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Molten Salt Actinide Recycler and Transforming System with and without Th-U support: MOSART

Summary / Objectives:

The Molten Salt Reactor designs, where fissile material is dissolved in the molten salt fluorides, under consideration in the frame work of the GIF are briefly described. The presentation mainly focuses on the MOlten Salt Actinide Recycler & Transforming (MOSART) system without and with U-Th support fueled with different compositions of transuranic elements trifluorides from spent LWR fuel. New design options with homogeneous core and fuel salt with high enough solubility for transuranic elements trifluorides are being examined at NRC "Kurchatov Institute" because of new goals. The webinar has the main objective of presenting the fuel cycle flexibility of the MOSART system while accounting technical constrains and experimental data received in this study. A description is given of the experimental results on key physical and chemical properties of fuel salt and combined materials compatibility to satisfy MOSART system requirements. In the webinar the main design choices and characteristics of MOSART concept are explained and discussed including safety, transient simulations, laboratory scale experiments and program plan for the development of the small power Demo MOSART unit.

Meet the Presenter:

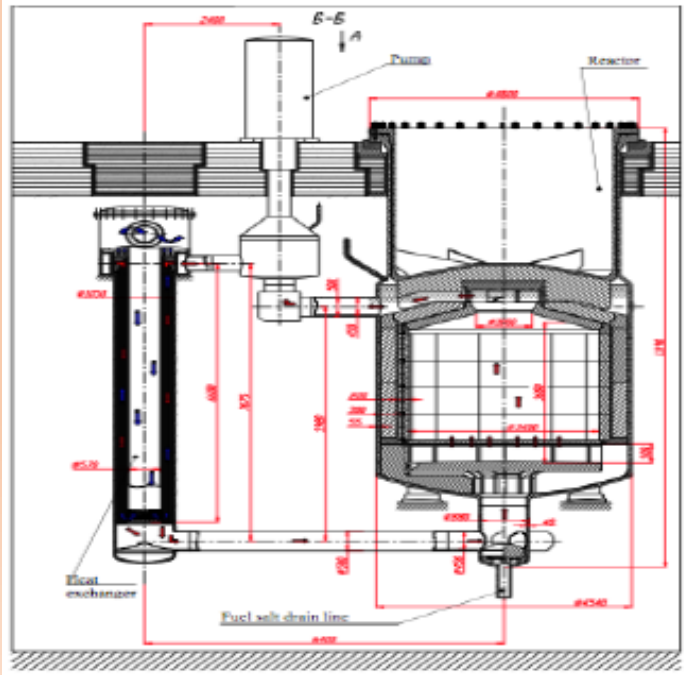
Dr. Victor Ignatiev works at the NRC-"Kurchatov Institute," Moscow, Russia, both as the Head of the Molten Salt Reactor Laboratory (since 2012) and as a Professor (since 2009). He graduated from the Nuclear Power Systems Moscow Physical Engineering Institute, USSR, in 1976, and earned his Ph.D. in 1986 from the Kurchatov Institute of Atomic Energy, Moscow, USSR. His Ph.D. research focused on molten salt reactors. Since 2014, he has been the co-chair of Generation IV International Forum MSR pSSC. In 1985, he received the Kurchatov Award on the Fundamental Studies of Molten Salt Reactors; and in 2016, he received the Kurchatov Award on Engineering studies of Molten Salt Reactors. His research activities mainly focus on Molten Salt Reactor: (1) Th - U fuel cycle and TRU burners, (2) Combined materials compatibility & salt chemistry control in selected molten salt environments at parameters simulating designs operation, (3) Physical & chemical properties for fuel and coolant salt compositions, and (4) Flow sheet optimization, including reactor physics, thermal hydraulics and safety related issues.

1. Introduction of MSR and MOSART:

In MSR (Molten Salt Reactor) device, solid fuel elements are replaced by liquids. Started with TRU Fluorides from LWR Spent Fuel, MOSART (Molten Salt Actinide Recycler & Transformer) can operate in different modes: Transmuter, Self-sustainable, Breeder.

2. MOSART – Transforming Reactor System

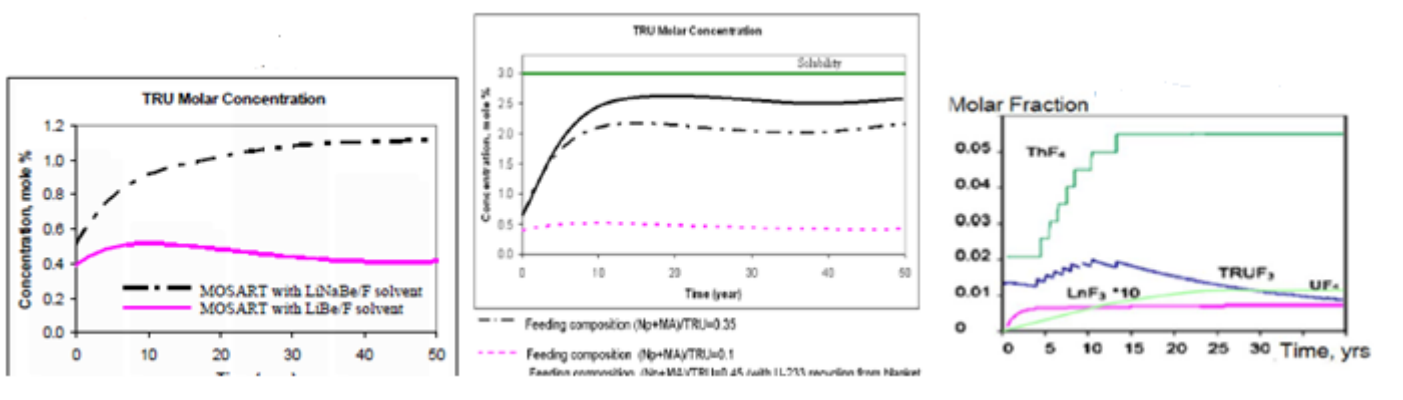
MOSART design has options with homogeneous core and fuel salt with high enough solubility for transuranic elements trifluorides.



System	burner	/ breeder
Fluid streams	1	2
Power capacity, MWt	2400	2400
Fuel salt inlet/outlet temperature, °C	600 /720	600 /720
Fuel salt composition, mole %	72LiF 27BeF_2 1$TRUF_3$	75LiF 16.5BeF_2 6ThF_4 2.5$TRUF_3$
Blanket salt composition, mole %	no	75LiF 5BeF_2 20ThF_4

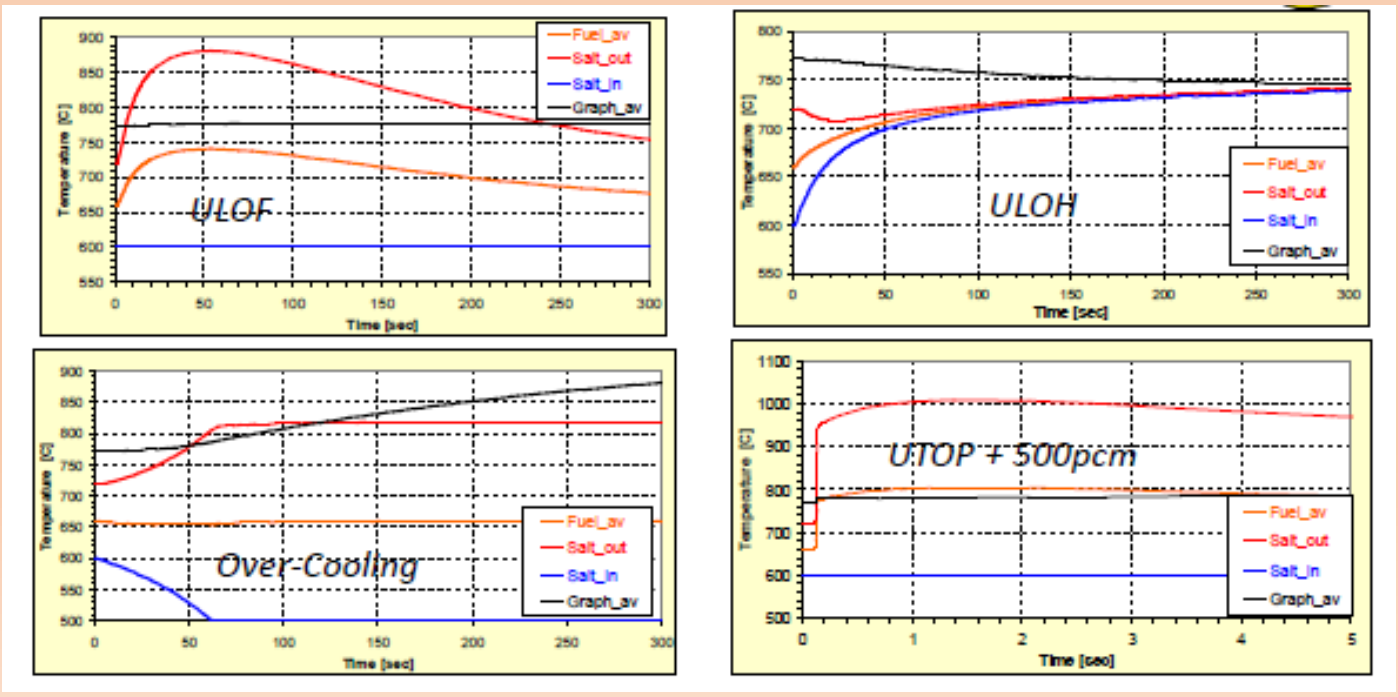
3. MOSART Fuel Cycles

- *MOSART core containing as initial loading 2 mole% of ThF_4 and 1.2 mole % of $TRUF_3$, with the rare earth removal cycle 300 epdf after 12 years can operate without any $TRUF_3$ make up basing only on Th support as a self-sustainable system.*
- *At equilibrium molar fraction of fertile material in the fuel salt is near 6 mole %.*



4. MOSART Transients Analysis :

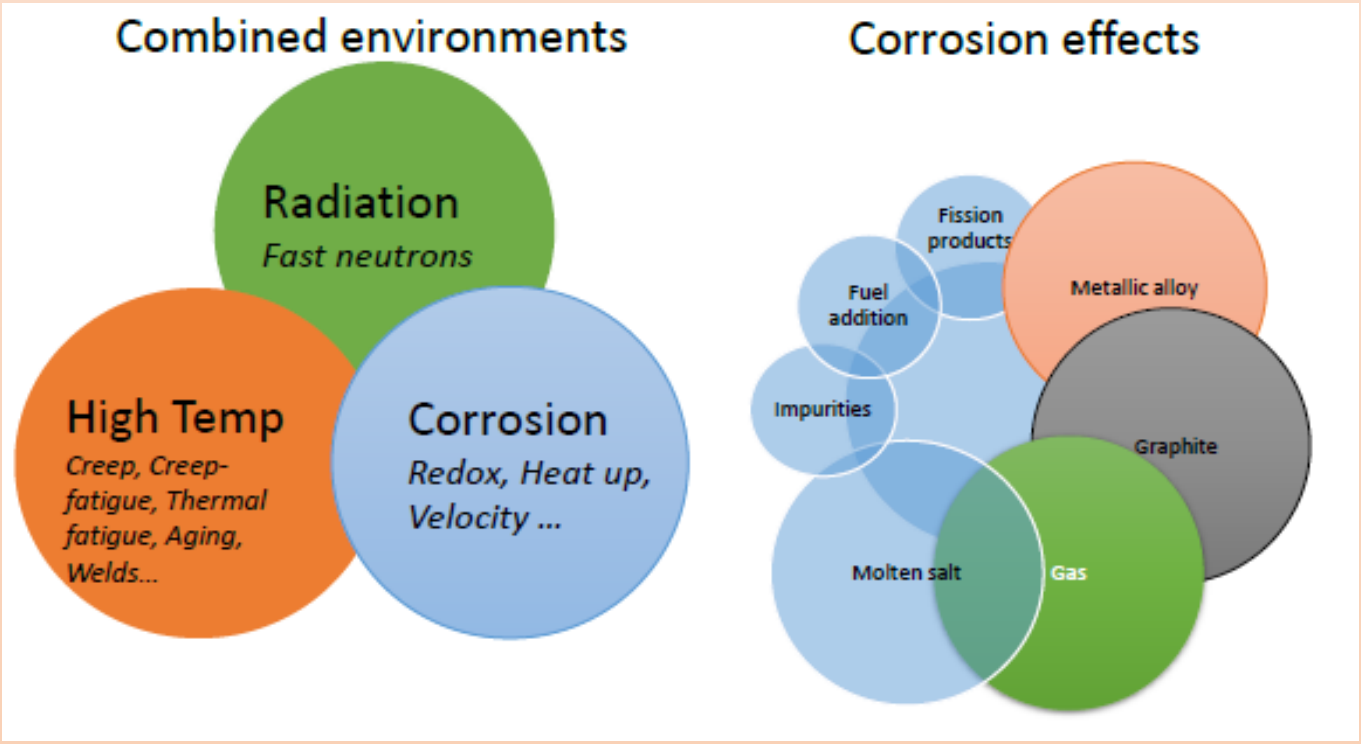
The MOSART is expected not to be seriously challenged by the major, unprotected transients such as ULOF, ULOH, overcooling, or even UTOP.



5. MSR container materials:

Experiments Results In polythermal loops with redox potential measurement demonstrated that operations with Li, Be/F salt, fueled by UF_4 or PuF_3, are feasible using carefully purified molten salts and loop internals.

Alloys modified by Ti, Al and V have shown the best post irradiation properties



6. Selection of Fuel / Coolant options :

In most cases the base-line fuel / coolant salt is lithium-beryllium fluoride salt as it has best properties.