Abstract

The use of CFD for the industrial studies related to PTS, including DCC is already possible; improvements of the two-phase modeling capabilities have to be undertaken to qualify the codes for the simulation of such flows. The DCC in horizontally stratified flow regime constitutes very considerable challenge exercises for a computational fluid dynamics (CFD) simulation of the thermal hydraulics PTS phenomenon because the interplay between turbulence and interfacial heat and mass transfer problem. The main purpose of our study is to investigate numerically the DCC in horizontally stratified steam water flow in a 2D and 3D channel using TransAT CMFD code. The new methodology known as Large-Eddy & Interface (LEIS) have been implemented for treatment of turbulence combined with interface tracking ITM (level set approach). Among of the so-called 'coarse-grained' ITM's models, the modified original surface divergence has been chosen as well as the treatment of the turbulence by URANS and VLES. This contribution addressed on the validation of interfacial phase-change heat transfer and turbulence models with special correction of the damping function at the free surface for single and combined-effect thermal hydraulic studies for LIM and KAERI & KAIST test facilities. The LIES methodology was found to apply successfully to predict the condensing steam flow rate in the all cases of the LIM test case involving a Smooth to Wavy turbulent, concurrent stratified steam-water flow in a 2D channel. The CMFD TransAT code predicting capability is analyzed, comparing the liquid temperature and to much the velocity profile of KAERI & KAIST Countercurrent Stratified Flow (CCSF) combined-effect in 2D and 3D geometry to one predicted by analytical Biberg model. The vertical profiles of CFD local water velocity calculations have been corrected using AKN free surface damping model where the agreement with KAERI & KAIST data is sufficiently good. The KAERI & KAIST test case is actually more challenging than all low subcooling cases (COSI, TOPFLOW) where the application of the ASD model (and the other interfacial DCC models) for high subcooling ($\Delta T_{sub} \sim 70.0°$ K) is still questionable. A modified ASD model should be implemented, to taking into account the effect of the degree of the water subcooling through the introduction of the Jakob number