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Main outcomes from the JASMIN project: development of ASTEC-Na for severe accident simulation in Na cooled fast reactors

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The JASMIN project was launched in the frame of the 7th Framework Programme (FP) of the European Commission (EC). It was inspired by the Gen-IV target of designing innovative reactors that intrinsically prevent severe accidents from occurring or drastically reduce their consequences. One of the main objectives of the 7th FP was the enhancement of the current capability of analysis of severe accidents in Na-cooled fast reactors notably by developing new simulation tools able to evaluate the consequences of unprotected accidents leading to fuel pin failure, fuel and cladding relocation, primary system loads, fission product and aerosols releases. To do so, the ASTEC platform originally developed for LWRs, was chosen to be adapted and extended to the environment of Na-cooled fast reactors, the result being called ASTEC-Na. The main advantage was to simulate all phenomena of interest that are today generally simulated by separate codes focusing on specific aspects (i.e., SAS-SFR, CATHARE, RELAP, CONTAIN-LMR, etc.) using only a single code. In fact, this integrated approach is not complex to be implemented due to the high modularity of ASTEC-Na which allows developing, validating and maintaining separately each of its modules that represent a macro-phenomenon. In addition, the flexibility in defining the core geometry, materials composition and reactor components makes ASTEC-Na able to study new SFR designs, e.g. with fertile layers in outer radial or inner axial core regions (such as in ASTRID design), subassemblies with an inner duct channel to induce fast fuel axial relocation (such as FAIDUS design), or new safety systems to shut-down the core power. The JASMIN project has addressed four main areas: thermal-hydraulics, pin thermal-mechanical behavior, source term and core neutronics. In each area, model development and assessment have been performed. In addition to the experimental test matrix built within the frame of the project and used as references for the model validation, the adequacy of ASTEC-Na models have been evaluated through the comparison with results of other suitable and referenced codes used for benchmarking purposes. The main outcomes from the assessment and validation work have been summarized in the form of a SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) that clearly allows identifying the main needs for future model developments.

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