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

Contribution ID: **86** Type: **ORAL**

France-Japan Collaboration on Thermodynamic and Kinetic Studies of Core Material Mixture in Severe Accidents of Sodium-Cooled Fast Reactors

Friday 22 April 2022 14:30 (12 minutes)

In the framework of the current implementing arrangement on France-Japan collaboration on Sodium-cooled Fast Reactors (SFRs) from 2020 to 2024, the R&D tasks called "Thermodynamic and Kinetic Studies of Core Material Mixture"is intended to improve models on material interactions at thermodynamic equilibrium and kinetics of reactions for use in severe accident simulation codes with experimental data production. This task includes experimental study on chemical interaction between (U,Pu)O2, B4C and stainless steel (SS), high temperature thermodynamic and thermo-physical properties of complex mixtures studies, and modelling of mixtures thermodynamics and liquefaction kinetics.

The previous implementing arrangement (2014-2019) was organized in two phases:

• The first phase (2014-2015) focused on the comparison between French and Japanese thermodynamic databases using the Calphad method. The French and Japanese teams developed a modelling approach for the severe accident simulation code SIMMER based on possible accidental scenarios during the reactor degradation.

• In the second phase (2016-2019), CEA and JAEA has conducted thermodynamics studies, experimental programs to support core material mixture modelling, and the development of models for severe accident simulation code.

These collaborative tasks were successfully accomplished and continuous R&D items were identified.

Based on the previous collaboration, CEA and JAEA defined the following sub-tasks under the current implementing arrangement:

 Kinetics of interaction in core material mixtures,

 Physical properties of core material mixtures,

 High temperature thermodynamic data for the UO2-Fe-B4C system,

 Experimental studies on B4C-SS kinetics and B4C-SS eutectic material relocation (freezing) with/without sodium,

 B4C/SS eutectic and kinetics models for SIMMER code systems,

 Methodology for the modelling of mixtures liquefaction kinetics.

This paper describes major R&D results obtained in the France-Japan collaboration under the previous implementing arrangement as well as experimental and analytical roadmaps under the current arrangement.

Country/Int. organization

France

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Session Classification: 5.3 Experimental Programs II

Track Classification: Track 5. Test Facilities and Experiments