6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

Validation of a multiscale coupling algorithm by experimental tests in TALL-3D facility

A. Cervone[1], A. Chierici[2]*, L. Chirco[2], R. Da Vià[2] and S. Manservisi[2]

[1] ENEA, Via Martiri di Monte Sole, 4, 40129 Bologna, Italy
[2] University of Bologna - DIN, Via dei Colli 16, 40136 Bologna (BO), Italy
*e-mail: andrea.chierici4@unibo.it

Keywords: *Multiscale Methods, Coupling Codes, Thermo-Hydraulics, Nuclear Systems*

A multiscale coupling algorithm has been developed and validated through the numerical simulation of the thermal hydraulic behavior of an unprotected loss of flow in the experimental TALL-3D facility. During the loss of flow the system goes from forced to natural circulation flow. TALL-3D is a liquid Lead Bismuth Eutectic (LBE) loop, with an oil-cooled secondary loop, developed according to the requirements for the experimental data for validation of coupled CFD and system codes. In this work we perform the coupling between the multigrid finite element code FEMuS and a system code, by using a defective coupling algorithm of a one-dimensional circuit and a three-dimensional test section with overlapping meshes. The multiscale and multiphysics open-source coupling platform has been developed with joint effort between ENEA and UNIBO, and is based on open-source SALOME platform. MED data structure has been used as the base structure where all the field operations are performed. The MEDmem libraries come with the Salome platform and include basic methods for handling meshes and fields. The coupled system is solved for different computational cases: laminar natural circulation, turbulent $k-\omega$ with SUPG regularization and with standard up-wind regularization for the advection term. Each case is also simulated through two different heat exchange models: with constant and non constant turbulent Prandtl number. These tests show the importance of the coupling approach for the analysis of transient simulations where the three-dimensional phenomena play an important role.

REFERENCES

[1] D. Grishchenko, M. Jeltsov, K. Kööp, A. Karbojian, W. Villanueva and P. Kudinov, *The TALL-3D facility design and commissioning tests for validation of coupled STH and CFD codes*, Nuclear Engineering and Design Volume 290, Pages 144-153, 2015.

[2] A. Chierici, L. Chirco, R. Da Vià, S. Manservisi, and R. Scardovelli *A multiscale numerical algorithm for heat transfer simulation between multidimensional CFD and monodimensional system codes*, Journal of Physics: Conference Series (Vol. 923, No. 1, p. 012025), 2017.