

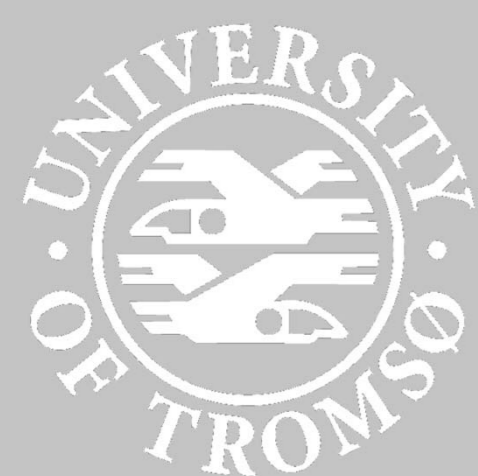
Is Thorium a Viable Nuclear Fuel?

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Abstract

Thorium was discovered in 1829 by the Norwegian mineralogist Morten Thrane Esmark and identified by the Swedish chemist Jöns Jacob Berzelius, who named it after Thor, the Norse god of thunder. Thorium is more abundant in nature than Uranium. It is fertile rather than fissile, and can only be used as a fuel in conjunction with a fissile material such as recycled plutonium. Thorium fuels can breed fissile Uranium-233 to be used in various kinds of nuclear reactors. Molten salt reactors such as liquid Fluoride reactors are well suited to Thorium fuel. The use of Thorium as a new primary energy source has been prospected for many years however extracting Thorium in cost-effective manner remains a challenge, and requires extensive R&D.

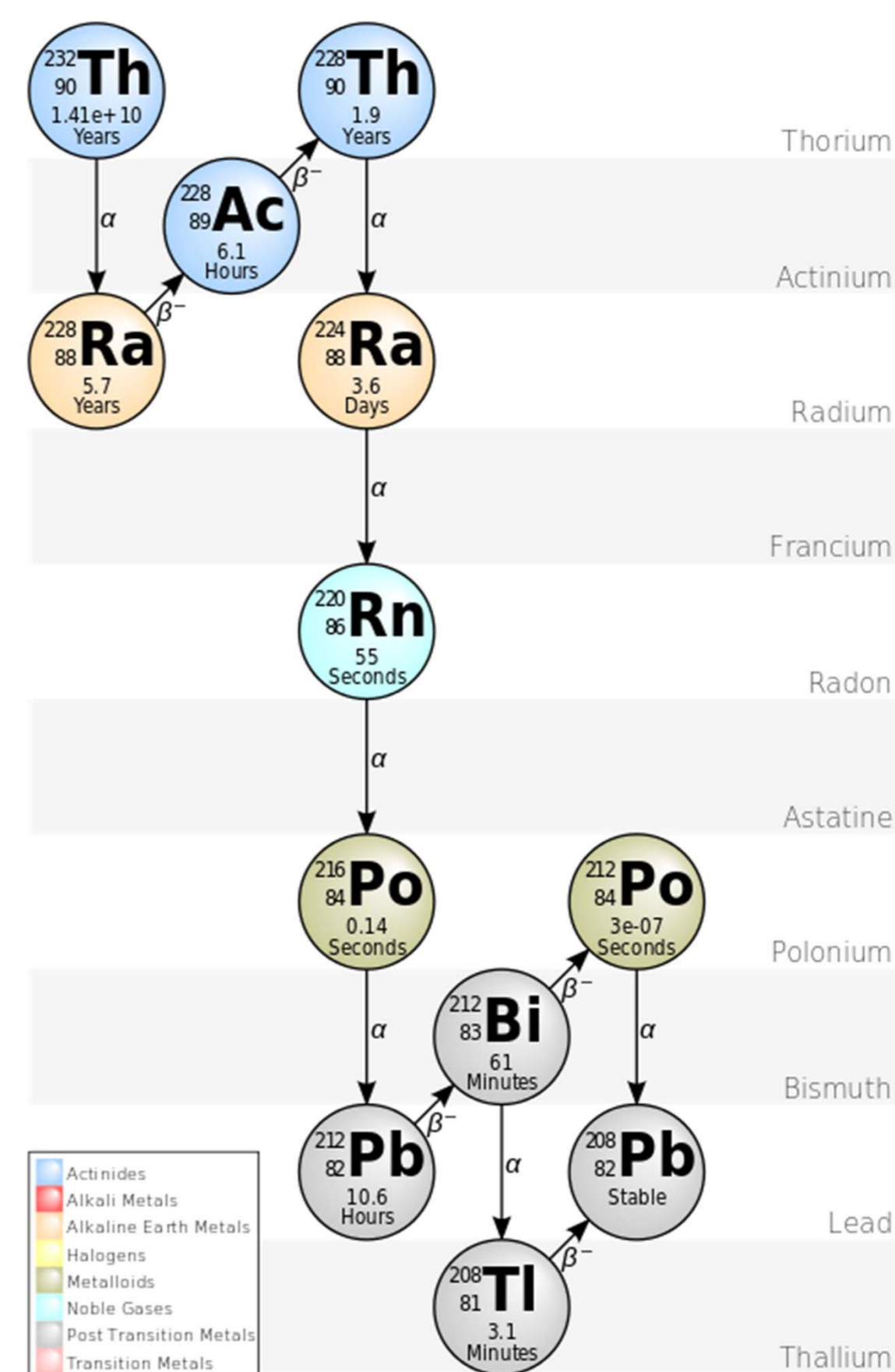
Attempts are being worldwide to also evaluate the feasibility of Thorium fuel. For example, Thor Energy, Norway in collaboration with University of Cambridge, UK is developing new generation of Thorium oxide fuel pellets that can be used in already existing nuclear reactors. They have undertaken a number of studies aiming to compare thorium-plutonium oxide fuel with other fuel types, uranium- and thorium-based. Thorium-MOX proved to be a viable and in many respects advantageous option. To further characterize these advantages, fuel design work is underway.

Worldwide Thorium Reserves*

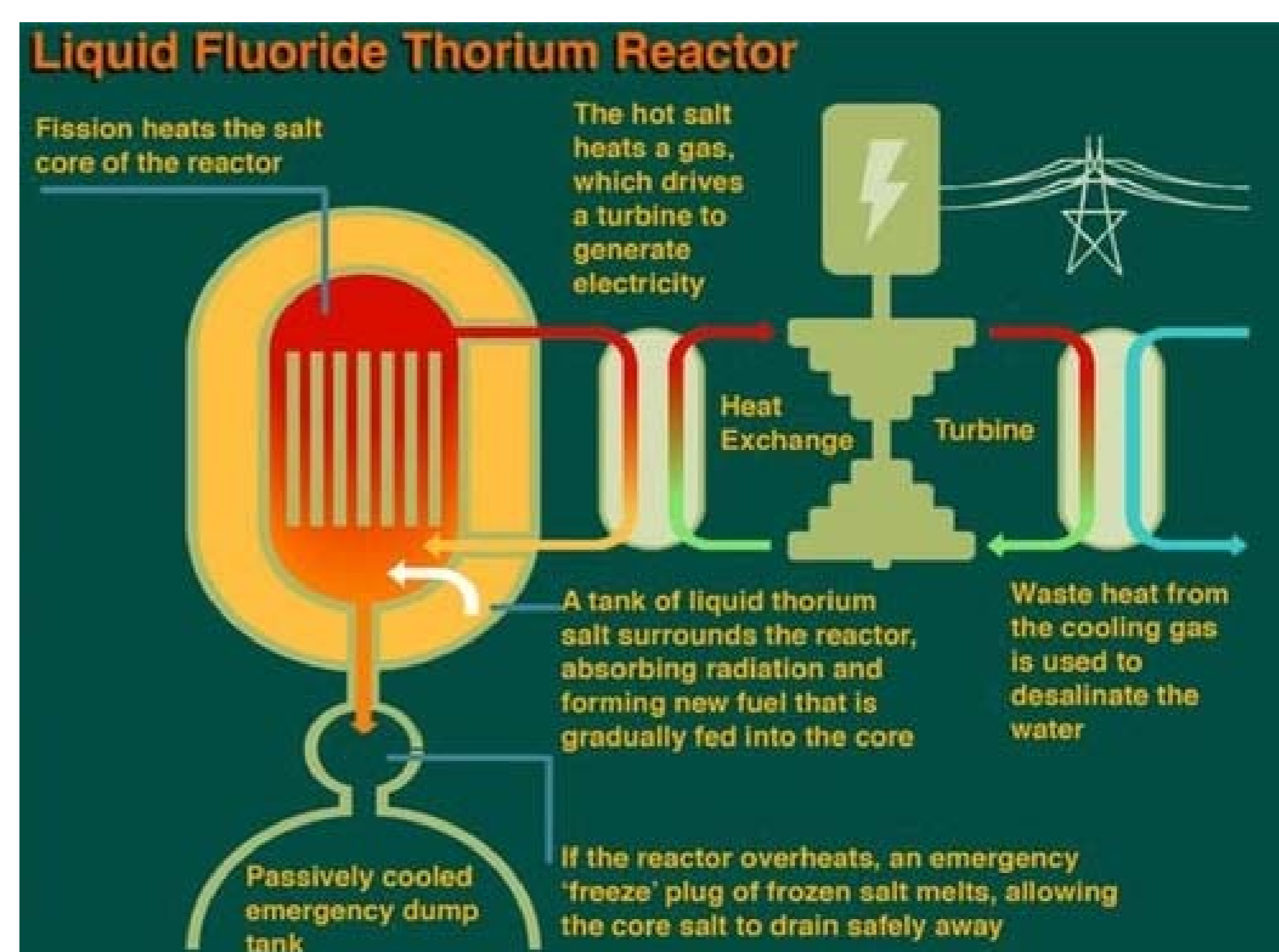
| Country | Mass in Tons |
|--------------------|------------------|
| India | 846,000 |
| Brazil | 632,000 |
| Australia | 595,000 |
| USA | 595,000 |
| Egypt | 380,000 |
| Turkey | 374,000 |
| Venezuela | 300,000 |
| Canada | 172,000 |
| Russia | 155,000 |
| South Africa | 148,000 |
| China | 100,000 |
| Norway | 87,000 |
| Greenland | 86,000 |
| Finland | 60,000 |
| Sweden | 50,000 |
| Kazakhstan | 50,000 |
| Other countries | 1,725,000 |
| World total | 6,355,000 |

*Uranium 2014: Resources, Production and Demand, OECD Nuclear Energy Agency and the International Atomic Energy Agency.

Decay Chain of Thorium



Liquid-Fluoride Thorium Reactor



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