

Research topic proposal for an MSCA Postdoctoral Fellowship 2025

Topic title:	Decay heat calculations applied to nuclear waste long-term storage
Topic description (0.5 page max.):	<p>The ability to reliably predict spent nuclear fuel composition in terms of radionuclide inventory, decay heat and radiation source term is relevant for both operational and long-term safety assessment in geological disposal. It also has an important influence on the cost of disposal. Questions are regularly raised about their safe storage (intermediate and long-term disposal), handling, transport, or reprocessing. Countries having selected long-term solutions such as deep geological repositories need to optimize the cost of such facilities with their safety aspect. In a recent Nuclear Energy Agency Joint Workshop, it was recognized that decay heat suffers from a lack of realistic uncertainties and open questions related to conservatism, biases and required margins remain [1]. One of challenges is to then better estimate the decay heat produced in spent fuel but also to calculate the associated uncertainties for storage facilities.</p> <p>The Subatech Laboratory developed over the past ten years some expertise in the simulation of nuclear reactor cores using Monte-Carlo approaches with a special interest in decay heat calculations. The Cocodrilo code coupled to the fuel depletion code SERPENT2 is also developed at Subatech to propagate the uncertainties associated with nuclear data in depletion calculations and estimate the impact on decay heat calculations.</p> <p>The main objective of this research project is to characterize the decay heat and associated uncertainties of spent fuel at high burnup of a long-term storage. The first step of this project will be to validate the use of the SERPENT2 and COCODRILLO codes to estimate the decay heat production and associated uncertainties in PWR Spent Fuel. Some comparisons will also be performed using the OpenMC depletion code, an open-source code recently developed at the Massachusetts Institute of Technology. The developed tools will be then applied to the decay heat characterization of spent fuel at high burnup of a long-term storage.</p> <p>[1] Brandauer M, Smadja L, Blommaert W, et al. Multifactor Optimization of Predisposal Management of Radioactive Waste. Proceedings of the NEA Joint Workshop, 10-14 February 2020, OECD Conference Centre, Paris.</p>
Keywords:	nuclear waste, reactor physics, decay heat, Pressurized water reactors, nuclear safety, Monte Carlo methods, nuclear data, uncertainty propagation

Background/ competencies/ skills needed from the candidate:	Skills: <ul style="list-style-type: none">- Modeling- Reactor physics and nuclear physics- Coding in PYTHON- Use of depletion codes such as Serpent, OpenMC or similar ones Profile: <ul style="list-style-type: none">- Fluent English- Team work- Good writing and oral skills
Supervisor(s):	Prof. Lydie Giot https://www.imt-atlantique.fr/fr/personne/lydie-giot