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S. Schmidt-Stiefel, T. Wenz,

I. Ivanov[1], D.Popov[2]

Institut für Kern- und Energietechnik

Programm Nukleare Sicherheitsforschung

[1]Technical University of Sofia, Bulgaria

[2]Kozloduy NPP, Bulgaria

Forschungszentrum Karlsruhe GmbH, Karlsruhe

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Abstract

The sequence of a postulated core melt down accident in the reactor pressure vessel (RPV) of a pressurised water reactor (PWR) involves a large number of complex physical and chemical phenomena. To improve the understanding of possible scenarios of core melt down accidents with core degradation, melt pool formation and relocation in the RPV, possible melt dispersion to the reactor cavity and finally corium concrete interaction and corium coolability in the reactor cavity, the LACOMERA project at the Forschungszentrum Karlsruhe was started in September 2002. The LACOMERA project was a four year action within the 5th Framework programme of the EU and offered research institutions from the EU member Countries and Associated States access to the four large-scale experimental facilities QUENCH, LIVE, DISCO and COMET at the Forschungszentrum Karlsruhe.

Within the LIVE experimental programme two experiments (LIVE-L1 and LIVE-L2) have been performed within the LACOMERA project. The experiment LIVE-L1 is part of this report and was planned and performed in close co-operation with the Technical University Sofia, Bulgaria and the Kozloduy NPP, Bulgaria.

The main objective of the LIVE program is to study the core melt phenomena during the late phase of core melt progression in the RPV both experimentally in large-scale 3D geometry and in supporting separate-effects tests, and analytically using CFD codes in order to provide a reasonable estimate of the remaining uncertainty band under the aspect of safety assessment.

The experiments LIVE-L1 and LIVE-L3 are aimed at investigating the melt pool and crust behaviour during the stages of air circulation at the outer RPV surface with subsequent flooding of the lower head. The initial and boundary conditions in both tests were almost the same except of the pouring position of the melt into the test vessel. In LIVE-L1 the melt was poured in central position and in LIVE-L3 the melt was poured near to the wall of the test vessel. The information obtained in these experiments includes heat flux distribution through the RPV wall in transient and steady state conditions, crust growth velocity and dependence of the crust formation on the heat flux distribution. Supporting post-test analysis contributes to the characterization of solidification processes of binary non-eutectic melts.

The experimental results are being used for the development of mechanistic models to describe the in-core molten pool behaviour, which should then be implemented in severe accident codes like ASTEC.

The present report summarizes the objectives of the LIVE program and presents the main results obtained in the experiments LIVE-L1 and LIVE-L3.