containment∇FOAM

JÜLICH Forschungszentrum

Modelling the passive cooling of small modular reactor containments submerged in a water pool using containmentFOAM

Currently, various reactor concepts are being developed in the category of small modular reactors. The reduced power and, consequently, size of these reactors opens the doors to safety concepts not feasible to traditional designs and of high interest from a modelling perspective. One of the most extended is the passive cooling of the reactor by totally of partially submerging the containment building in a water pool. In case of any mass and energy release from the reactor pressure vessel, the so-called water wall concept sketched in Fig.1 will cool down the containment atmosphere using the external pool as a heat sink. The heat transfer enhancement by changing the air environment by water combined with the pool's large heat capacity allows the long-term removal of the reactor's decay heat.

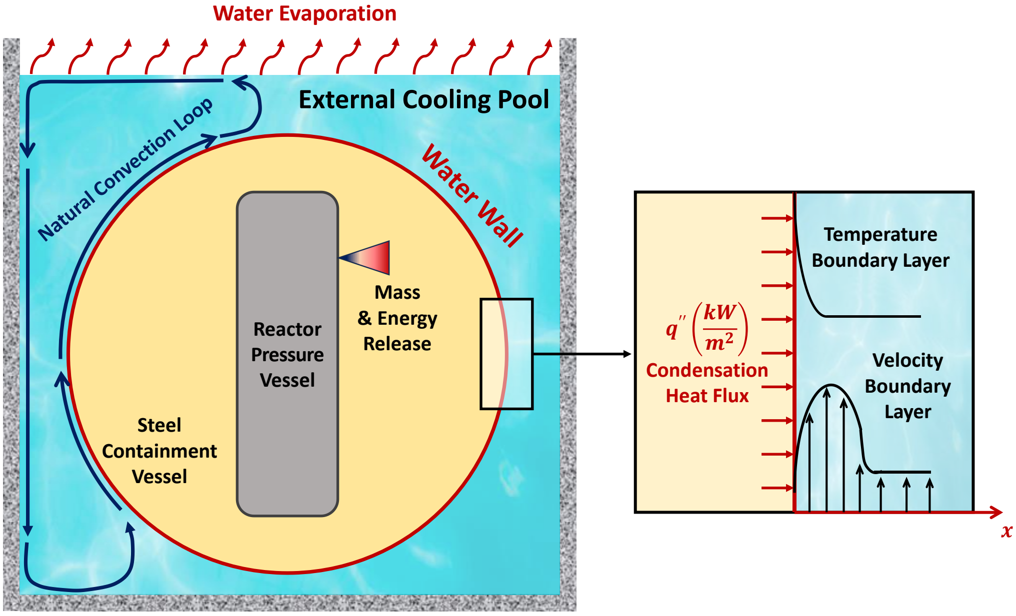

Figure 1. Submerged small modular reactor: main items for containment external cooling

The extensive interest in the water-wall heat transfer as the final heat sink of small modular reactors, and the unavailability of data at the expected Rayleigh numbers (above 10^{16}), encouraged the planning of several research activities in the recent and coming years. The relevance of the phenomenology combined with the growing availability of experimental results have motivated the definition of the external pool cooling as one of the prior developments for the containmentFOAM package. The proposed work will consist of testing the current modelling approaches with the available experiments. First, the heat source from the water wall will be defined as a boundary condition to explore later the coupled simulation of both physical domains (containment gas space and external pool). The geometry and mesh for the containmentFOAM models will be provided.

Schedule (6 months):

2 weeks: literature review on external cooling of submerged containments.
4 weeks: familiarization OpenFOAM / containmentFOAM
2 weeks: evaluation of optimal modeling approach to simulate the external cooling with containmentFOAM
6 weeks: development of model input and simulation of available experiments (boundary condition as a heat source for the external pool)
8 weeks: set-up coupled case with the current version of containmentFoam to represent the heat source to the external pool
4 weeks: Preparation of the final documentation

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