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Numerical activities in support of the development of GEN IV LMFRs at the University of Pisa: a review of recent works

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Liquid metal fast reactors represent one of the most promising proposals for the upcoming GEN IV of nuclear power plants. They indeed allow for both breeding processes and increased plant efficiencies: nevertheless, several challenges still need to be overcome. During the last years the European Union launched several projects in support of the development of such a technology: the University of Pisa joined the common effort providing numerical analyses addressing the thermal-hydraulics aspects of LFMBRs.
In particular, system thermal-hydraulics codes and CFD approaches were considered for the analysis of both normal operating conditions and accidental scenarios. Buoyancy-induced phenomena were particularly addressed aiming at understanding the capabilities of passive cooling systems. Both forced and natural circulation conditions were investigated: the results of the calculations were validated and compared against available experimental results showing in general good predicting capabilities.
The present paper reports the recent numerical activities performed at the University of Pisa in support of Gen IV LMFBRs. The addressed experimental facilities and experimental data are presented discussing the limits and capabilities of the adopted modelling techniques being STH, CFD and coupled STH/CFD applications. The obtained results are considered as a basis for the suggestion of best practice guidelines for the simulation of some of the NPP primary system components paying particular attention to the required computational resources and expected/required refinement of the adopted model. In addition, the capabilities of pre-test analyses in support of the final design of experimental facilities are highlighted. The future perspectives and foreseen developments are eventually resumed.

Speaker Bio

Primary authors: PUCCIARELLI, Andrea (University of Pisa); GALLENI, Francesco (University of Pisa); FORGIONE, Nicola (University of Pisa); STEFANINI, Pietro (University of Pisa)

Presenter: FORGIONE, Nicola (University of Pisa)

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