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LFR Design and Technologies Development at ENEA: Status and Perspectives

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The next generation of nuclear energy systems, also known as Generation-IV reactors are being developed to meet the highest targets of safety and reliability, sustainability, economics, proliferation resistance and physical protection, with improved performances with respect to plants currently operating or presently being built. Among the proposed technologies, Lead-cooled Fast Reactors (LFRs) have been identified by nuclear industries and Member States among the optimal Generation IV candidates.
Since 2000, ENEA is supporting the core design, safety assessment and technological development of innovative nuclear systems cooled by heavy liquid metals (HLM), and most recently fully oriented on LFRs, developing world-recognized skills in the fast spectrum core design and one of the largest European fleets of experimental facilities aiming at investigating HLM thermal-hydraulics, coolant chemistry control, corrosion behavior for structural materials and material properties in HLM environment, as well as at developing corrosion-protective coatings, components, instrumentation and innovative systems, supported by experiments and numerical tools.
Efforts are also devoted in developing and validating numerical tools for the specific application to HLM systems, ranging from neutronics codes, system and core thermal-hydraulic codes, computational fluid dynamics (CFD) and fuel pin performance codes, including their coupling.
The present work aims at highlighting the capabilities and competencies developed by ENEA so far in the framework of liquid metal technologies for GEN-IV LFRs. In particular, an overview on the ongoing R&D experimental program will be depicted considering the actual fleet of facilities: CIRCE, NACIE-UP, LIFUS5, LECOR, BID-1, HELENA, RACHEL and Mechanical Labs. An overview on the numerical activities performed so far and presently ongoing is also reported.
Finally, an overview of the ENEA contribution to the ALFRED Project in the frame of the FALCON international consortium is reported, mainly addressing the activity ongoing in terms of core design, technology development and auxiliary systems design.

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