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INSTAB

Couplings and instabilities in reactor systems

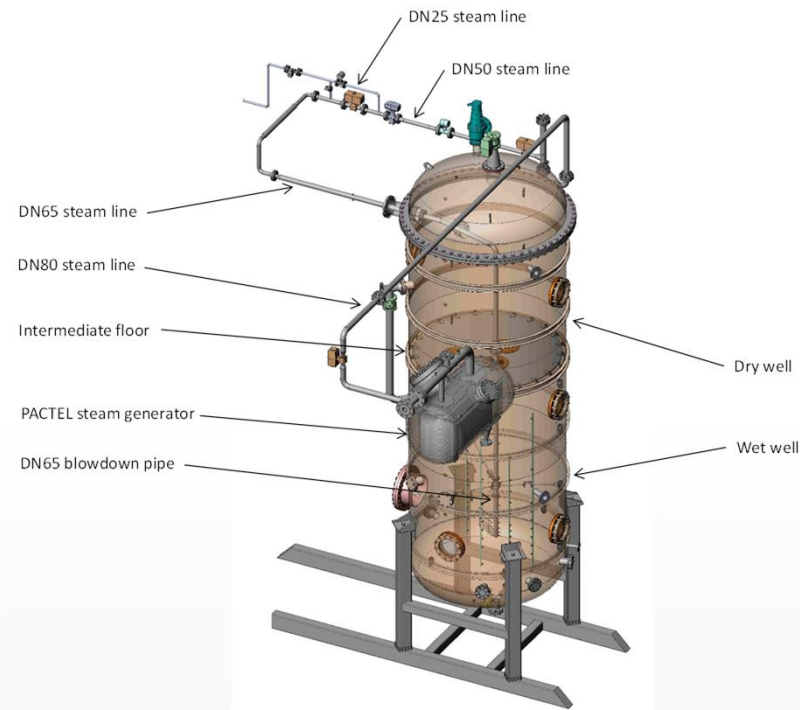
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SAFIR2018 Final Seminar

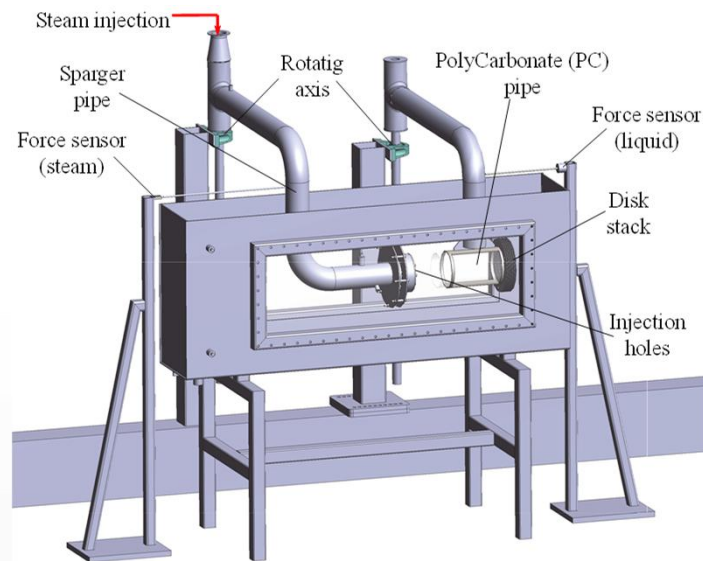
Espoo, March 21-22, 2019

INSTAB – Motivation

- § Condensation pool is an in-containment heat sink in BWRs
- § Steam discharges are received from safety/relief valves and blowdown pipes
- § Water discharge from containment spray and Residual Heat Removal (RHR) return lines
- § **Thermal stratification** of the condensation pool **limits the volume of water** absorbing heat
- § Full capacity of the pool not used à **containment overpressure risk**
- § The INSTAB project studies the stability of stratification and mixing mechanisms in pool and details of direct-contact condensation



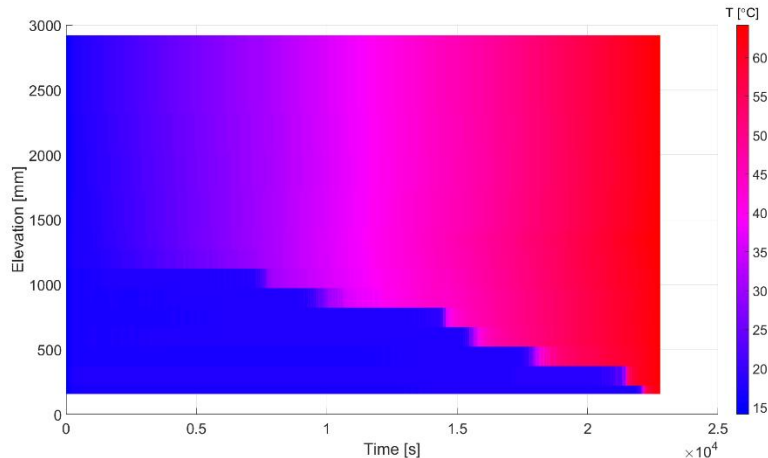
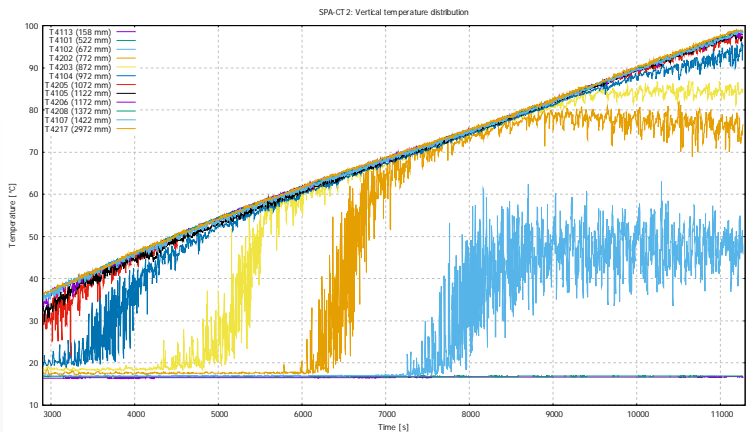
INSTAB – Enhancement of safety



- § There is a need for validated tools for simulation of realistic accident scenarios with interplay between phenomena, safety systems, operational procedures, and overall containment performance
- § Understanding of the phenomena related to BWR pressure suppression function has been increased and capabilities to analyse Nordic BWR containments under transient and accident conditions has been enhanced
- § Mixing and stratification of the wetwell pool
 - effects of the SRV spargers, RHR nozzles and spray
- § Numerical simulation models have been developed, improved and validated on the basis of INSTAB tests

INSTAB - Erosion of thermal stratification

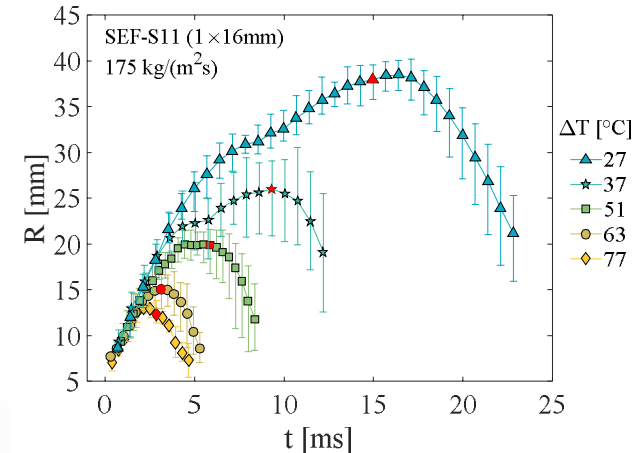
§ The tests with a model of a SRV sparger in the PPOOLEX facility verified that mixing of a thermally stratified water pool could happen also through an erosion process in addition to internal circulation, if suitable flow conditions prevail



§ With the sparger in the centre of the pool and with increased water level mixing through erosion was incomplete, instead new stratification phase starts

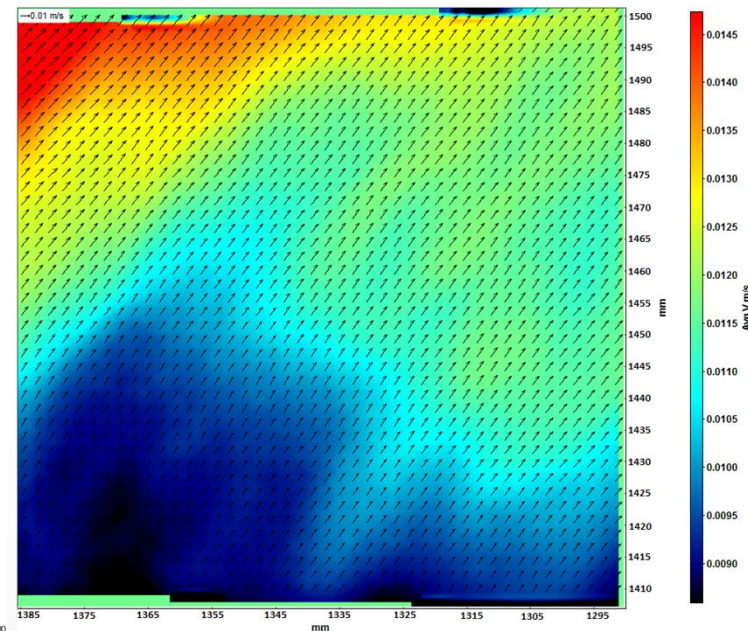
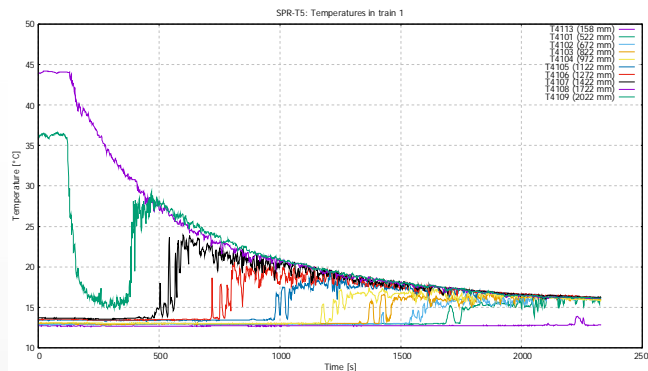
INSTAB – Separate effect tests

- § Prediction of the effective momentum induced by the oscillatory bubble regime is necessary for the modelling of the pool behaviour
- § Data of the characteristics of small-scale phenomena affecting the effective heat and momentum sources have been provided in the SEF-POOL tests
- § Data is used in the validation of the simplified, and thus computationally efficient, EHS/EMS models by KTH
- § Tests also support the validation effort of the DCC and interfacial area models of CFD codes for steam injection through spargers at VTT and LUT



INSTAB – Spray tests in PPOOLEX

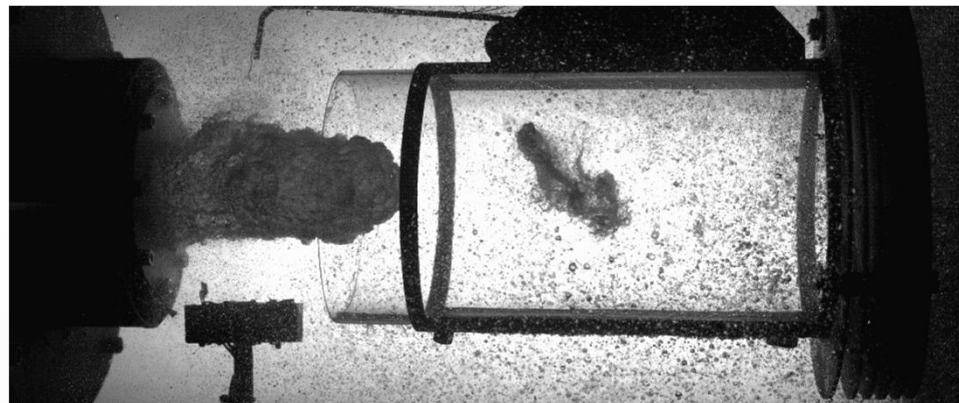
- § Mixing of a thermally stratified pool with the help of spray injection from above was studied in PPOOLEX tests
- § PIV measurements were conducted in order to produce velocity field data for improving simulation models related to spray operation in CFD and system codes as well as to contribute to the development of the EMS and EHS models
- § The cold spray water first cools the topmost layers and then the internal circulation induced by density differences starts to mix the pool



INSTAB – Conclusions

INSTAB tests in PPOOLEX and SEF-POOL have generated a large database on suppression pool phenomena which could threaten containment pressure suppression function

- Data on stability of pool stratification and efficiency of pool as a heat sink
- Strong contribution to the development of the EMS and EHS models for blowdown pipes, SRV spargers and RHR nozzles
- DCC modelling in CFD (Fluent, NEPTUNE_CFD, OpenFOAM) evaluated on the basis of the PPOOLEX tests





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