Species Mass Transport Analysis of a Versatile Experimental Salt Irradiation Loop (VESIL)

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Motivation
- Molten Salt Reactors (MSRs) are fluid fuel nuclear reactors originally developed by Oak Ridge National Laboratory in the 1960’s
- Fission products (Fig. 1) are generated directly in the coolant-fuel-salt and circulate throughout the entire primary loop

Objectives
- Develop and couple various physics models to track insoluble fission product within the TH code CTF
- Solve Coupled PDEs - \( \frac{\partial N}{\partial t} = - (\nabla \cdot N \cdot v) + S \)
- Characterize Noble Metal and Noble Gas interactions within VESIL – a dynamic fuel-salt loop proposed for irradiation in the ATR

Results – He Sparging: \( ^{132}\text{Sn} \rightarrow ^{132}\text{Sb} \rightarrow ^{132}\text{Te} \rightarrow ^{132}\text{I} \rightarrow ^{132}\text{Xe} \)

Conclusions
- Simplest VESIL design model shows gas plenum design to be adequate although source term build up is larger
- Gas sparging design model shows enhanced gas/source term mitigation as well as extraction of noble metal particles
- Additional mesh filter may be needed to collect noble metal particles before entering off gas system

References
1. Abou-Jaoude, A. Evaluation of a Versatile Experimental Salt Irradiation Loop (VESIL) inside the Advanced Test Reactor (2019)