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3D SIMULATION IN THE PLEIADES SOFTWARE ENVIRONMENT FOR SODIUM FAST REACTOR FUEL PIN BEHAVIOR UNDER IRRADIATION

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In the framework of the basic design of ASTRID (Advanced Sodium Technological Reactor for Industrial Demonstration) the GERMINAL fuel performance code is developed in the PLEIADES software environment. In order to improve one dimensional modelling of GERMINAL, a 3D simulation for the SFR fuel pin behavior under irradiation has been proposed.
The 3D model represents a single pellet fragment and its associated piece of cladding. The scale transfer between this single fragment model and the fuel pin scale is achieved through appropriate boundary conditions given by GERMINAL results. The 3D thermo-mechanical computation scheme is implemented in the LICOS code of the PLEIADES platform. In this approach, chemo-physical aspects are still computed by the GERMINAL code and are introduced in the 3D computation scheme as some input data in a two-step procedure. First studies have been achieved in order to analyze pellet-to-cladding gap closure mechanisms at the beginning of irradiation. Two mechanisms of fuel relocation are simulated through the 3D simulation. The first one is linked to the hourglass shape of the fragmented fuel pellet under thermal gradient, and the second one is induced by the mass transfer due the central hole formation and fuel restructuration. According our results, the gap closure rate given by the GERMINAL empirical model can be understood. The 3D coupling formulation has now to be extended to the mass transfer equations in order to improve the results.

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