NRG is looking for an MSc. thesis student for:

DNS of stratified two-phase flow in the primary coolant of a nuclear reactor

Background

The Nuclear Research and Consultancy Group (NRG) is responsible for a continued nuclear research effort in the Netherlands. An important part of this research is dedicated towards improving Nuclear Reactor Safety (NRS) using Computational Fluid Dynamics (CFD) tools.

In many so-called postulated accident scenarios, such as a Loss Of Coolant Accident (LOCA), two-phase flow scenarios may occur. When large pipe ruptures occur, the cold leg of the reactor pressure vessel may contain both steam and water in a stratified flow configuration. Turbulent mass, momentum and heat transfer in such conditions is not yet fully understood and models which can accurately describe the problem are yet to be developed. In this graduation project, focus will be put on the development of a Direct Numerical Simulation (DNS) approach for stratified two-phase flow, using the RK-Basilisk code. RK-Basilisk is a numerical code developed by NRG and based on Basilisk. Basilisk, in turn, is specially designed to handle two-phase interfaces with very high resolution, and is therefore very suitable for simulation of stratified two-phase flow. The purpose of the DNS is to (1) support the development of more coarse turbulence models or (2) support validation of such models.

The project location will be at NRG's site in Petten. NRG offers a monthly allowance, as well as compensation for housing and transportation for the period of your stay.

Objectives

- Validation of RK-Basilisk for turbulent single phase channel flow and pipe flow using reference DNS datasets
- Development of a benchmark stratified turbulent two-phase flow configuration
- Development of DNS for this flow configuration, using RK-Basilisk
- Further code development on RK-Basilisk
- Analysis and post-processing of the DNS dataset

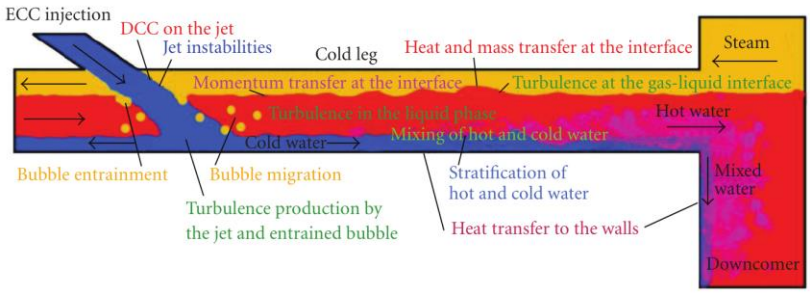

Fig. 1: schematic overview of ECC injection during a LOCA, and the relevant physical processes which take place (from [1]).

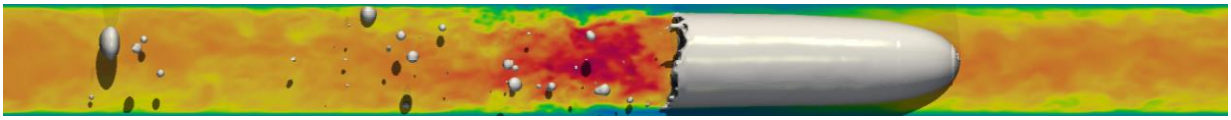

Fig. 2: cross section of a Taylor bubble in turbulent co-current flow, simulated with RK-Basilisk.

Your profile

- MSc. student in applied science, with specialization in CFD
- Good knowledge of turbulence, multiphase flows and numerical methods
- Required computer experience: Linux and Windows
- Recommended computer experience: C, C++ and Python
- Fluency in written and spoken English
- Good analytical and problem solving skills
- Dedicated, good communication and social skills, independent

Our offer

- A challenging thesis project with a scientific scope, to be executed within a successful team with an informal atmosphere and an excellent reputation in CFD
- Strong support from enthusiastic members of the CFD team
- Monthly allowance/stipend
- Housing and transportation compensation for the period of stay

Contact details

NRG
Dr.ir. Edo Frederix
frederix@nrg.eu

References

[1] Lucas et al., "An overview of the pressurized thermal shock issue in the context of the NURESIM project", *Science and Technology of Nuclear Installations*, (2009).