FACTS CONCERNING USED FUEL HAZARDS

(Notes prepared following round table discussion on February 10, 2005

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This note addresses ONLY the radiological hazards of used nuclear fuel. Chemical and security hazards are not addressed here.

FACT 1: The total ionizing radiation emitted from used fuel decreases rapidly with time after fuel is discharged from the reactor.

FACT 2: Most of the fission products decay to stable elements within 1000 years following discharge. The main exceptions are 129I, 93Zr, and 99Tc as shown in this figure (from Benedict, Pigford, Levy, 2nd Edition, 1981. "Toxicity" as plotted in these figures is defined by the amount of air or water needed to dilute an isotope to meet health standards established by the ICRP). Since these remaining radioactive isotopes have very long half-lives, their inhalation and ingestion toxicity levels are low.

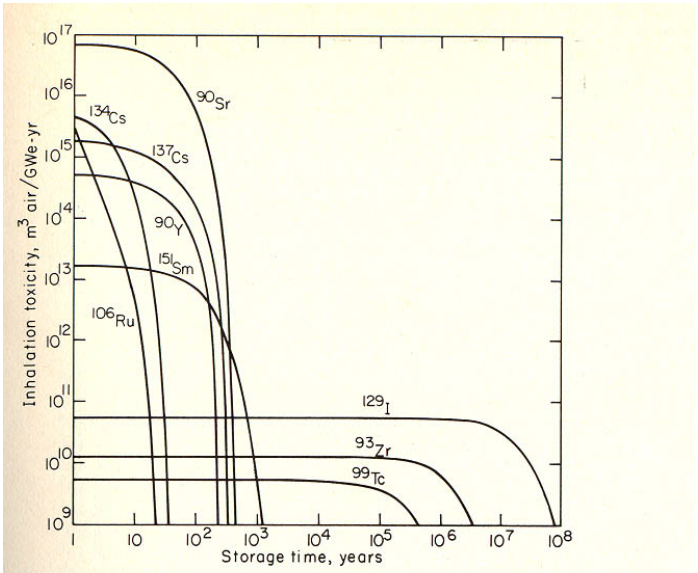


Figure 8.3 Inhalation toxicity of the fission products from a uranium-fueled LWR.

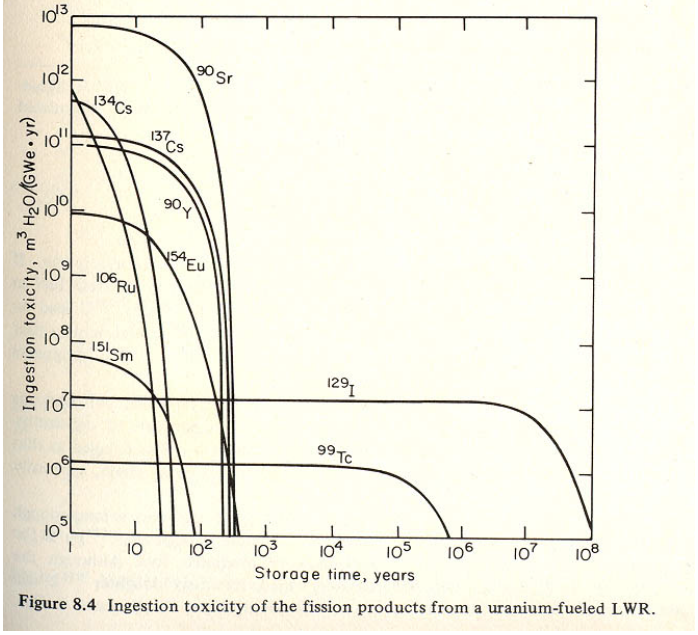


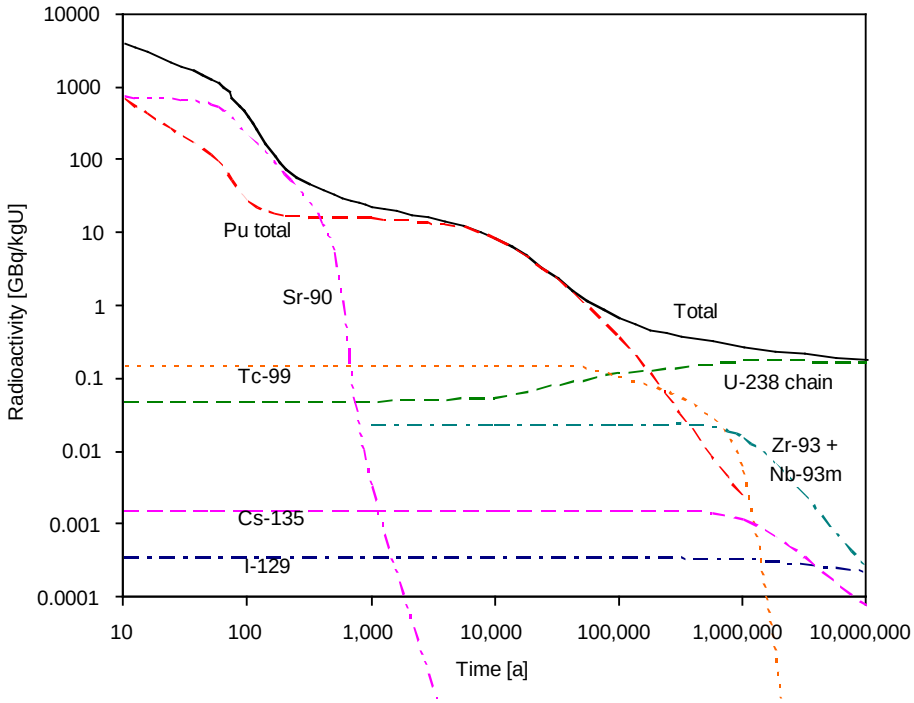
Figure 8.4 Ingestion toxicity of the fission products from a uranium-fueled LWR.

FACT 3: After about 1000 years following discharge from the reactor, only low activity, long half-life fission products remain in the fuel. Nuclides Americium 241 and Americium 243, Neptunium 239, Plutonium 239 and Plutonium 240 now are the dominant radio-nuclides. Other actinides have rather short half-lives and have already decayed to their stable state.

FACT 4: Plutonium, Neptunium and Americium are bound tightly in a ceramic matrix (similar to the material in a coffee cup) consisting mainly of uranium dioxide. They are dangerous if ingested, but possible pathways to humans are very limited.

FACT 5: After about 100,000 years, plutonium, neptunium and americium become unimportant contributors to toxicity. (Note that this contribution could be reduced to nearly zero by reprocessing of used fuel and recycle of plutonium into power reactors.)

from P. Gierszewski et al. 2004. Third Case Study - Postclosure safety assessment, OPG Report 06819-REP-01200-10109-R00.



FACT 6: Radioactive emissions from the U238 decay chain build up slowly, and reach their natural equilibrium level after ~1 million years. (During the same period, radioactive emissions from the tailings left behind when this uranium was first mined decay to insignificant levels.)

FACT 7: The important reality is that used fuel can be safely isolated from humans and environment for the indefinite future. Provided only conventional and achievable protection measures, radiation dose from this source to present and future biota on this earth will be trivial.

FACT 8: Present-day empirical evidence suggests strongly that trivial radiation dose rates such as those discussed in the previous paragraph actually can be tolerated by living cells, and cause little or no harm to people or the environment.

FACT 9: Radiation dose from various sources ranging from cosmic rays to gamma, beta, and alpha radiation from within our own bodies is a fact of everyday life. These radiation doses will always persist. They will remain by far the most important radiation doses to humans, forever.

CONCLUSION: Worrying about trivial radiation doses that may or may not be received in the far-distant future by life that may or may not exist at that time and, if it does, and to which low levels of ionizing radiation may well cause no harm, is at best an unrewarding exercise.