Task for student research project or diploma thesis

Modelling of a Heat-Pipe Nuclear Microreactor (HPMR) using the Serpent/OpenMC Monte Carlo neutronics code

The Nuclear Energy Agency (NEA) aims to collect simulation results from international efforts that capture complex neutronic and thermal-hydraulic phenomena for a realistic small-geometry, flexible-operational microreactor. This 2 MW thermal heat-pipe microreactor was developed at the ANL and uses TRISO fuel material, metal hydride moderator pins, a graphite matrix and sodium heat pipes. This will support the design and licensing of this type of reactor.

TUD is participating in this benchmark exercise and will provide results focusing on phase one of the benchmark: the neutronics-only analysis (k-eff, power distribution, etc.). Exchanging results from the benchmark with international participants from other institutions will help us identify gaps and weaknesses in the modelling capabilities of the code used for reactor simulation. This work will help to identify the best modelling practices and provide reference solutions for code-to-code comparisons for reactor licensing. The results obtained during this work will be provided to the NEA and used to publish the code-to-code comparison results in a conference or journal paper by the international organizations participating in the benchmark. To this end, the following points are to be addressed:

- Study of literature on Monte Carlo methods for neutron transport.
- Familiarization with the Monte Carlo neutron transport code OpenMC/Serpent.
- Understanding of the reactor design and relevant output quantities.
- Simulation of the HPMR using OpenMC/Serpent.
- Code-to-code comparison and exchange of results with the NEA.
- Documentation of the results of the research project in a thesis.

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Internet: https://serpent.vtt.fi/, https://docs.openmc.org/en/stable/,

https://www.oecd-nea.org/jcms/pl_115087/heat-pipe-microreactor-benchmark-for-code-to-code-multiphysics-comparison-hp-mr