P2-046

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Application of a Best-Estimate methodology to the tests performed on a Helium Cooled First Wall Mock-up

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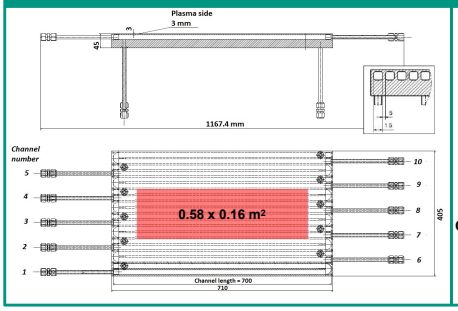
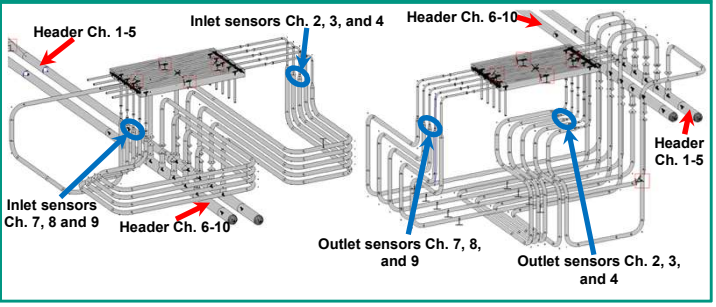
Background

- **Validation of codes and models in DEMO relevant conditions is required** in view of licensing & operation.
- **Validation** of a RELAP5-3D model reproducing the First Wall Mock Up (FWMU).
- **Uncertainty analysis** with the use of the Best-Estimate Model Calibration and Prediction through Experimental Data Assimilation.

First Wall Mock-Up & HELOKA-HP facility

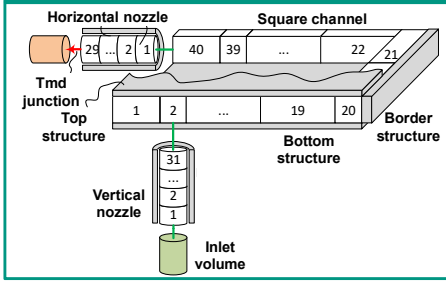




Investigated tests

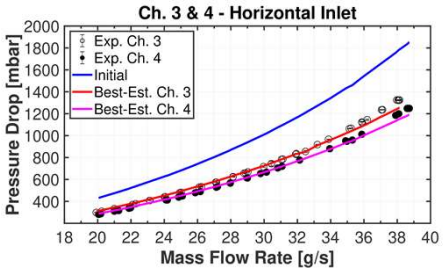
- **Pressure drop characterization tests**
  - Air flow at 0.6 MPa and 20 °C through each channel.
  - Step-by-step decrease of the air flow rate.
- **LOFA tests**
  - Reproduced by closing a valve installed on the outlet header of channels. 1-5.
  - Opening: 60, 40, 20, 10, 5, 0 %.
  - Constant heat load of 300 or 300 MW/m² on top of FWMU plate (red area in the box above).

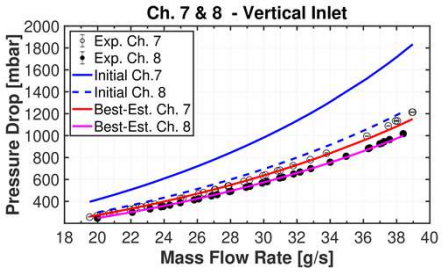
RELAP5-3D model



- Single channel model (left) used for Pressure drop characterization tests.
- HELOKA-HP model reproducing the FWMU and the ancillary pipes from the inlet sensors up to the flow meter on outlet headers.
- **Key model tested**:
  - Fluid-wall heat transfer correlation (Gnielinski correlation);
  - Heat conduction model among neighbor heat structures.

Pressure drop characterization tests

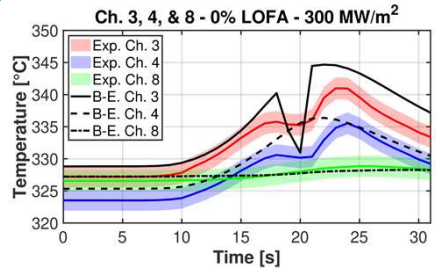


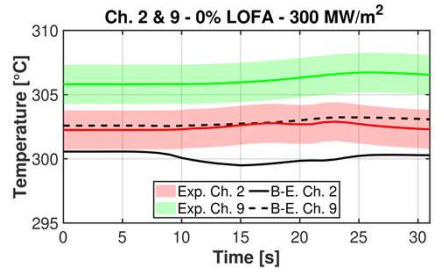


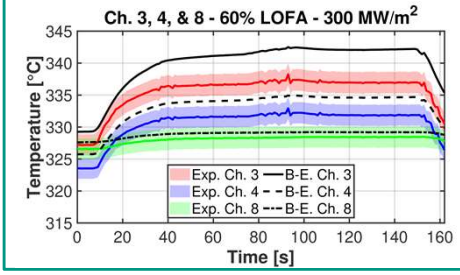
- First application of the Best-Estimate (BE) methodology.
- **Goal**: obtain best-estimate parameters (see below) to reproduce the channel's thermal-hydraulic behaviors.
- **Capabilities of the BE methodology tested reintroducing the BE parameters in the model.**
- **Computed results well agree with the experimental one. BE methodology is working.**

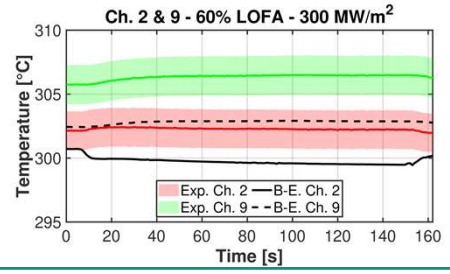
Adopted parameters:
- Surface roughness.
- Pressure drop coefficients of the junctions at geometrical discontinuities.

LOFA tests









- First application of the BE methodology to a fast transient.
- **Goal:** Validate key models of RELAP5-3D and continue the assessment of the BE methodology.
- BE methodology used to calculate BE parameters, which are then reintroduced in the model.
- **Case 0% LOFA**: Discrepancies after 17 s. Insufficient heat transferred to channels 2 and 9 (not heated).
- **Case 60% LOFA**: Discrepancies still due to the insufficient heat transfer to channels 2 and 9

Adopted parameters:
- Same of pressure drop characterization tests.
- Thermal conductivity AS.S18E EUROFER.
- 90° bend pressure drop coefficients on the ancillary pipes between FWMU and sensors.

Considered responses:
- Coolant Pressure and temperature at the outlet of channels 2, 3, 4, 7, 8, and 9.

Conclusions

- **The Best-Estimate methodology demonstrated to be a trustworthy tool**
- **Further analysis on the LOFA tests are under progress to better assess the Gnielinski correlation and the heat conduction model.**