

Postdoctoral position in reactor design

Conceptual design of a Thermoelectric ElectroMagnetic (TEM) pump applied to the Residual Heat Removal system (RHR) of sodium-cooled small modular reactor

KEYWORDS: SMR, SFR, design, safety, reactor, TEM, MHD, thermoelectricity

In the framework of researches on generation IV nuclear reactors, CEA deeply study Sodium-cooled Fast Reactor (SFR). This post-doctoral position is available at the Technological Innovation Design Laboratory within the Nuclear Technology Department at CEA Cadarache. Simulation and design of critical components such as electromagnetic pump or heat exchangers are realized in this lab.

Small Modular Reactors (SMR) (100-500MWth) show promise for addressing the energy challenges in terms of flexibility, cost, safety, manufacturability, ease of operation, integration in electricity networks, and coexistence with renewable energies. Simplifying the boiler design and using thermoelectric electromagnetic pump to remove residual heat in accidental case allow reaching high safety level of these reactors. The low power to be extracted from the SMR allows simplifications resulting on a more safe design and a global cost reduction. In this framework, the use of TEM pump will upgrade the cooling system while keeping it fully passive.

The post-doctoral work will consist in dimensioning TEM. Different conceptual choices like hydraulic system geometry, type of fluid or type of thermo-elements have to be studied in the case of transient phenomena induced by the complete cold source loss of a sodium-cooled SMR of 400MWth. Objectives are to estimate benefits of TEM on RHR system and SMR itself in case of accident. Consideration of the use of TEM for special reactors or primary loop of SMR will be discussed based on the flow rate and power limits issued from dimensioning. The candidate will have to design a prototype of a reduced scale TEM in order to validate the performances of such component.

This work shows strong transversality based on the expertise of three different departments:

- SESI (DES/IRESNE/DER/SESI) to design and simulate innovative systems.
- STCP (DES/IRESNE/DTN/STCP) to design and simulate components such as electromagnetic pump.
- SCTR (DRT/LITEN/DTBH/SCTR) to develop and manufacture SiGe thermo-elements.

The candidate will have to rely on the expertise of these three units to carry out his reflections on the design of the TEM.

EMPLOYER: Commissariat à l'Energie Atomique et aux Energies Alternatives – CEA (Atomic Energy Commission)

LOCATION: Cadarache, France

DISCIPLINES: reactor physics, MHD, thermoelectricity, TEM design

DURATION: 12 month (renewable once)

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The position will remain open until a suitable candidate is identified; however, applications received in November will receive priority.