Air Oxidation Modelling at PSI

Jon Birchley (Paul Scherrer Institute)

The MELCOR code is used in Switzerland for analysis of severe accident transients in light water reactors. One area of concern is that of air ingress, which can lead to accelerated cladding oxidation, core degradation and enhanced release of fission products, especially the highly radiotoxic ruthenium. Existing oxidation models do not fully represent all the relevant physical processes, and cannot be guaranteed to be conservative. A new model has been developed at PSI which captures the essential features of initial parabolic (protective) kinetics and the transition to linear (breakaway) kinetics. It is aimed primarily at oxidation in air or steam-air mixtures, but also represents the breakaway oxidation that can occur if the cladding is exposed to pure steam for long periods at temperatures less than about 1300 K. The model has undergone developmental assessment against data from separate effects experiments carried out at FZK, covering a range of temperatures and oxidising environments. Implementation into MELCOR, and assessment against independent separate-effects and integral data, are in progress. In parallel, PSI is participating in the OECD-sponsored Spent Fuel Pool (SFP) project, in which experiments are being performed by SNL using full-scale fuel assemblies with prototypic materials and arranged in a simulated dried-out storage pond. The project will provide high quality data with which to assess the capability of models to simulate the air oxidation and its potential to trigger a self-propagating fire in an uncovered spent fuel pond. The PSI model, when implemented into MELCOR, will be assessed against the SFP data.

Presented at the 2nd European MELCOR Users' Group Meeting, held in Prague, March 2010