International Conference on Fast Reactors and Related Fuel Cycles FR22: Sustainable Clean Energy for the Future (CN-291)

Contribution ID: **325** Type: **ORAL**

Development of SFR core degradation simulation code SIMMER-V and its validation & verification studies

Thursday 21 April 2022 12:04 (12 minutes)

In the framework of reactor safety analysis of Sodium cooled Fast Reactors (SFR) using applicable code systems, the CEA and JAEA are involved in the achievement of SIMMER-V (owned by JAEA and co-developed by JAEA and CEA) developments dedicated to the simulation of the Severe Accident (SA) events of SFR.

The demand for new physical models into SIMMER-V rises in SIMMER previous versions related works, since new features are necessary in order to give a mechanistic evaluation of SA events. In order to enhance functions of SIMMER-V code system, a ranking of additional models has been proposed i.e. the detailed pin model or more adapted heat exchange correlations. Regarding the importance of predicting severe accident progression and consequences, verification and validation (V&V) work has been planned and conducted to get high value feedback on the applicability of the SIMMER-V to SFR severe accident simulation.

This paper outlines the CEA-JAEA collaboration on SIMMER-V development including V&V work, its achievement and perspective. The following two exercises of v&v work are highlighted.

First exercise presented in this article will consist on the validation of a natural convection correlation in fuel molten pools through the SCARABEE experimental program dedicated to the study of the Total Instantaneous Blockage (TIB) severe accident scenario in a SFR. Among the different tests performed, the program BF ("Bain Fondu"which means molten pool in French) aimed to study the behavior of molten and boiling heat-generating fuel pools using real reactor materials. Then, this study focuses on the evaluation of BF tests input data set using the latest SIMMER-V version and on the implementation and validation of the Chawla-Chan natural convection correlation in SIMMER-V sources.

The second exercise will focus on the verification of fluid dynamics scheme on SIMMER-V considering the updated test (2019) of classical benchmark problem of the Ideal Shock Tube, which was already part of SIMMER-III validation test basis. The main objectives are 1) to confirm the capability of SIMMER- V to simulate, in 1-D geometry, a single compressible fluid flow with strong pressure gradients, and 2) to verify the stability of results when varying mesh discretization, pressure solver options, time step control, domain decomposition and check basic conservation laws.

Country/Int. organization

France

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Session Classification: 6.3 Multiscale and Multiphysics Calculations

Track Classification: Track 6. Modelling, Simulations, and Digitilization