J Astrophys Aerospace Technol 2017, 5:2 (Suppl)
DOI: 10.4172/2329-6542-C1-009

Fast neutron reactor with liquid U-Pu fuel

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Some essential problems of the contemporary nuclear power, based on the thermal reactors with ^{235}U fuel (resources, minor actinides) can be solved using fast reactor. However, this reactor is not inherently safe (in Weinberg's definition) and has some problems with the hot spent fuel handling, especially with the low limit of fuel elements burning and their fabrication from the hot spent fuel. Molten salt reactors (MSR) are free from these shortages, because their void and temperature coefficients are negative, they do not need in the fuel elements fabrication and give the opportunity to organize *on line* hot spent fuel reprocessing. MSR was in operation during almost 5 years with Th-U fuel and thermal neutron spectrum adequate to this fuel. However, its neutron balance is poor in comparison with U-Pu fuel and fast neutron spectrum. Till recently there was impossible to combine all three ideas (fast neutron spectrum, molten salt and U-Pu fuel) because the PuF_3 solubility in the fluoride salts was too small (<3 mole percentage). However, 4 years ago it was established experimentally that PuF_3, UF_4 and AmF_3 solubility in the eutectic 46.5 LiF-11.5 NaF-42.0 KF (FLiNaK) is equal 33, 45 and 43 mole percentage respectively at 700°C. This observation opens the way for the development of the Fast Molten Salt Reactor with U-Pu fuel cycle (U-Pu FMSR) as well as the effective FMSR reactor-burner of Am. U-Pu FMSR based on FLiNaK can work in the equilibrium mode at the concentration UF_4 and PuF_3 22 and 7 mole percentages respectively using as a fuel ^{238}U only. FMSR reactor-burner can transmute ~300 Kg Am/year•MWth without Pu feeding, i.e., 1 GWth FMSR-burner can disintegrate Am from the spent fuel of ~ 40 1GWel. Thermal reactors after five years of cooling the recent development of the conception of U-Pu FMSR and FMSR-burner will be presented in the talk.

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