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ABSTRACT

Development of Inert Matrix Fuels for Plutonium and Minor Actinide Management in LWRs

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Commercial power reactors are the only viable option for active management of plutonium and minor actinides in the short to mid-term (10-20 years). There is thus interest world-wide in the use of the existing commercial reactor fleet for fuel cycle scenarios involving burn down of plutonium and stabilization of minor actinide inventories. This proposal seeks to develop feasibility data related to the use of Inert Matrix Fuel (IMF) as fuels and minor actinide targets in the existing fleet of LWRs.

IMF offers potential advantages when compared to conventional uranium matrix mixed oxide fuel (MOX) for plutonium management, allowing for more efficient destruction of plutonium relative to MOX, since the exclusion (or significant reduction) of ^{238}U from the fuel precludes the breeding of additional plutonium. Greater efficiency in plutonium reduction results in greater flexibility in managing plutonium inventories. The potential for fuel cycle cost savings also exists due to the reduced number of rods required to effect a given plutonium burn rate. In addition, IMF can be used in strategies for disposition of minor actinides (MA), particularly americium and neptunium. The choice of matrix material may be manipulated either to facilitate fuel recycling or direct disposal; plutonium recovery can be made relatively straightforward or extremely difficult. Inert matrix fuels having high thermal conductivity may also have operational and safety benefits. Cermet fuel, for example, operates at very low fuel temperatures; this fact can be used to increase operating and safety margins or uprate reactor power. Minor actinide targets contain high MA contents and are designed for heterogeneous MA burning schemes.

As a consequence of the desire to use existing water-cooled reactors, all research and development concepts considered in this proposal will be suitable for loading into present-day (Generation II and III) power reactor designs. Completion of this program will result in generation of comparative data on the fabrication, properties, and irradiation behaviour of several IMF fuel candidates. This data will provide valuable information on the feasibility of IMF for plutonium and minor actinide management in LWRs.