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Complete Co-processing of Spent Fuel as a Back-End Nuclear Fuel Cycle Strategy

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U and Pu in spent nuclear fuel are obtained as separate and pure streams by the standard reprocessing method, Purex solvent extraction. Economical and technological conditions and safeguard concerns have not allowed the standard Purex (and recycling) to be an integral part of the nuclear fuel cycle. Easier and cheaper methods to recover U and Pu in spent fuel are worth taking into account. Complete co-processing, based on a Purex scheme, is probably the easiest way of separating U and Pu from spent fuel; in addition, it is advantageous with regard to safeguards because it does not yield pure Pu. Products of complete co-processing are two separate mixtures: (1) U+Pu and (2) FPs+MAs (Fission Products and Minor Actinides). Because U+Pu mixture obtained from spent LWR fuels has a total fissile content of roughly 1.5 weight percent, which is not suitable for LWRs, special approaches are required for recycling in case of complete co-processing. The other product is High Level Waste by definition, which does not contain any isotope usable for energy generation.

This study focuses on a scenario in which, after a proper precooling period, the complete co-processing is applied, and U+Pu and FPs+MAs are obtained. Then, these mixtures are stored: U+Pu as a potential reserve to be utilized in energy production and FPs+MAs as waste to be permanently disposed of in the middle and/or long run. The purpose is to investigate effects of such a scenario on the back-end of the nuclear fuel cycle. Radiotoxicity levels and compositions of U+Pu and FPs+MAs products of the complete co-processing are determined as a function of length of the storage period, and several options regarding what to do with them in the long term is discussed and compared.

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