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ALFRED FLOW BOCKAGE ANALYSIS

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In the context of Lead-cooled Fast Reactor development and safety assessment, the flow blockage in a fuel sub-assembly is considered among the most relevant issues to be addressed. Hence, the event shall be postulated assessing its consequences, also considering that grid-spaced fuel assemblies could partially mitigate the occurrence of sudden blockages with respect to wire-spaced fuel assemblies.
The Advanced Lead-cooled Fast Reactor European Demonstrator (ALFRED) is a 300 MWth pool-type reactor aimed at demonstrating the safe and economic competitiveness of the Generation IV LFR technology. The ALFRED design, currently being developed by ANSALDO NUCLEARE and ENEA in the frame of the FALCON Consortium, is based on prototypical solutions intended to be used to boost the DEMO-LFR development.
Within the scope of FALCON consortium and in the frame of investigating the thermal-hydraulics of the average ALFRED FA, a CFD computational model is built looking for the assessment of its thermal field in nominal flow conditions and when affected by a blockage. Starting from the experience in this kind of simulations and in experimental work, the whole model of the ALFRED Fuel Assembly is first presented and calculation of flow and temperature field in nominal conditions is carried out. RANS simulations of idealized blockage scenarios adopting three different spacer grid locations (under the active length, at half active length, above the active length). Results showed that the most likely blockage in the lower grid positioned before the active region do not perturb the temperature distribution in the fuel assembly, while the ones at the central grid may have strong consequences and lead to a clad temperature peak behind the blockage with possible clad failure. In particular, the CFD analysis on the ALFRED FA suggested to install the spacer grids –or at least the first one –in the not-active region to avoid any clad failure due to an internal blockage.

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