MULTI-SCALE THERMAL-HYDRAULIC ANALYSIS OF SAFETY SYSTEMS OF ADVANCED PWRS USING THE CUPID CODE

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ABSTRACT

Computer codes having different length scale are utilized to provide a high fidelity safety or performance analysis of PWRs, which is called as a multi-scale analysis. In this paper, a multi-scale thermal hydraulic analysis is introduced using CUPID and MARS which are component- and system-scale thermal hydraulics codes. The PASCAL test is simulated using the CUPID-MARS where the CUPID code has been coupled with the MARS code. PASCAL is an assessment loop of KAERI intended to validate the passive auxiliary feedwater system (PAFS) of APR+. The two-phase flow phenomena of the steam supply system including the condensation inside the heat exchanger tube were calculated by MARS while the natural circulation and the boil-off in the large water pool that contains the heat exchanger tube were simulated by CUPID. The long transient of PASCAL which lasted during 8 hours has been successfully analyzed using the coupled code. Then, a multi-scale analysis of the VAPER test is introduced. VAPER is a prototypical full-scale test facility of APR1400 advanced safety injection tank (SIT). The pressure drop inside the fluidic device is calculated in a CFD-scale. Then a component-scale pressure drop model is proposed based on the CFD-scale calculation for the simulation of the discharge transient of VAPER. Pressure, SIT water levels, and discharge flows have been accurately predicted. Analysis models are proposed for the MARS code based on the results of CUPID.

KEYWORDS
Multi-scale, coupling, CUPID, MARS

* Footnote, if necessary, in Times New Roman font and font size 10