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Recent thermal hydraulic studies of Gas Fast Reactor demonstrator ALLEGRO

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The helium cooled high-temperature fast-spectrum reactor (GFR) with closed fuel cycle is one of the six GEN IV reactors selected by the Generation IV International Forum (GIF) to be developed for the foreseeable future. The European reference concept of the GFR technology is a unit with an envisaged power of 2400 MWth, which is currently in the pre-conceptual design phase. Prior to the building of the full scope facility the viability of the GFR technology will be proven by means of the ALLEGRO demonstrator with an envisaged thermal power of 75 MWth. The ALLEGRO development is led by the V4G4 Centre of Excellence consortium associating research organizations, companies and laboratories from Czech Republic (UJV Rez), France (CEA) Hungary (MTA-EK), Poland (NCBJ) and Slovakia (VUJE). One of the key tasks of ALLEGRO is to test the new ceramic refractory fuel for the industrial version of GFR2400. In this paper the latest outcomes of thermal hydraulic calculations of ALLEGRO are summarized. First, the work that has been done under the EU VINCO project is reviewed. It was carried out by V4G4 consortium aiming to transfer the GFR technology know-how from the CEA to the V4G4 and to establish the platform for continuation of the ALLEGRO demonstrator development. It comprises the methods, specific calculations and outcomes of the ALLEGRO thermal hydraulic benchmark which were carried out by the V4G4 partners using the CATHARE, RELAP and MELCOR codes. Based on the benchmark future experimental program is proposed using helium-cooled experimental facilities the S-ALLEGRO build in Czech Republic and the STU helium loop operating in Slovakia. Subsequently, a short summary of a recent work is presented, in which the hot duct break scenario is studied for the two and the three-loop ALLEGRO versions. The preliminary results of this analysis showed that the three-loop ALLEGRO has better cooling performance in case of hot duct break. Finally, the gas mass flow distribution in two parallel geometrically identical pipes is investigated, when they are heated with different power and when they have the same pressure loss. The results show that the pipe (or a closed subassembly in the reactor core) heated with higher power usually has lower coolant mass flow rate, which deteriorates the cooling capabilities of the subassemblies in a real reactor.

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