

Development of containmentFOAM towards LW-SMR analyses

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ABSTRACT

The Horizon Euratom SASPAM-SA Project aims to explore the transferability of knowledge from large LWRs to water-cooled SMRs. More specifically, the project investigates the ability of different codes to simulate the driving phenomena of potential Severe Accident sequences for two different “generic” SMRs. The “Design II” represents a dry containment with several passive safety features—a Pressure Suppression System, among others—based on information available in the open literature.

One of the codes being evaluated in the framework of SASPAM-SA is containmentFOAM, an open-source CFD package based on OpenFOAM developed by Forschungszentrum Jülich. Since containmentFOAM was initially conceived to simulate conventional PWRs, a number of upgrades have been implemented based on the assessment of the SA sequences simulated in SASPAM-SA to tailor the code to LW-SMRs' specific needs.

The simulations presented in this article are focused on the containment thermo-fluid dynamic processes resulting from the mass and energy releases from the reactor pressure vessel and on the interaction with passive safety features. A multi-fidelity approach is used by coupling containmentFOAM—to simulate the containment atmosphere mixing—with OpenModelica—to simulate the PSS at a system scale. The pressure coupling did not compromise the numerical stability of the simulation and was able to represent the containment pressurization induced by the non-condensable gas compression in the PSS.

KEYWORDS

SMR, CFD, containmentFOAM, Modelica, Coupling