Title Modelling of blowdown of steam in the pressurized PPOOLEX facility

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Abstract

PPOOLEX experiment WLL-04-02 on condensation of vapour is studied with CFD simulations. Wall condensation model has been adapted to an Euler-Euler multiphase model of the Fluent CFD code for this purpose. In addition, a simple direct-contact condensation model has also been included in the code.

The main focus of the CFD modelling work was on modelling condensation in the drywell. The amount of condensation found in the CFD calculation was in fair agreement with the experiment. The present simulation was so short that the gas flowing into the wetwell contained significant amount of air. The mole fraction of vapour at the outlet of the vent pipe had the maximum value of about 0.3. Therefore, the non-condensable gas strongly affected the direct-contact condensation in the water pool. Much longer simulations are needed in order to study jugging and condensation oscillations.

FSI calculations of the experiments were performed by using the Star-CD, ABAQUS and MpCCI codes. An approximate method that makes possible numerically stable FSI calculations for the experimental facilities was used. The method is based on linear perturbation method which necessitates small structural deformations. The calculations showed that FSI has to be taken into account for the POOLEX facility which has relatively light structures.

A way for determining the pressure source for the acoustic model from pressure measured at the pool bottom was also examined. Separation of the pressure component due to wall motion from the blowdown load was attempted by conducting a Fourier analysis on the measured displacement signal. The study showed that in practise sufficiently accurate acceleration signal cannot be obtained this way because the transformed signal gets easily out of phase. A measurement system was proposed which could be used for determining the pressure fluctuations.

Key words Condenstion pool, pressure suppression pool, BWR, CFD, fluid-structure interaction, FSI