Increasing mass of mother nuclide shifts mass of the lighter fission product (Why?)

Increasing the mass of the mother nuclide shifts the mass of the lighter fission product because it affects the energetics of the fission process. When the mother nuclide is heavier, the resulting fragments are lighter, and vice versa. This is due to the conservation of energy and momentum in the fission process. This can be found on page 33 of J. Wallenius & S. Bortot's Fast neutron Generation IV reactors document.

What are the major contributors to radio-toxic inventory and heat emission of spent fuel?

The major contributors to radio-toxic inventory and heat emission of spent fuel are transuranium elements such as plutonium isotopes and americium, as well as fission products like 137Cs and 90Sr. These elements produce alpha and beta particles during their decay, resulting in heat production. This information can be found on pages 3 and 4 of the document "Fast neutron Generation IV reactors" by J. Wallenius & S. Bortot.

What is the impact on safety when introducing minor actinides into the fuel of a fast reactor?

The introduction of minor actinides into the fuel of a fast reactor can impact safety due to the increase in radioactivity and decay heat emitted by the spent fuel. This can result in challenges for the management of the fuel and may require additional safety measures. This is discussed in chapter 4 of "Fast neutron Generation IV reactors" by J. Wallenius & S. Bortot, specifically in the section on Minor Actinide Burning. (Page 32)

What are the mechanism for noble gas and decay heat production and that are unique for minor actinide bearing fuels?

Minor actinide bearing fuels produce more decay heat due to the decay of isotopes with shorter half-lives, such as curium-242. Additionally, they produce higher amounts of noble gases, such as xenon and krypton, due to their higher neutron capture cross-sections. These gases can build up and lead to increased pressure in the fuel cladding, potentially compromising its integrity. (Page 277-278)

What are minor actinide burning blankets and how do they mitigate the adverse effects of americium?

Minor actinide burning blankets are a type of nuclear fuel blanket designed to mitigate the adverse effects of americium in fast reactors. They work by introducing small amounts of minor actinides into the fuel mix. This reduces the required fraction of power produced by the reactors and reduces the impact of americium on safety parameters. These are discussed in detail on pages 37-39 of the document.

How does americium affect the safety and performance of fast reactors?

The presence of americium in fast reactors leads to a reduced safety margin during transients due to adverse effects on the fuel Doppler feedback, coolant temperature coefficient, and effective delayed neutron fraction. Increasing the ratio of americium to plutonium in the fuel can improve specific minor actinide burning, but complications such as helium gas production, alpha decay heating, and deterioration of safety parameters arise when america inventory is increased (page 10-11).

What are the challenges of managing americium in nuclear waste repositories?

The challenges of managing americium in nuclear waste repositories include its high-level of radioactivity, heat load, and its ability to deteriorate important neutronic safety parameters. These are explained on pages 37-38 of the document "Fast neutron Generation IV reactors" by J. Wallenius & S. Bortot.