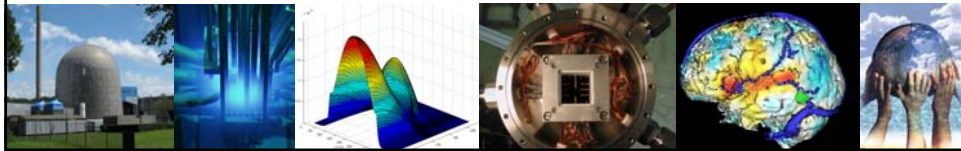


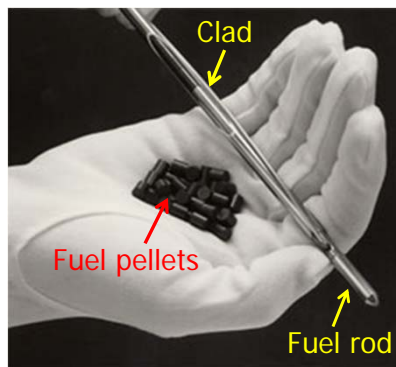
# Thorium in Molten Salt Reactors From LWR to MSR

19-4-2015

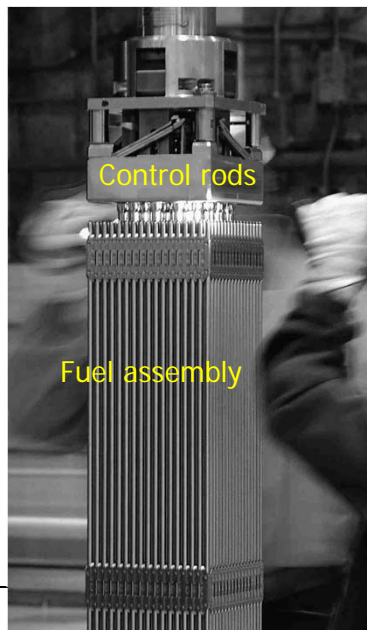
Jan Leen Kloosterman  
TU-Delft



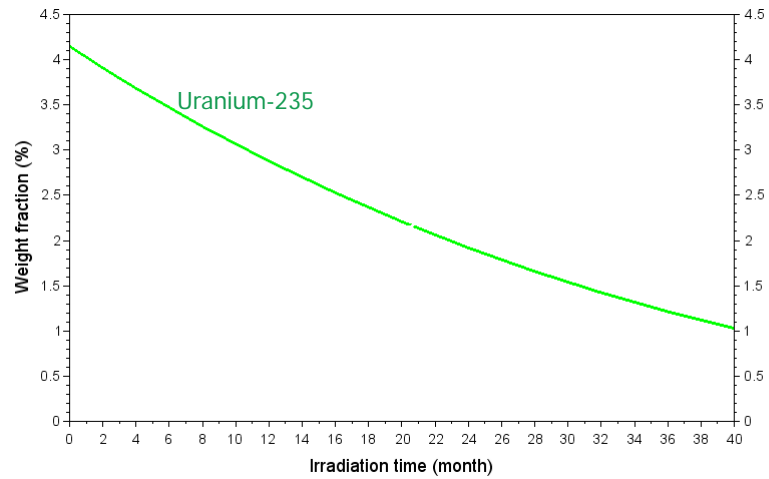
## Fuel assemblies LWR



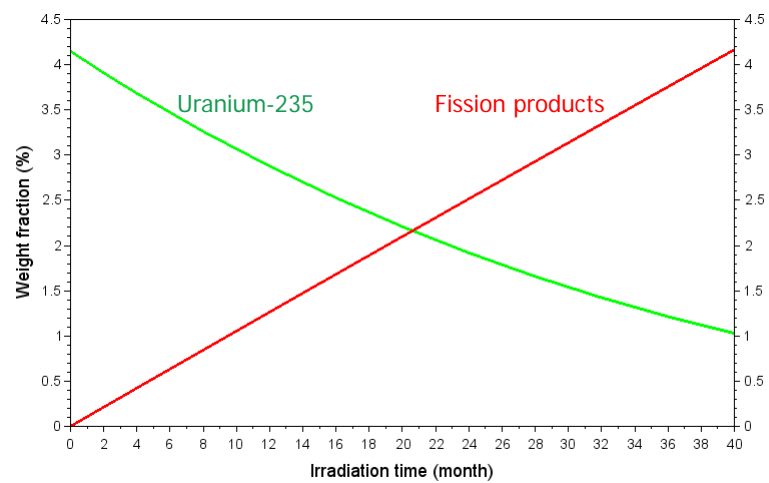
Fuel separated from coolant



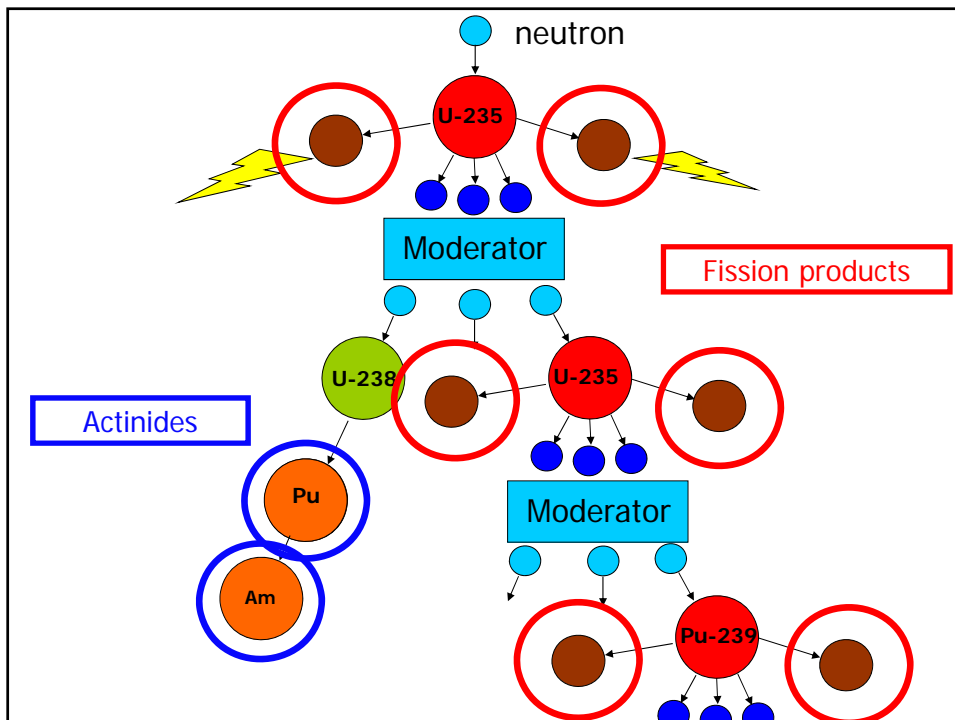
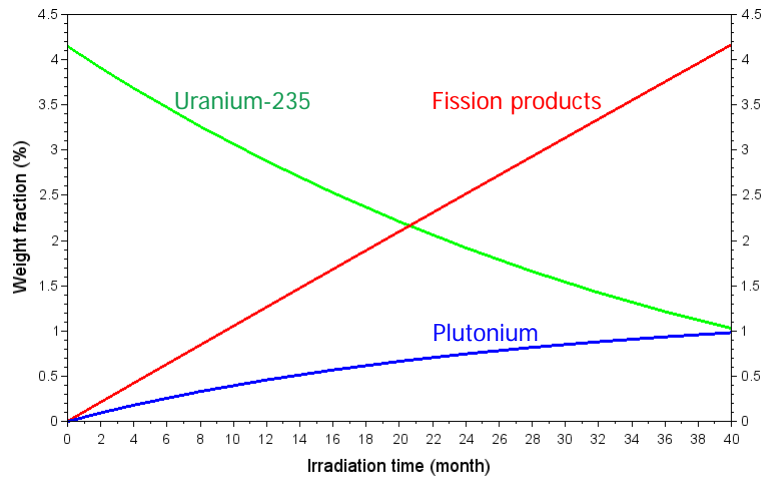
## Fuel composition LWR



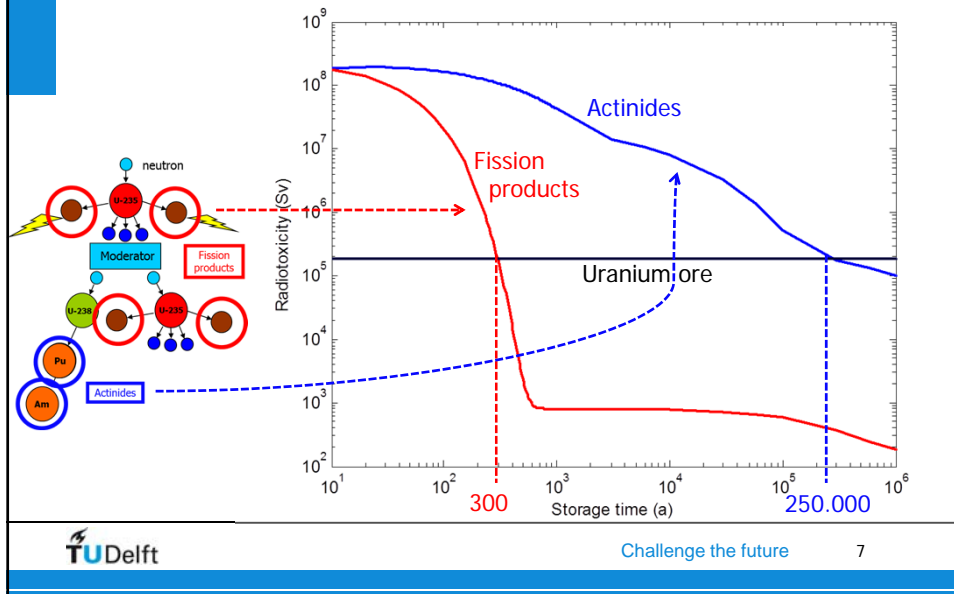
## Fuel composition LWR



# Fuel composition LWR



## Radiotoxicity LWR

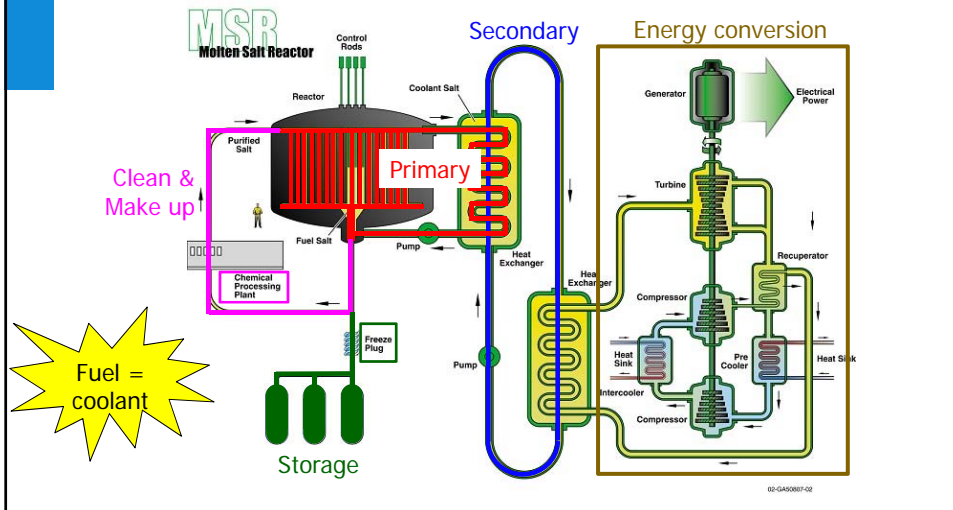


## Imagine a reactor with...

- No surplus fuel in the core
- No decay heat removal issue
- No high pressure coolant
- No volatile fission products
- No long-lived nuclear waste
- Virtually unlimited resources

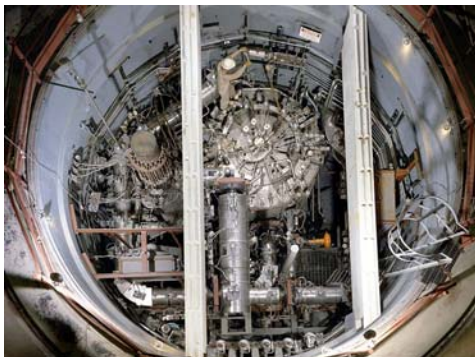


# Molten Salt Reactor

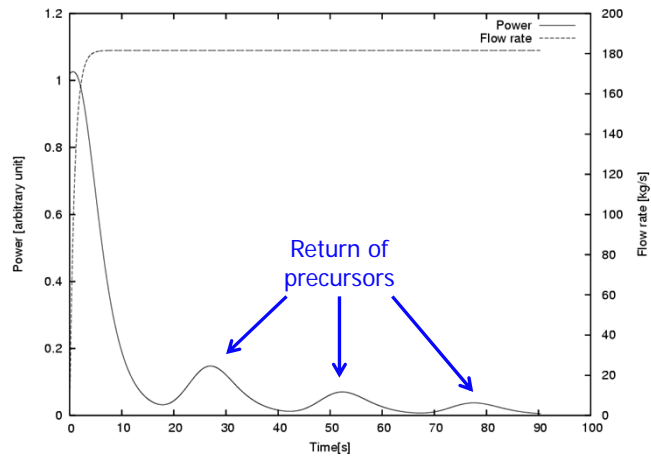


# Molten Salt Reactor Experiment

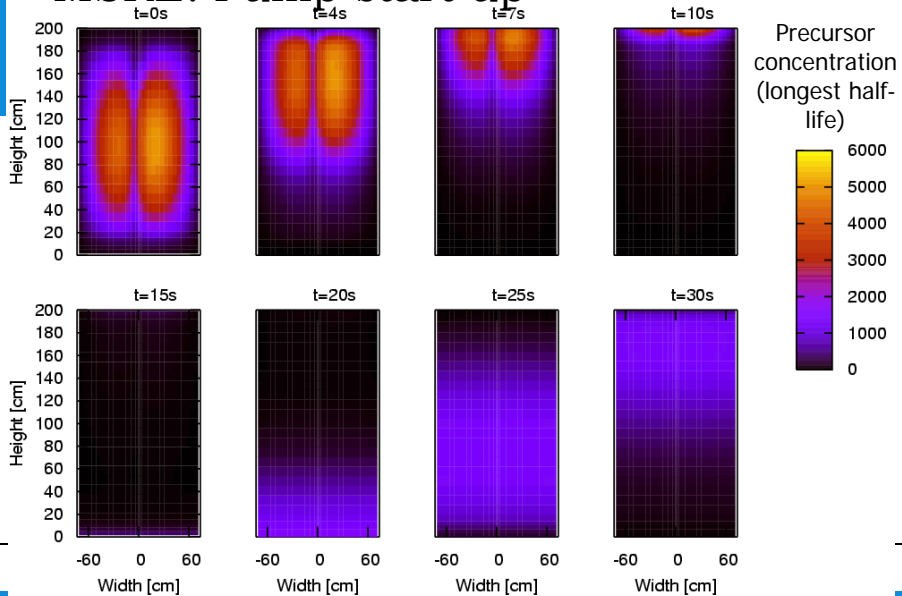
MSRE 1965-1969



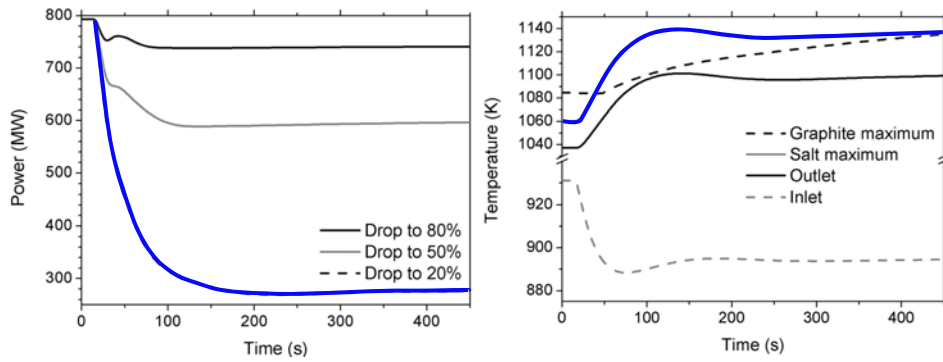
## MSRE: Zero power pump startup



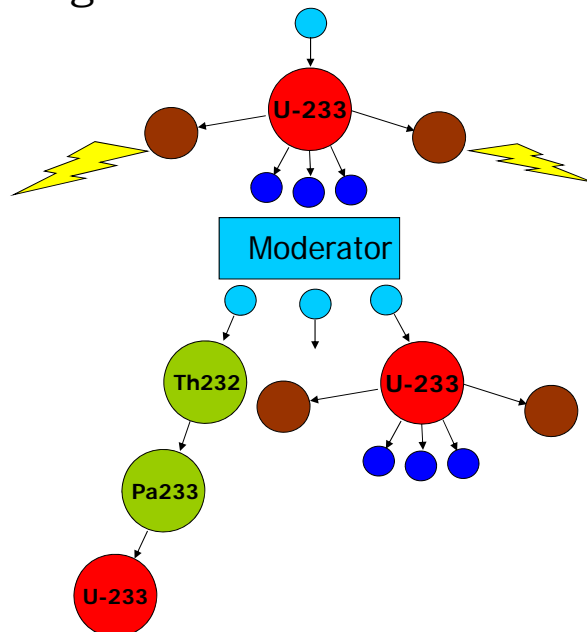
## MSRE: Pump start up



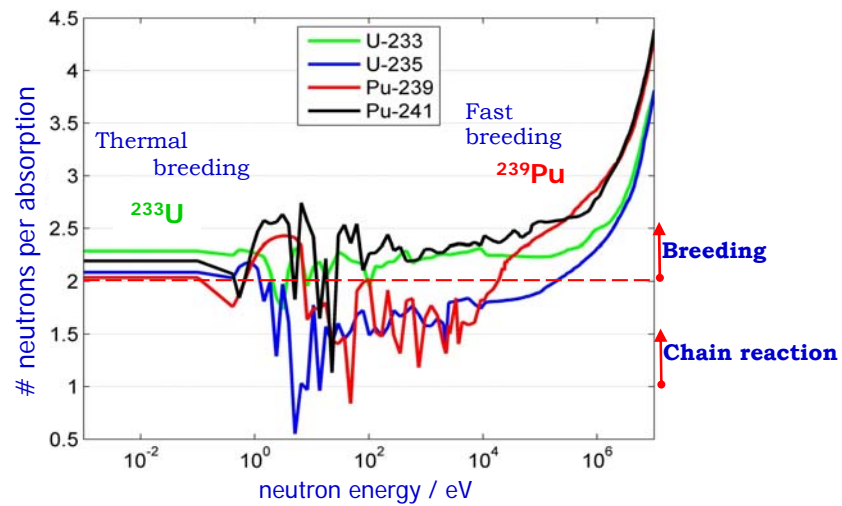
## MSR: Pump coast-down at full power



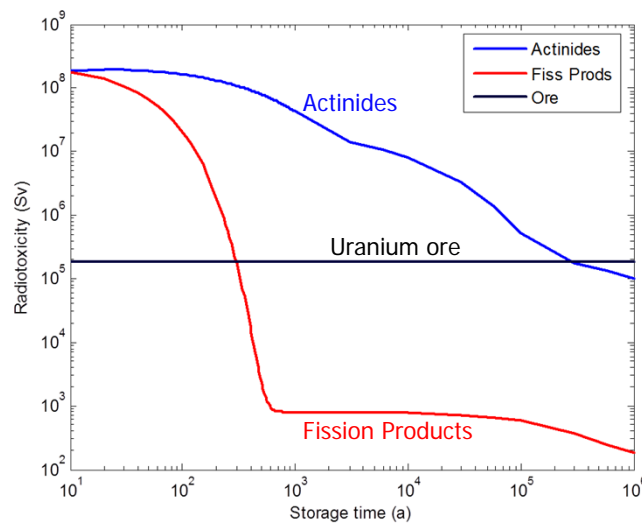
## Breeding with thorium



## Number of neutrons per absorption

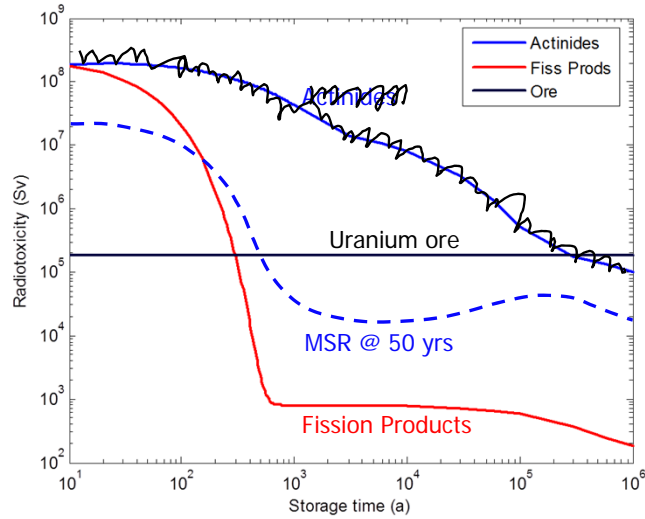


## Radiotoxicity LWR

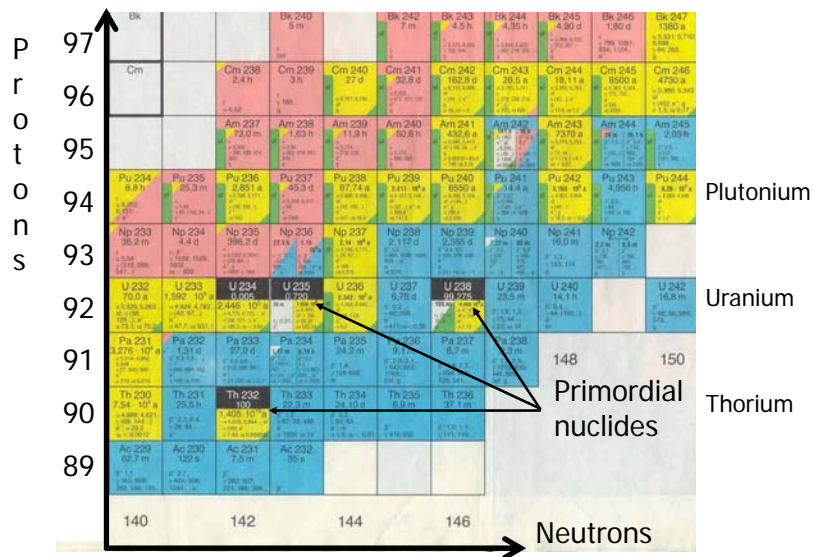




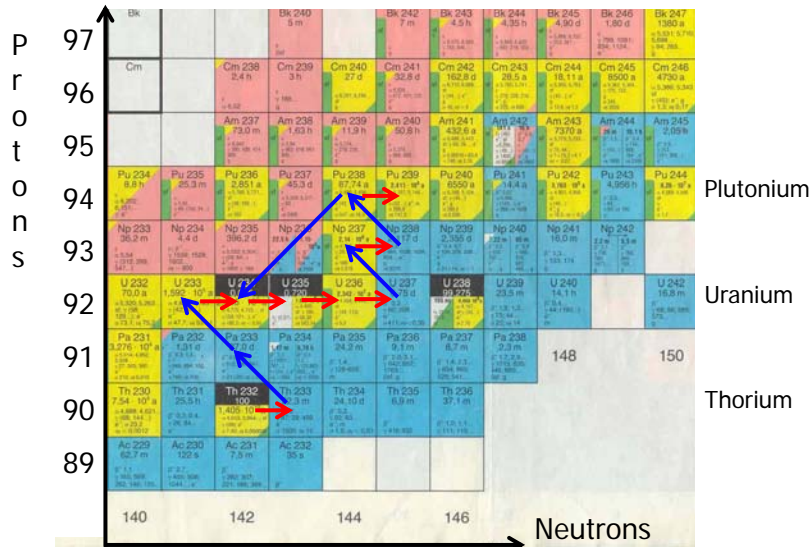
# Radiotoxicity thorium-MSR



# Nuclides



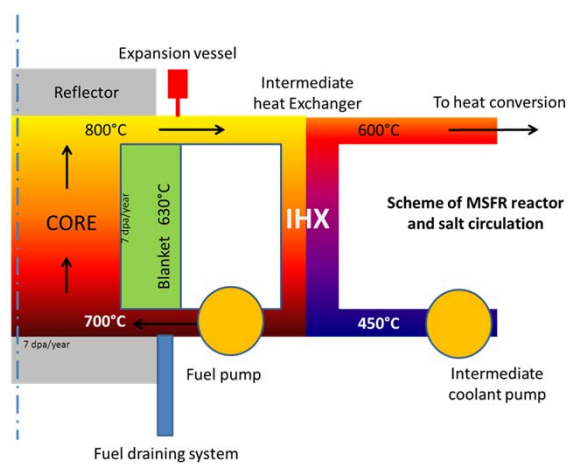
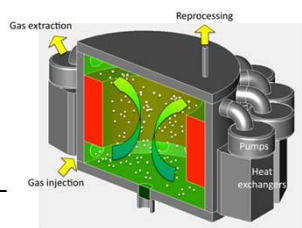
# Nuclides



# GEN-IV: Molten Salt Fast Reactor

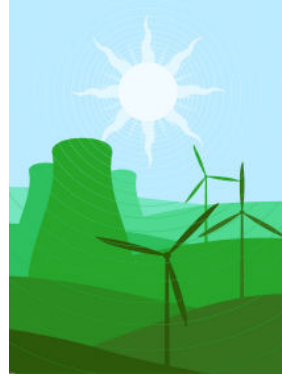
## Working parameters MSFR

- High temperature (750 °C)
- Low pressure (1 bar)
- Circulation time (4 sec)
- LiF-ThF4-UF4-(TRU)F3 (77.5-6.6-12.3-3.6 mol%).
- Online processing / fueling
- Three (fuel) salt loops



## Summary MS(F)R

- Fuel salt is at ambient pressure
  - No driving force for dispersion
- Fuel salt is a fluid
  - No compaction, free expansion
  - Freeze plugs and draining
  - Load-following
- Fuel salt cleaning
  - Removal of fission products
- Flexible fuel cycle
  - From breeding to burning
  - No external fuel processing



## Conclusions

- A Molten Salt Reactor has a completely new safety philosophy: let the fuel expand and flow!
- Thorium in a Molten Salt Reactor does not produce long-lived nuclear waste
- Thorium in a Molten Salt Reactor fits in a sustainable energy supply