Internship Proposal – 2020-2021

Title : Neutronic benchmark of MSFR concept in the frame of the SAMOSAFER european project

Location: SUBATECH Laboratory– Institut Mines Telecom Atlantique,
Group : Nuclear structure and Energy

http://www-subatech.in2p3.fr/fr/component/content/article?id=193

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Tutor:

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Context and Objectives:

The Molten Salt Fast Reactor (MSFR) was chosen by the Generation IV International Forum (GIF) as a representative molten salt reactor fitting the Gen IV criteria in 2008. The reference MSFR, used for interdisciplinary studies, is a 3 GW_{th} with a fast neutron spectrum based on a thorium fuel cycle. The particular feature of such liquid fuel concept is to have half of the fluoride salt in the core and half circulating in external circuits, also associated to fuel salt cleaning and reprocessing. The fuel salt management combines physical and chemical processes. management combines an online gaseous extraction system and an offline lanthanide extraction component by pyrochemistry. The online gaseous extraction system, where helium bubbles are injected into the core, removes all nonsoluble fission products. In the Fuel Treatment Unit (FTU), the off-line reprocessing consists in removing the fission products (especially the lanthanides) and adjusting the fuel content in fissile/fertile isotopes for criticality control.

The SAMOSAFER european project launched in 2019 aims to develop and demonstrate new safety barriers for more controlled behaviour of Molten Salt Reactors in severe accidents, based on new simulation models and tools validated with experiments. Within the Work Package 3 Source term distribution and mobility, Subatech has the task to quantify the nuclide inventory through the whole reactor including the Fuel Treatment Unit (FTU) in collaboration with the Molten Salt team of LPSC-Grenoble, POLIMI-Milano and PSI-Switzerland.

Work:

A neutronic benchmark is currently done between the different partners of the task to assess the quality of the codes currently avalaible to determine the fuel inventory of the MSFR concept taking into account the material exchanges between the primary circuit, the off-gaz system and the fuel treatment unit for a fluoride salt case (Th/U cycle). Using the SERPENT2 code, the intern will contribute to this benchmark by working on the fluoride (Th/U) and chloride salt cases (U/Pu cycle). Depending on the status of the benchmark when the internship starts, it also foreseen to perform with SERPENT2 coupled to the JEFF3.1.1 and JEFF3.3 libraries part of the neutronic studies proposed in the EVOL benchmark by the LPSC team and comparison with their results obtained with the REM code.

This internship is linked to a PhD offer in the team on « **Decay heat uncertainty calculations with associated sensitivity studies. Impact of nuclear data »,** starting from September/October 2021.

Developed skills:

- Reactor Physics, Modeling, Monte Carlo Methods
- Computing in C++, PYTHON3.
- Code : SERPENT

Competency profile :

- Student in Master 2 or last year of engineering school with some knowledge in reactor physics, reactor modeling, reactor codes, numerical methods and/or Monte Carlo methods.

- Good proficiency in the use of computer tools (Linux, computer clusters…), and/or languages such as Python, C or C++ will be an asset.