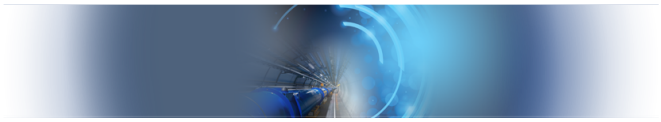

Contribution ID: **69** Type: **Talk**

Numerical study of saturation steam/water mixture flow and flashing initial sub-cooled water flow inside throttling devices

Thursday 22 September 2016 15:00 (20 minutes)

Saturation of steam/water mixture flow and flashing initial sub-cooled flow inside throttling devices (i.e., safety and control valves) is investigated here. Due to thermal non-equilibrium and mechanical non-equilibrium effects, this phenomenon is of actual interest in the research community. Thermal non-equilibrium effect is accounted for boiling delay before vaporization when flow experiences sudden depressurization and reaches the saturation state. Mechanical non-equilibrium effect is encountered with slip between vapor and liquid.
In this work, a Computational Fluid-Dynamics (CFD) approach to model this phenomenon inside throttling devices is proposed. To validate CFD results, different nozzle geometries are analyzed, comparing numerical results with experimental data. Two cases are studied:

Case 1: saturation steam/water mixture flow inside 2D convergent-divergent nozzle (inlet, outlet and throat diameter of nozzle are 0.1213m, 0.0452m and 0.0191m respectively).
In this benchmark, a range of total inlet pressure (134 −189kPa) and inlet liquid mass fraction (0 - 0.36) is investigated. Results show an agreement with experimental data in term of mass flow rate.

• Case 2: initial sub-cooled water flow inside 2D-axisymmetric and 3D convergent-divergent nozzle (both of inlet, outlet diameter are 0.051m and nozzle throat diameter is 0.025m).
Validation of CFD model is performed with total inlet pressure, inlet temperature and outlet pressure equal to 555.9kPa, 422.25K and 402.5kPa, respectively. An agreement between CFD results and experiment data in both mass flow rate and local values of vapor fraction is also observed.

This simulation is the first part of a project aimed to generate more data for establishing a new formula of sizing valves in case of two-phase flow with phase change.

Primary author: DANG LE, QUANG (Politecnico di Milano)

Co-authors: Prof. INZOLI, Fabio (Politecnico di Milano); Dr BESAGNI, Giorgio (Politecnico di Milano); Dr MEREU, Riccardo (Politecnico di Milano); Prof. DOSSENA, Vincenzo (Politecnico di Milano)

Presenter: DANG LE, QUANG (Politecnico di Milano)

Session Classification: R&D in Cryogenic Safety

Track Classification: Cryogenic Safety