

Thorium: Fuel Cycle, Potential Advantages, Challenges, and Prospective Reactors

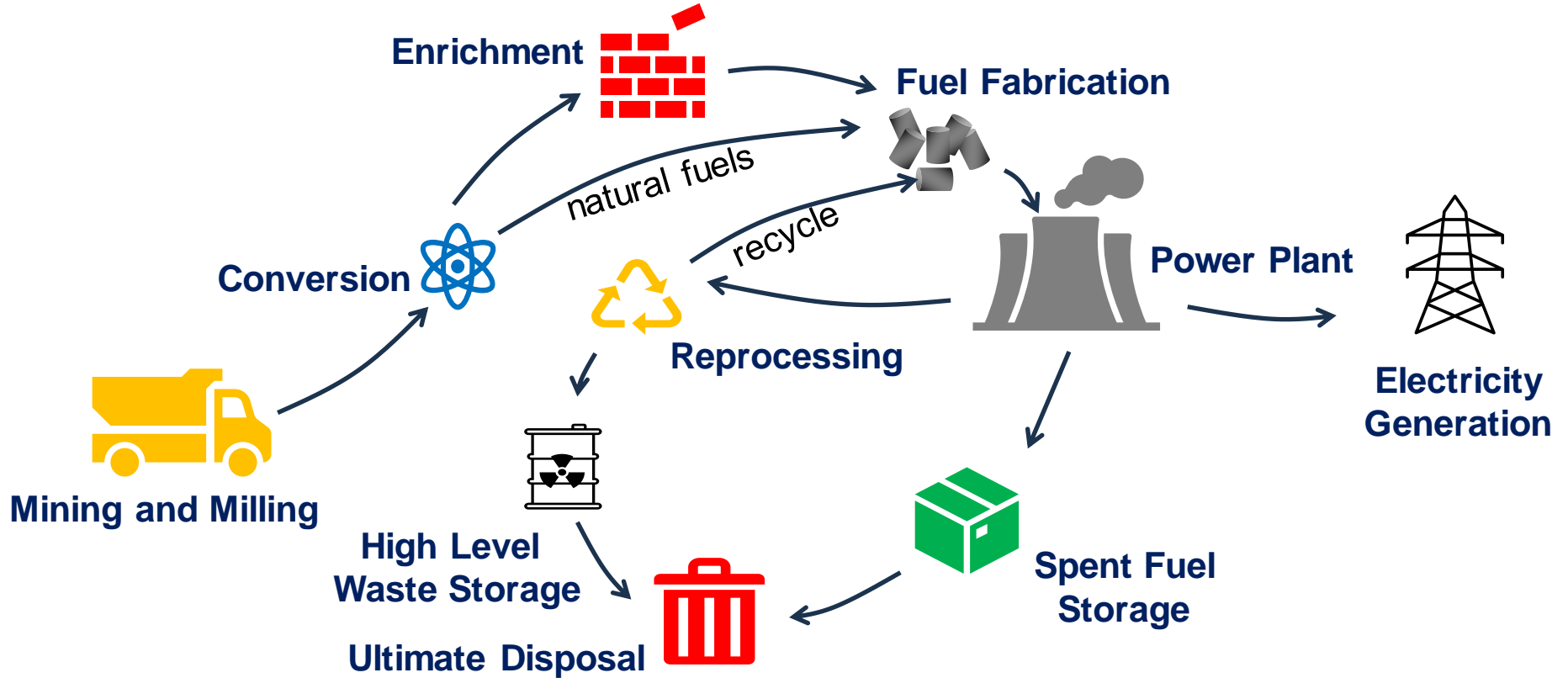
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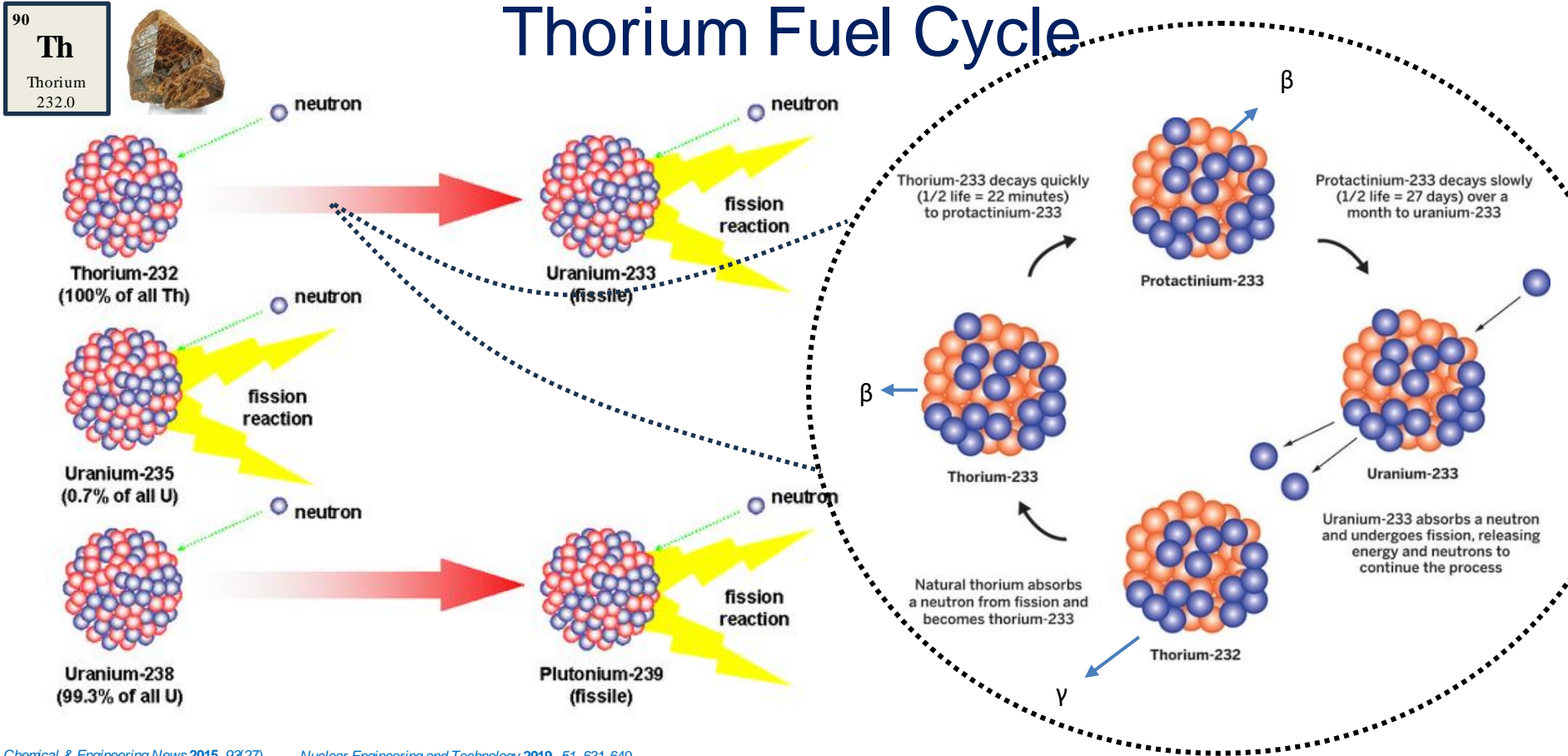


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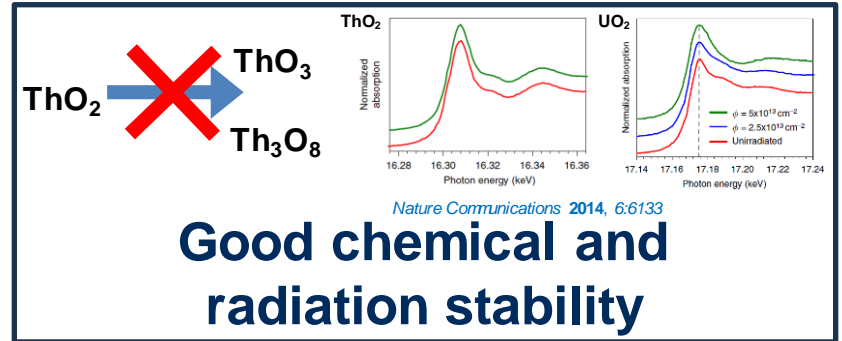
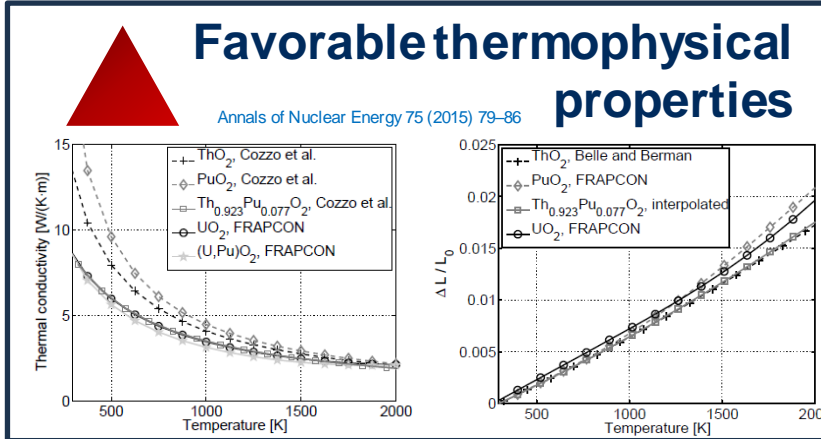
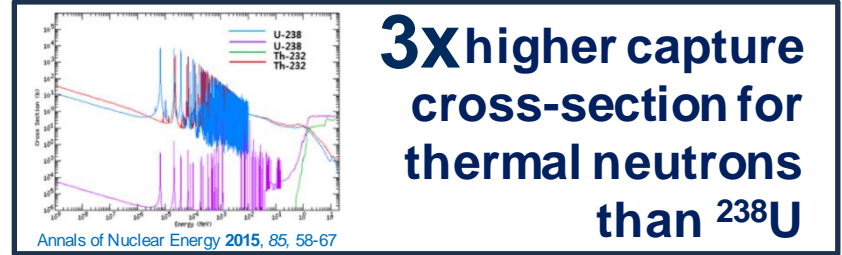
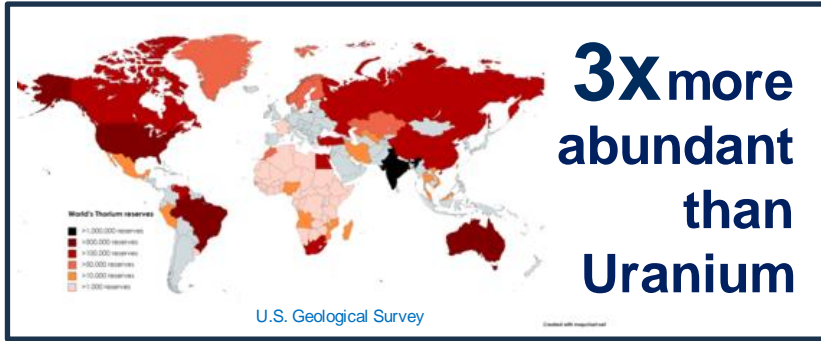
Nuclear Fuel Cycle in General



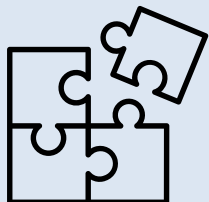
Thorium Fuel Cycle



Potential Advantages of Thorium



Challenges of Thorium-based Fuel



Lack of Infrastructure



Limited Operational Experience



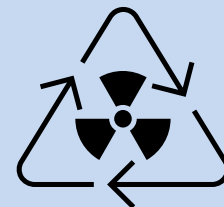
Low-demand of Thorium mineral source, yet

Relatively expensive extraction cost

Economic Viability



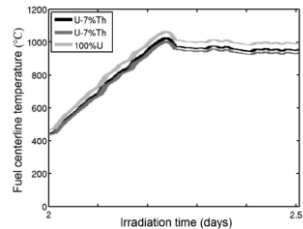
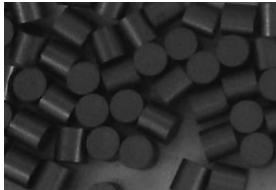
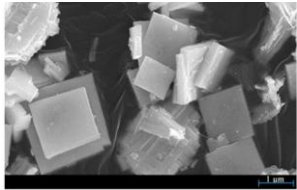
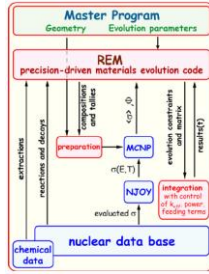
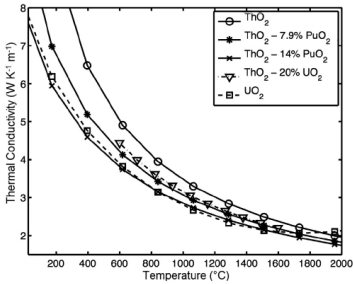
Reactor Design Complexity



Waste Management

Strategies to Introduce Th-based Nuclear Fuel

- Characterizations of basic physico-chemical data at laboratory scale
- Qualification of reactor-physics and safety codes
- Testing and qualification of fuel fabrication technology
- Execution of irradiation experiments and integral testing
- Post-irradiation analyses aimed at fuel rod/assembly characterization
- Re-evaluation of safety documents of reactors and fuel cycle facilities



Brief History of Thorium Utilization in Reactors



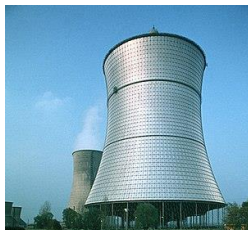
Shippingport (LBWR)
USA



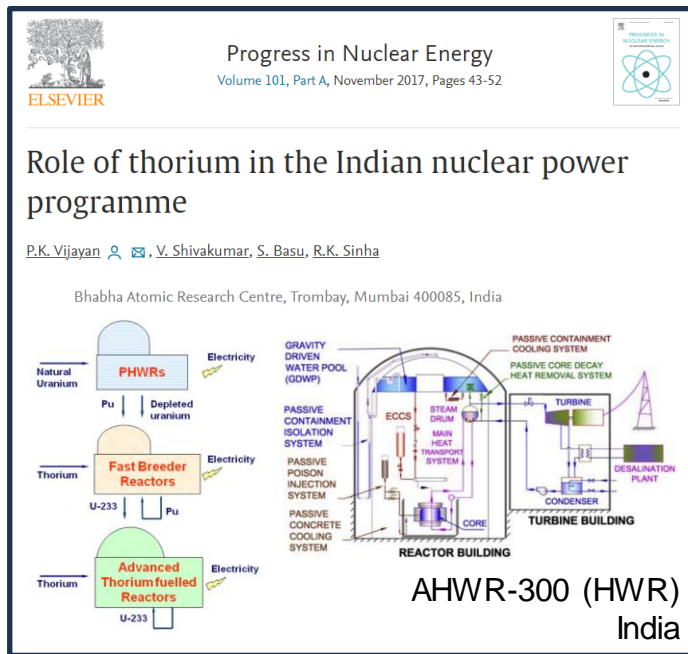
Fort St Vrain (HTGR)
USA



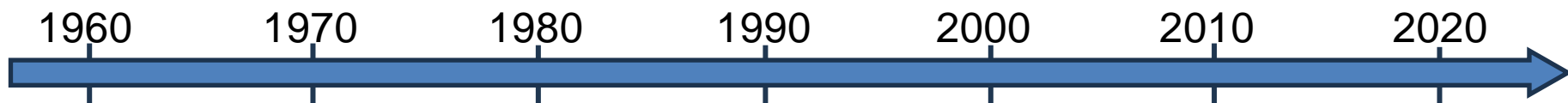
AVR (HTGR)
Germany



THTR-300 (HTGR)
Germany

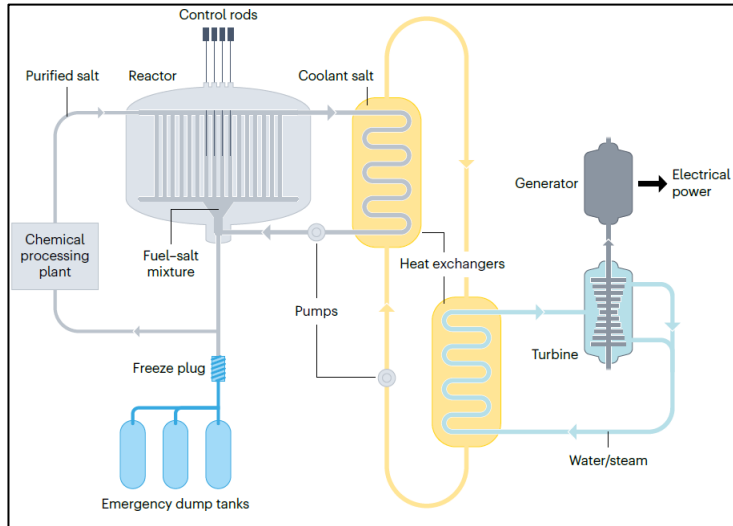


AHWR-300 (HWR)
India

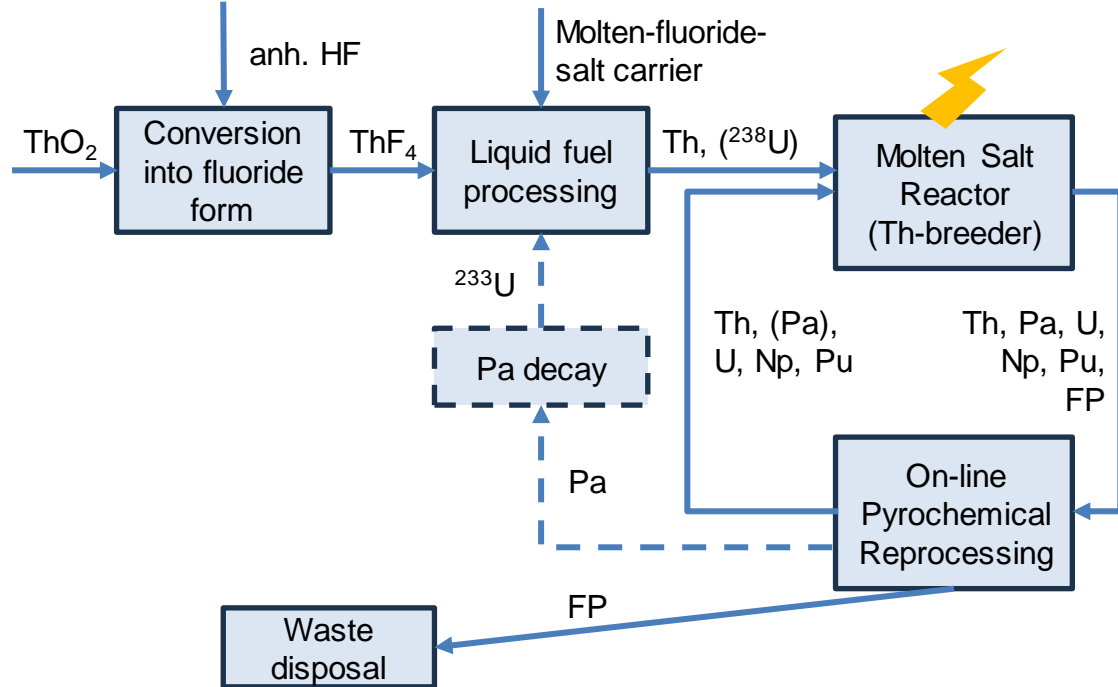


Prospective Reactors Using Thorium-based Fuels

Molten Salt Reactor (MSR)

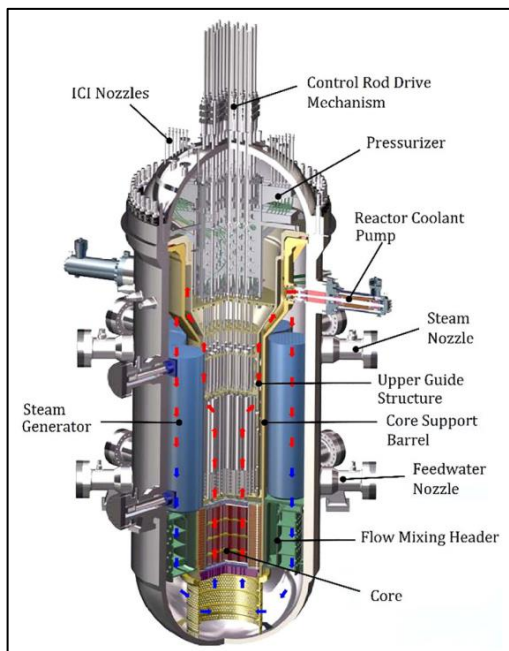


Scheme of fuel cycle of MSR Th-breeder

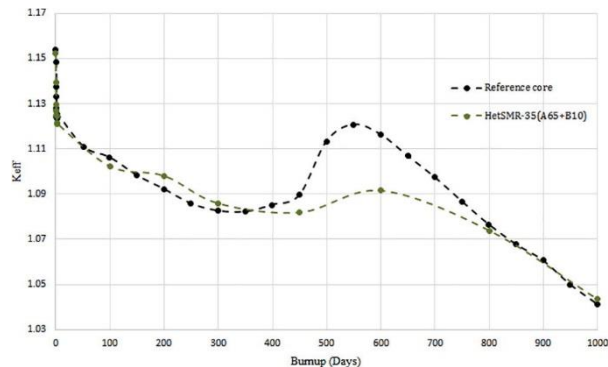


Prospective Reactors Using Thorium-based Fuels

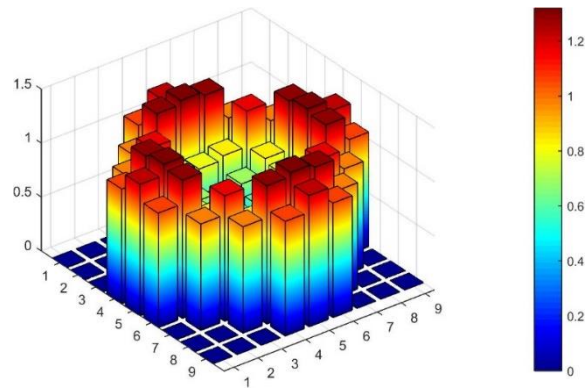
Small Modular Reactor (SMR)



Burnup Calculation (Th/U)O₂ vs Reference Core



Power Peaking Factor of (Th/U)O₂ at the Beginning of Cycle (BOC)



Future Perspectives

- ❑ Thorium as a complement to the uranium/plutonium cycle
- ❑ Thorium minerals exploration activities need to be increased worldwide
- ❑ Develop an industrial-scale reprocessing capability to recover ^{233}U from spent fuel and a fuel fabrication facility
- ❑ Increase the initiatives in research and development of thorium-based fuel and reactors
- ❑ Clear economic incentives for industries and operators of nuclear power plants using thorium-based fuel

THANK YOU