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Dependence of molten salt liquidus temperature on its composition

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Molten Salt Reactors (MSR) are very specific from the fuel properties perspective. Many issues related to the solid fuel behavior are not relevant for this liquid fuel. At the same time, many new issues arise. The viscosity, liquidus temperature, its difference from solidus temperature, thermal conductivity and capacity and many other parameters depends on the fuel composition and its redox conditions.
In this presentation the evolution of liquidus temperature is evaluated for Molten Salt Fast Reactor (MSFR). This reactor uses molten fluorides salt, which roughly consist of eutectic mixture of LiF and AcF4. It is designed for operation in closed Th-U fuel cycle. Nevertheless, it is not so obvious how to reach this state. Basically the are only three available option for initial fuel loading of this reactor: 1) using LWR TRU, 2) using enriched uranium and 3) using mixtrure of both previous options. The transition towards equilibrium Th-U cycle was evaluated for several initial fuel compositions and the evolution of liquidus temperature was observed along each of these trajectories.
The burn up calculations were accomplished by EQL0D procedure using Monte Carlo code Serpent 2 and the liquidus temperature was obtained by GEMS TM core using Heracles database.
During all transitions certain amount of PuF3 was created. Since the solubility of trivalent fluorides in this carrier salts is limited, the respective salt liquidus temperature evolves strongly.
The results of neutronics burn up calculations for each transition paths are presented ins the traditional liquidus temperature diagram. They show the possible range of liquidus temperature and options how to transit towards the equilibrium Th-U cycle.

Author: KREPEL, Jiri (Paul Scherrer Institut)

Co-author: NICHENKO, Sergii (Paul Scherrer Institut)

Presenter: KREPEL, Jiri (Paul Scherrer Institut)

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