nuclear fuel cycle

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This paper aims at finding solutions of so important problems of nuclear power as decreasing the scope and the number of technological operations, as well as enhancing the proliferation resistance of fissile materials in nuclear fuel cycle by means of minimal changes in the cycle. The method is including fusion neutron sources with thorium blanket into future nuclear power system. In addition to production of light uranium fraction consisting of ^{233}U and ^{234}U , high-energy 14-MeV neutrons emitted in the process of fusion (D,T)-reaction can generate ^{231}Pa and ^{232}U through (n,2n)- and (n,3n)-reactions.

It has been demonstrated that admixture of ^{231}Pa into fresh fuel composition can stabilize its neutron-multiplying properties thanks to two well-fissile consecutive isotopes ^{232}U and ^{233}U , products of radiative neutron capture by ^{231}Pa . Coupled system of two well-fissile isotopes can allow us to reach the following goals: the higher fuel burn-up and, as a consequence, the longer fuel lifetime; the shorter scope and the lower number of technological operations in nuclear fuel cycle; the better economic potential of nuclear power technologies. Such a fuel cycle presumes shifting from ^{235}U to ^{233}U as more attractive fuel material for thermal nuclear reactors. Uranium component will be protected from unauthorized proliferation by the presence of light uranium isotope ^{232}U . The use of well-mastered traditional uranium-based fuels in power LWR will be preserved. The idea suggests fresh fuel fabrication for power LWR without applications of isotope separation technologies.

Country/Int. organization

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