# Reducing Actinide Production Using Inert Matrix Fuels

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**ABSTRACT**

The environmental and geopolitical problems that surround nuclear power stem largely from the longlived transuranic isotopes of Am, Cm, Np and Pu that are contained in spent nuclear fuel. New methods for transmuting these elements into more benign forms are needed. Current research efforts focus largely on the development of fast burner reactors, because it has been shown that they could dramatically reduce the accumulation of transuranics. However, despite five decades of effort, fast reactors have yet to achieve industrial viability. A critical limitation to this, and other such strategies, is that they require a type of spent fuel reprocessing that can efficiently separate all of the transuranics from the fission products with which they are mixed. Unfortunately, the technology for doing this on an industrial scale is still in development.

In this proposed research, we explore a strategy for transmutation that can be deployed using existing, current generation reactors and reprocessing systems. We show that use of an inert matrix fuel to recycle transuranics in a conventional pressurized water reactor could reduce overall production of these materials by an amount that is similar to what is achievable using proposed fast reactor cycles. Furthermore, we show that these transuranic reductions can be achieved even if the fission products are carried into the inert matrix fuel along with the transuranics, bypassing the critical separations hurdle described above. The implications of these findings are significant, because they imply that inert matrix fuel could be made directly from the material streams produced by the commercially available PUREX process. Zirconium dioxide would be an ideal choice of inert matrix in this context because it is known to form a stable solid solution with both fission products and transuranics.

The proposed work is significant because it opens the door to a transmutation strategy that *uses currently available reactors and reprocessing systems.* The goal of the proposed work is to demonstrate that a reactor running this type of recycle strategy could be licensed for commercial operation.