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Molten Salt Reactor for the management of minor actinides from VVER 1000/1200 used fuel

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This paper mainly considers the MOlten Salt Actinide Recycler & Transmuter (MOSART) system without U-Th support fueled with different compositions of transuranic elements from VVER 1000/1200 used nuclear fuel (UNF). Last developments concerned single fluid MOSART design addresses advanced large power unit with main design objectives to close nuclear fuel cycle for all actinides, including Np, Pu, Am and Cm. The optimum spectrum for Li,Be/F MOSART is fast spectrum of homogeneous core without graphite moderator. The effective flux of such system is near $1 \times 10^{15} \text{ n cm}^{-2} \text{ s}^{-1}$. Single fluid 2.4 GWt MOSART unit can utilize more than 250 kg of minor actinides per year from VVER 1000/1200 UNF. The main attractive features of MOSART system deals with the use of (1) simple configuration of the homogeneous core (no solid moderator or construction materials under high flux irradiation); (2) proliferation resistant multiple recycling of actinides (separation coefficients between transuranic (TRU) and lanthanide groups are very high, but within the TRU group are very low); (3) the proven container materials (high nickel alloys) and system components (pump, heat exchanger etc.) operating in the fuel circuit at temperatures below 1023K, (4) core inherent safety due to large negative temperature reactivity coefficient (-3.7 pcm/K), (5) long periods for soluble fission products removal (1-3 yrs). The fuel salt clean up flowsheet for the Li,Be/F MOSART system is based on reductive extraction in to liquid bismuth. The paper has the main objective of presenting the transmutation advantages and fuel cycle flexibility of the large power Li,Be/F MOSART system while accounting technical constrains and experimental data received in this study. The main design choices and characteristics for MOSART concept are explained, including fuel maintenance and engineering safety features. The need for the experimental small power test MOSART unit to demonstrate the control of the reactor and fuel salt management with different minor actinides loadings for start up, transition to equilibrium, drain-out, shut down etc. with its volatile and fission products, is discussed

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Country or International Organization

Russian Federation

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