MSRs for Medical Isotopes Production

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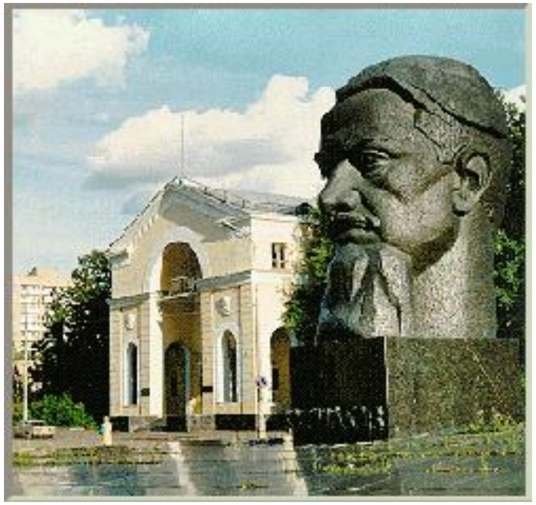


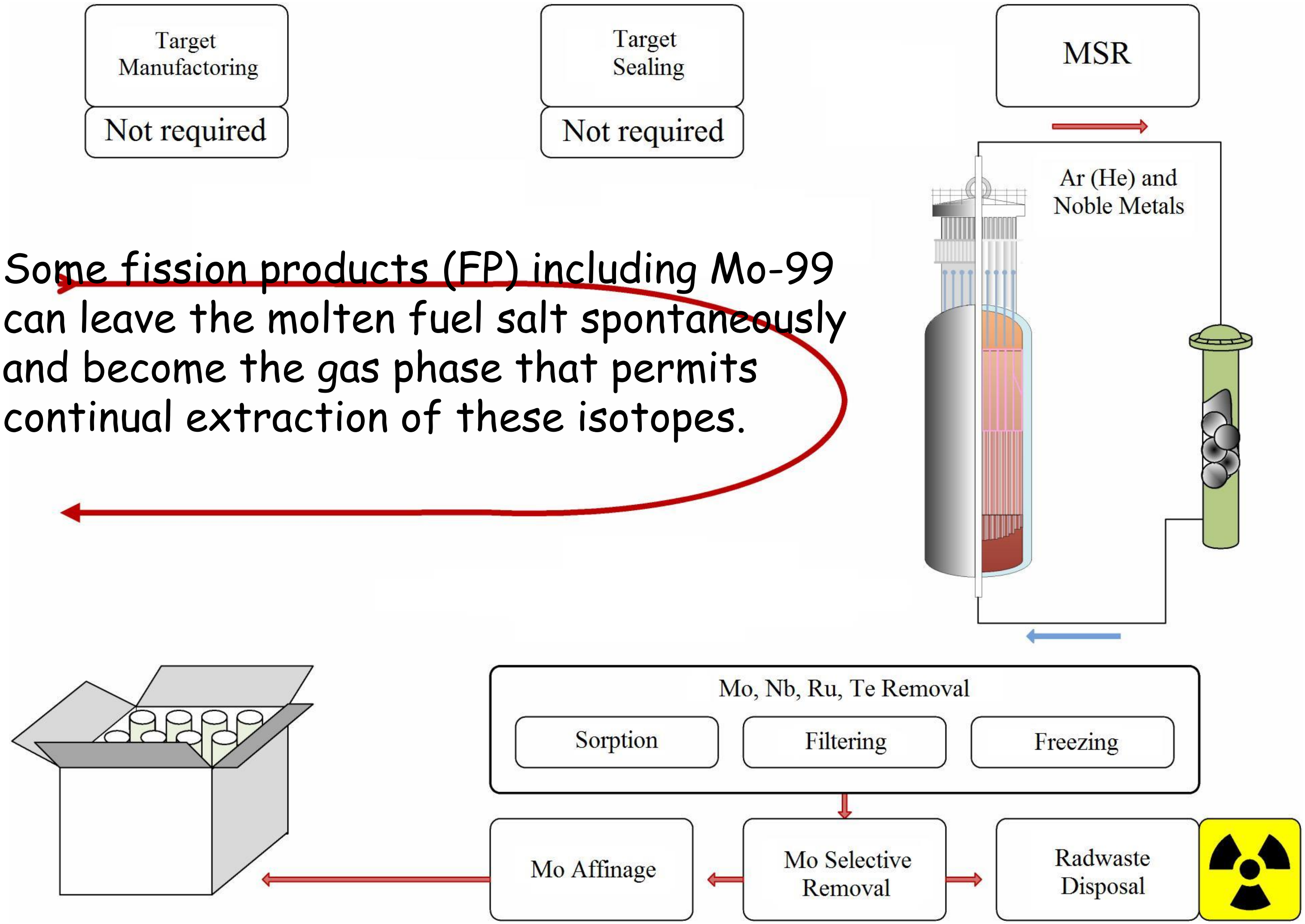
^{99}Mo Production in 1MWt MSR

A dominant portion of present sources of Mo-99 is produced using high-enriched uranium targets irradiated in nuclear reactors and most of global supply relies on the operation of only five aging research reactors.

Among reactor methods of Mo-99 production, extracting radioisotopes from molten-salt fluoride fuel by fission is an attractive technology that has a great potential for large-scale production .

^{99}Mo Production in 1MWt MSR

Some fission products (FP) including Mo-99 can leave the molten fuel salt spontaneously and become the gas phase that permits continual extraction of these isotopes.



Small MSR for Mo Production

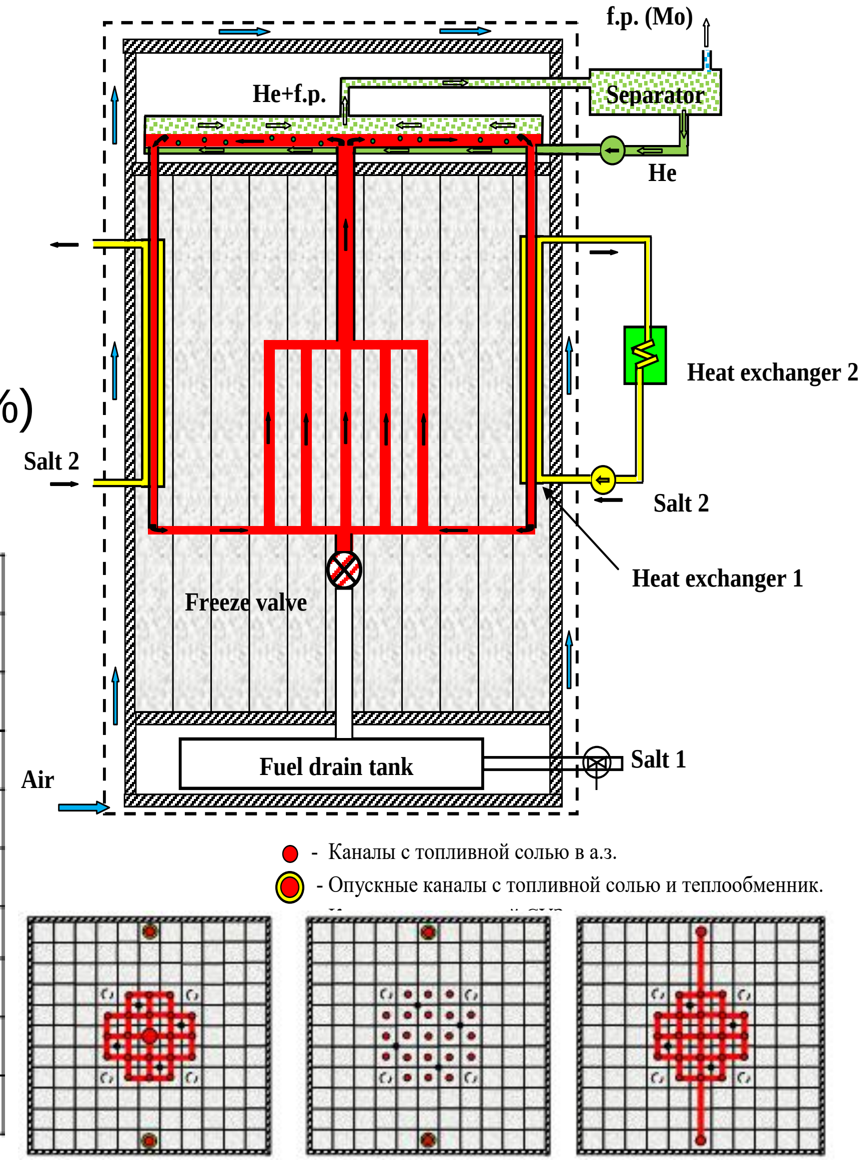
Institute of Nuclear Engineering and Science, National Tsing-Hua University R. J. Sheu a,b, C. C. Chaoa, O. FeY.-W. H. Liua

A small reactor of heterogeneous type with natural convection and without reprocessing

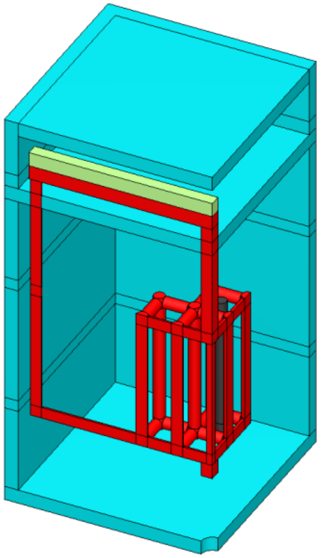
- Power: 1MW
- Fuel salt: LiF-BeF_2-UF_4(73-27-x%)
- ^{235}U enrichment: 20%
- Salt of second loop: $NaBF_4$-NaF(92-8%)

Main characteristics

1	Height of the graphite [cm]	220
2	Height of the core [cm]	100
3	Number of fuel channels	21
4	Radius of fuel channel [cm]	4.0
5	Height of top and bottom reflector [cm]	60
6	Fuel/Graphite ratio in the core [%]	12.8
7	U-235 enrichment [wt%]	20.0
8	Thickness of the side reflector [cm]	75
9	Dimensions of the reactor [cm]	275 x 275
10	U in the salt for BOL [mole%]	1.12



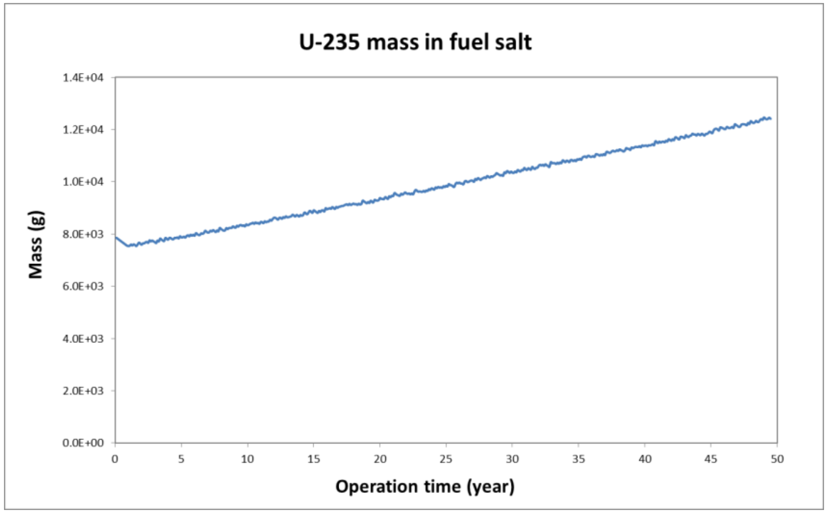
Small MSR for Mo production

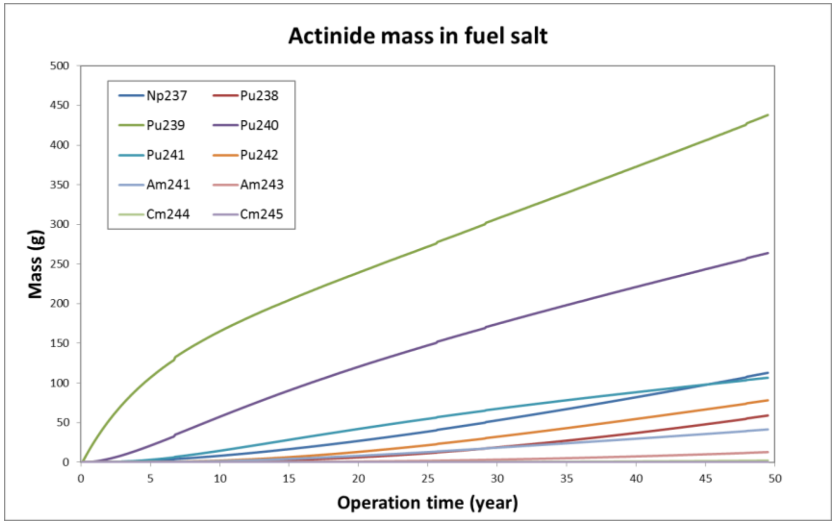


FUEL ADDITION AND CONSUMPTION

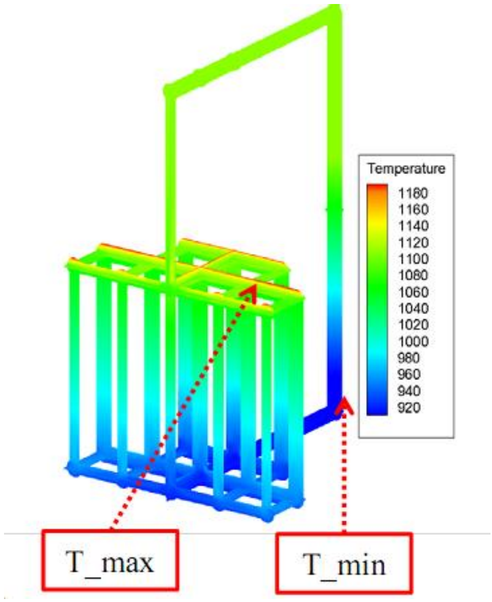
Mass [kg]	Initial loading	Addition in 50y	Total fuel in 50y	Fuel left in core (50y)	Fuel consumed
U-235	7.86	21.68	29.53	12.47	-17.06
U (U235+U238)	39.69	108.38	148.07	130.67	-17.40
Heavy metal U+Actinides	39.69	108.38	148.07	134.58	-13.49
Actinides	0	0	0	3.91	+3.91

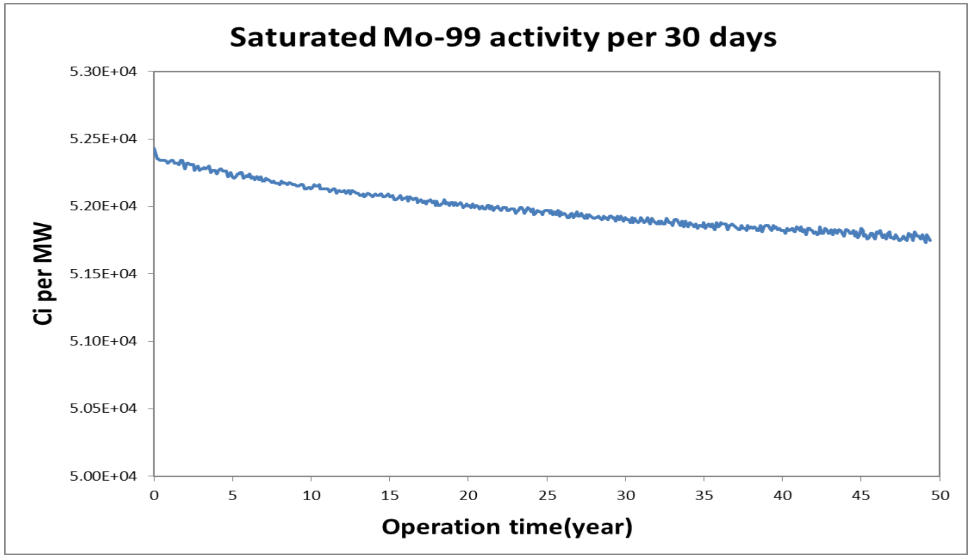
MASS OF U-235 & ACTINIDES IN FUEL SALT

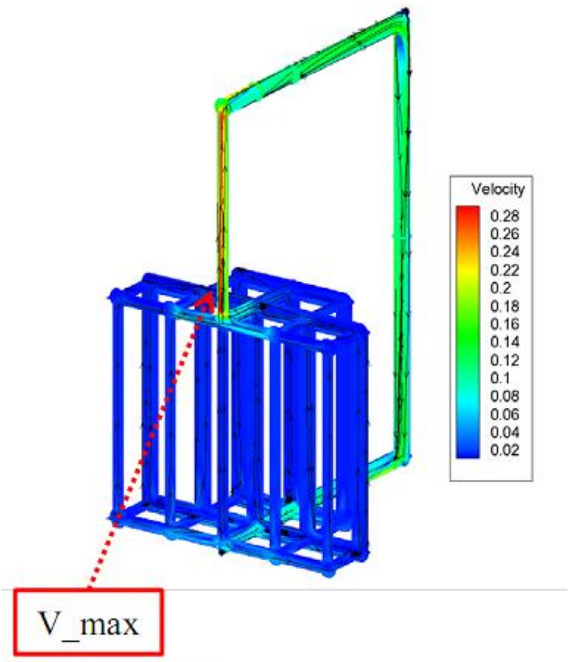




MO-99 PRODUCTION EFFECTIVNESS







Mo-99 is a major radionuclide in fission products and 1 MW MSR potentially can produce a significant amount of Mo-99, approximately 1922 TBq in saturation. The special filters must be created and experimentally approved.

Summary

- *The molten salts have many desirable properties for mentioned above applications, and it seems likely that – given sufficient development time and money - a successful burner or breeder system could be developed*
- *Introduction of MSR technology to nuclear power might include 3 stages: FSCR, MSCR and MOSART*
- *It is obvious from the discussion above that use of molten fluorides as coolant and fuel for a reactor system of new fuel production or incinerator type operating in critical or fusion driven modes faces a large number of formidable problems. Several of these have been solved, and some seem to be well on the way to solution. But it is also clear that some still remain to be solved*
- *It may even be uncertain whether such a system would serve a useful purpose if its successful development were assured. It is certain that effort to date has thrown light on e. g. much elegant high temperature non-aqueous chemistry and has shown how molten salts can operate under hard and strong conditions*
- *Finally, it open perspectives significantly different to the present reactor and fuel cycle technology*