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Fast reactor systems in the German P&T and related studies

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A study on partitioning and transmutation (P&T) for nuclear waste management was done in Germany in 2012-2014 [1]. In particular, possible fuel cycle options and systems for burning/utilization of transuranic elements in the German and European frameworks were proposed and analyzed at Karlsruhe Institute of Technology (KIT), while exploring results of earlier projects, to which KIT contributed together with its partners. In one type of scenarios, oriented to the German framework, the objective is to burn almost all transuranic elements accumulated due to operation of German nuclear power plants which are scheduled to be shut-down by 2022. In alternative European scenarios the main attention in the short term is on burning of minor actinide (MA) inventories accumulated in Germany and other countries, which are phasing out of nuclear soon; while in the long term it is on management of MA inventories produced in countries relying on nuclear energy also in the future.

These analyses have been extended by studies performed at KIT more recently. In particular new ASTRID-like and ESFR-like sodium fast reactor models have been established and analyzed in addition to those studied earlier [2,3]. These models are based on proposed in European projects designs, which are modified to allow a higher transuranic content, while avoiding deterioration of safety-related features. Their transmutation potential and safety performance are under investigation. In the paper these models are described and results of the investigations are reported. The preliminary conclusion is that the considered systems are suitable for all scenarios options considered in the German P&T study.

[1] O. Renn, (Hrsg.), „Partitionierung und Transmutation. Forschung –Entwicklung –Gesellschaftliche Implikationen (acatech STUDIE)“, München, Herbert Utz Verlag, 2014.
[2] F. Gabrielli, et al. „ASTRID-like Fast Reactor Cores for Burning Plutonium and Minor Actinides“, Energy Procedia 71 (2015) 130 –139.
[3] B. Vezzoni, et al. “Plutonium and Minor Actinides Incineration Options using Innovative Na-Cooled Fast reactors: Impacting on Phasing-Out and On-Going Fuel Cycles”, Progress In Nuclear Energy, 82 (2015), 58 –63.

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