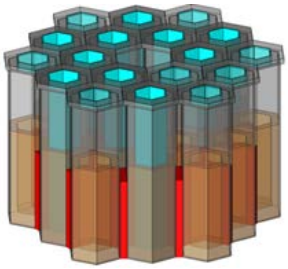
Modeling of the Molten Salt Fast Reactor emergency draining tank

M.Sc. thesis proposal

The Molten Salt Fast Reactor (MSFR) is a fast nuclear reactor design, included in the six innovative concepts chosen by the Generation IV Forum as the most promising GEN-IV designs. Its peculiarity is the nuclear fuel, which is a circulating liquid salt, acting as both heat source and coolant fluid. Its main advantages are the inherent safety, due to the negative temperature feedback coefficient, and the possibility of using a thorium fuel cycle rather than the uranium one.

A special emergency shutdown system is envisioned, based on the liquid state of the fuel: the core empties with a gravity-driven system into subcritical storage tanks, which ensure decay heat removal.

Thesis objective

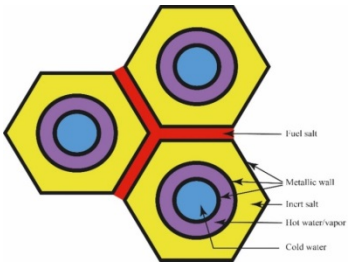


The thesis focuses on the design of the emergency draining tank (EDT), ensuring short- and long-term coolability of the discharged liquid fuel salt, which heats up due to decay heat.

Content

The student will model with a CFD code (e.g. ANSYS, OpenFOAM, …) a 3D unit cell of the EDT.

Different phenomena must be taken into account:



- Internal heat generation of the fuel salt;
- Heat transfer from the fuel salt to the inert salt to the heat sink;
- Natural convection within the salt due to internal heat production;
- Possible freezing of the fuel salt on the cooling rod wall;
- Melting of the inert salt for heat storage and thermal inertia.

The model will be used for steady state and transient analysis to understand if the chosen design is able to respect the constraints of the problem and as a support for the amelioration of the solution.

The work will be performed at KIT in the framework of the EU project SAMOFAR (HORIZON 2020).

The thesis will be written in English.

Optional activities

Additional optional activities might be proposed, based on student's interest and availability:

- SAMOFAR Summer School on Molten Salt Reactors (2 – 4 July 2017, Como Lake, Italy);
- Depending on the work results, collaboration in drafting of scientific publications.

Prerequisites

Thermodynamics, heat transfer and thermal fluid dynamics.

Knowledge of neutron physics or nuclear reactor technology is not required.

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