A view of strategies for transmutation of actinides

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Abstract

Developments in the field of recycling and transmutation of actinides are discussed. Three general strategies are discriminated: (i) an evolutionary strategy based on gradual implementation of partitioning and transmutation techniques in the fuel cycle; (ii) a radical strategy based on implementation of partitioning and transmutation in the fuel cycle, once all steps of this technology are proven; (iii) plutonium incineration, based on the conversion, with existing reactor types, of separated plutonium into a spent fuel form that is suited for direct storage. © 2001 Elsevier Science Ltd. All rights reserved.

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1. Introduction

Storage of spent fuel or high-level waste (HLW) in a geological repository is currently considered the most likely strategy for the management of nuclear waste from power generation. However, the radioactive inventory of spent fuel and HLW remains significant for more than 10^6 years so that man-made and natural barriers of the repository must ensure its isolation during this period to prevent exposure of mankind or nature to anthropogenic radiation. Reduction of this period to 10^4 years or less would be a major advancement in nuclear waste management. To achieve this, it is necessary to partition (separate) the most hazardous long-lived radionuclides from the spent fuel and to transmute (convert) them to less harmful products by neutron-capture or fission processes. The nuclides of principal interest in partitioning and transmutation (P&T) are the transuranium elements (TRU). They dominate the radiotoxic inventory of the cycle waste in the long term, as the contribution of the fission products is negligible after the first three hundred years of storage. An effective recycling of plutonium and the minor actinides (americium, curium, neptunium) is thus the main P&T goal. This encompasses the endeavour to reduce of plutonium masses, which is a relatively short-term goal, originating from concerns about the proliferation risks of accumulating plutonium stocks.

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* This paper is dedicated to the memory Dr. Harm Gruppelaar
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