

AGA 2: Nuclear Fuel Cycle

Time: Wednesday 17:00–18:30

Location: KH 00.016

AGA 2.1 Wed 17:00 KH 00.016

Nuclear archaeology with reprocessing waste: a Bayesian framework for reconstructing reactor operating parameters — •BENJAMIN JUNG — Peace Research Institute Frankfurt (PRIF), Frankfurt, Germany — Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Aachen, Germany

In order to verify declarations of fissile material for nuclear disarmament and non-proliferation regimes, nuclear archaeology seeks to reconstruct a state's history of fissile material production by analysing the isotopic composition of samples of material collected at its nuclear facilities. The novel Bayesian Reprocessing Waste Analysis Method (BRAM) aims to use waste from nuclear reprocessing activities as evidence for nuclear archaeology. Through simulation-based case studies, I demonstrate that this Bayesian framework can identify the type of source reactor and reconstruct important parameters such as burnup, cooling time, initial enrichment and power density. Using experimental data from the SFCOMPO database, I have successfully taken the first steps towards validating the framework by correctly reconstructing the operating parameters of a Magnox-type reactor and a pressurised water reactor (PWR). These results demonstrate the framework's potential and encourage further research and development in preparation for real-world applications.

AGA 2.2 Wed 17:30 KH 00.016

China's growing plutonium stockpile: Modelling the new CFR-600 reactors — •LAURA MERTES¹, JULIEN DE TROULLIQUOD DE LANVERSIN², MATTHIAS ENGLERT³, FRIEDERIKE FRIESS⁴, and MALTE GÖTTSCHE¹ — ¹TU Darmstadt, PRIF — ²The Hong Kong University of Science and Technology — ³Öko-Institut — ⁴BOKU University

China vastly expands the construction of new reactors to reach less dependence on coal. Two of more than 30 reactors under construction are sodium-cooled fast breeder reactors of type CFR-600, that are declared for civilian purposes, and their start of operation seems imminent according to satellite imagery. Fast reactors can be operated to produce more fissile material than they consume and the bred plutonium can be weapons-grade. This leads to proliferation risks typically

associated with fast reactors.

Despite the reactors' importance, there are no publicly available studies on the CFR-600's possible plutonium production rates which are necessary for the assessment of the Chinese nuclear modernization campaign.

We present burnup simulation results on the CFR-600 plutonium production using OpenMC and publicly accessible input data. Due to a lack of available data, that are required for the simulation, we resort to an alternative ansatz and include information of similar reactor types which may share significant similarities to the CFR-600. This procedure as well as the adaption to the Chinese fast breeder reactor involves a broad discussion of the role of uncertainties and not-knowing and the impact on the estimation of the plutonium production.

AGA 2.3 Wed 18:00 KH 00.016

Safeguards Monitoring in Geological Repositories - Physics, Systematics, Interfaces, and Constraints — •MATTHIAS ENGLERT — Öko-Institut, Rheinstraße, 95 Darmstadt

We outline a technical framework to integrate safeguards-relevant monitoring into the context of long-term safety for deep geological repositories. The approach maps monitoring measures (e.g., passive seismics, borehole radar, antineutrino detection, myon tomography) to Features-Events-Processes (FEP) catalogues and to safety functions (containment, isolation, retardation) across salt, clay, and crystalline host rocks. Using THMC classification and life-cycle phases (operation, closure, post-closure), we identify influence pathways such as direct paths via installation, heat, or mechanical perturbations, and indirect paths such as signal interpretation and scenario screening. The framework supports completeness and consistency checks by grouping by physics principle, intrusiveness, range, or system coupling and describes trade-offs between verification demands and barrier integrity. Preliminary results emphasize standardised tabulation for comparability, explicit treatment of uncertainties, and criteria for selecting complementary techniques. The aim is a transparent, auditable coupling of safeguards information with safety assessment reasoning rather than a new safety methodology.