How radioactive is uranium dioxide used for fuel production?

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Pierre and Marie Curie were the first to discover that the relative activity of uranium ore (calculated per rata uranium content in the ore) significantly exceeds the activity of chemically extracted pure uranium. The reason for this is that apart from uranium the ore contains less long-lived products of uranium decay. They form the so-called radioactive chains or rows, and remain in the state of radiative equilibrium (when the identical number of nuclei is formed and decays in the chain at any period of time). At that stage the activity of any member in the chain is equal to the activity of the source material (uranium) and the number of nuclei is inversely proportional to half-life period. That’s why relative activity of uranium ore is increasing in comparison with pure uranium to the extent equal to the number of radioactive nuclei in the chain: uranium-238 has 14 and uranium-235

– 11. Among these – polonium and radium, discovered by Pierre and Marie Curie, and the heaviest inert gas – radon. Stable lead isotopes conclude both chains. The time required to reach equilibrium is several times longer than the half-life of the longest-lived element of the chain. In nature this time for uranium isotopes was sufficient due to the fact that the Earth's age is believed to be more than ten billion years. However, if you refine uranium chemically from its daughter radionuclides (which is exactly what happens at an initial stage of nuclear fuel production), within a relatively short period of storage time uranium accumulates only short-lived elements of the chain immediately following uranium nucleus. The chain of uranium-238 has two isotopes (thorium-234 and protactinium-234), U-235 chain has one (thorium-231).

The intensity of uranium fuel radiation measured by external detectors is significantly less than for uranium ore radiation, mostly due to gamma radiation. Daughter products of the pure fuel uranium decay emitting this radiation (in particular radium) are able to reach equilibrium in fuel material only in a few million years. Uranium itself hardly emits any gamma radiation and its alpha radiation gets entirely retained by the material itself.