Preliminary results of PARAMETER SF2 post test calculation with ATHLET-CD

Christa Bals, Henrique Austregesilo, Klaus Trambauer,
Gesellschaft für Anlagen- und Reaktorsicherheit (GRS), Germany

Abstract

In the SF2 experiment, which was performed on April 3rd 2007 in the PARAMETER test facility, the initial stage of a severe accident with a large break LOCA was simulated. The special aim of this experiment was to study the efficiency of combined top and bottom flooding for the VVER-1000 assembly overheated to 1500 °C and to obtain valuable information for code verification. With the help of the experimental data especially the modelling of flooding and oxidation processes should be checked.

For the post test calculation of this test with ATHLET-CD a input data deck derived from the post-test calculation of the SF1 experiment was used, which was adjusted not only to the special initial- and boundary conditions of test SF2 but also to the changed geometry. A first calculation showed good agreement of the calculated temperatures until start of cooldown, but the used Sokolov correlation for simulation of Zirconium oxidation led to an underestimated hydrogen production. With the oxidation rates calculated by the Leistikow/Prater-Courtright kinetic data the calculated Hydrogen generation agrees well with the measured data besides a short time period of underestimation in the initial phase of pre-oxidation. After the start of top flooding at 16510 s the injected liquid dropped too fast down to the bottom of the bundle with the effect that the pre-cooling of the rods up to a bundle elevation of ~700mm was too strong. At the higher elevations some of the measured temperatures show local effects which cannot be simulated by the code but the overall behaviour was calculated in agreement with the test data. The cooling-fronts derived from measured temperatures and the calculated quench-fronts are in good agreement; so this calculation simulates very well the average behaviour of the cool down, including the time of complete cooling (~16620s) as well as the elevation where the last quenching occurred (1250 mm).

An additional calculation with increased interfacial friction for annular / annular-mist flows shows the right behaviour of cooling now also at the lower elevations; this indicates that the default modelling of interfacial friction should be checked for the PARAMETER test bundle configuration.

In spite of evaporation rates comparable to the value deduced from the test the pressure increase measured after start of bottom flooding is not calculated by ATHLET. It is assumed that the boundary condition of constant pressure at the end of the outlet pipe has to be substituted by a better modelling of the condenser tank.

With these results of the PARAMETER SF2 post-test calculation valuable hints were achieved for code verification concerning oxidation and entrainment model.