Today, nuclear energy represents around 26% (Eurostat 2016) of the electrical power produced in the European Union and 16% worldwide. With the growing energy demand and the decreasing of both fossil and nuclear fuel resources there is a severe need for efficient energy production technologies. Moreover, the environmental impact of the current energy production techniques remains a major concern.

The safety evaluation of new type nuclear reactors, such as the accelerator driven research reactor MYRRHA (SCK•CEN) is from the design phase on utmost important. Numerical simulations can provide insight to the thermal hydraulic behaviour of the reactor system. Moreover, Computational Fluid Dynamics is capable to perform simulations of both normal operation conditions and incident scenarios to verify and improve the safety of the design under all circumstances.

In the MYRRHA reactor, Lead-Bismuth Eutectic, LBE, was chosen as primary coolant mainly due to its low melting temperature, which results in lower corrosion rates and easier operation of the installation. Modelling liquid metal flows poses a great challenge to both researchers and engineers due to the unique physical properties of the substances despite its wide application in industrial processes. Though liquid metals obey the same laws than any other Newtonian fluids the bottleneck of predicting their behaviour lies in the fact that the numerical models of nowadays were developed mainly with more conventional fluids as water and air in mind.

The followed research path in the present case is the use of scaled experimental version of the reactor highly instrumented to gain detailed knowledge of the operating and transient scenarios. As support for the MYRRHA reactor two such prototypes have been constructed: MYRRHABelle (VKI) water pool facility, which is a 1/5th scale version of MYRRHA and E-SCAPE (SCK•CEN), which is the 1/6th scale of MYRRHA cooled by Lead-Bismuth Eutectic, LBE (Figure 1). The cores in both facilities are represented by electrical heating devices, which allow safe operation. The advantage of the MYRRHABelle facility is clearly that thanks to the transparency of water visual measurement techniques can be applied that can provide detailed velocity and temperature fields. While the E-SCAPE facility is capable to provide the correct heat transfer characteristics given that it is operated by the same liquid as the MYRRHA reactor is designed to.

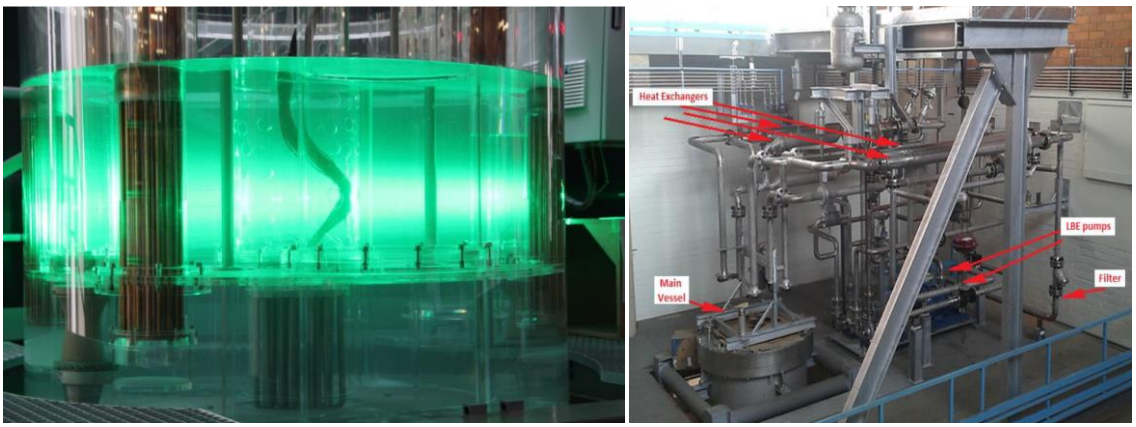

Figure 1: The MyrrhaBelle water facility at VKI and the E-SCAPE LBE facility at SCK•CEN

The current project aims to use the two facilities for an extended validation. Indeed, numerical simulations can provide as good results as the underlying modelling approaches allow. Simulating turbulent liquid metal flows in a pool-type reactor requires intense modelling as all the physical phenomena cannot be directly resolved with the current computational power. Using HPC system enables to reduce some of the modelling simplifications and in such way predict the flow and thermal fields with higher fidelity. Moreover, this is the only way a more systematic parametric study is viable to determine the applicability range of the different modelling approaches introduced in the simulations of the MYRRHA research reactor.