P2-125

Modelling an In-Vessel Loss of Coolant Accident in the EU DEMO WCLL Breeding Blanket with the GETTHEM Code

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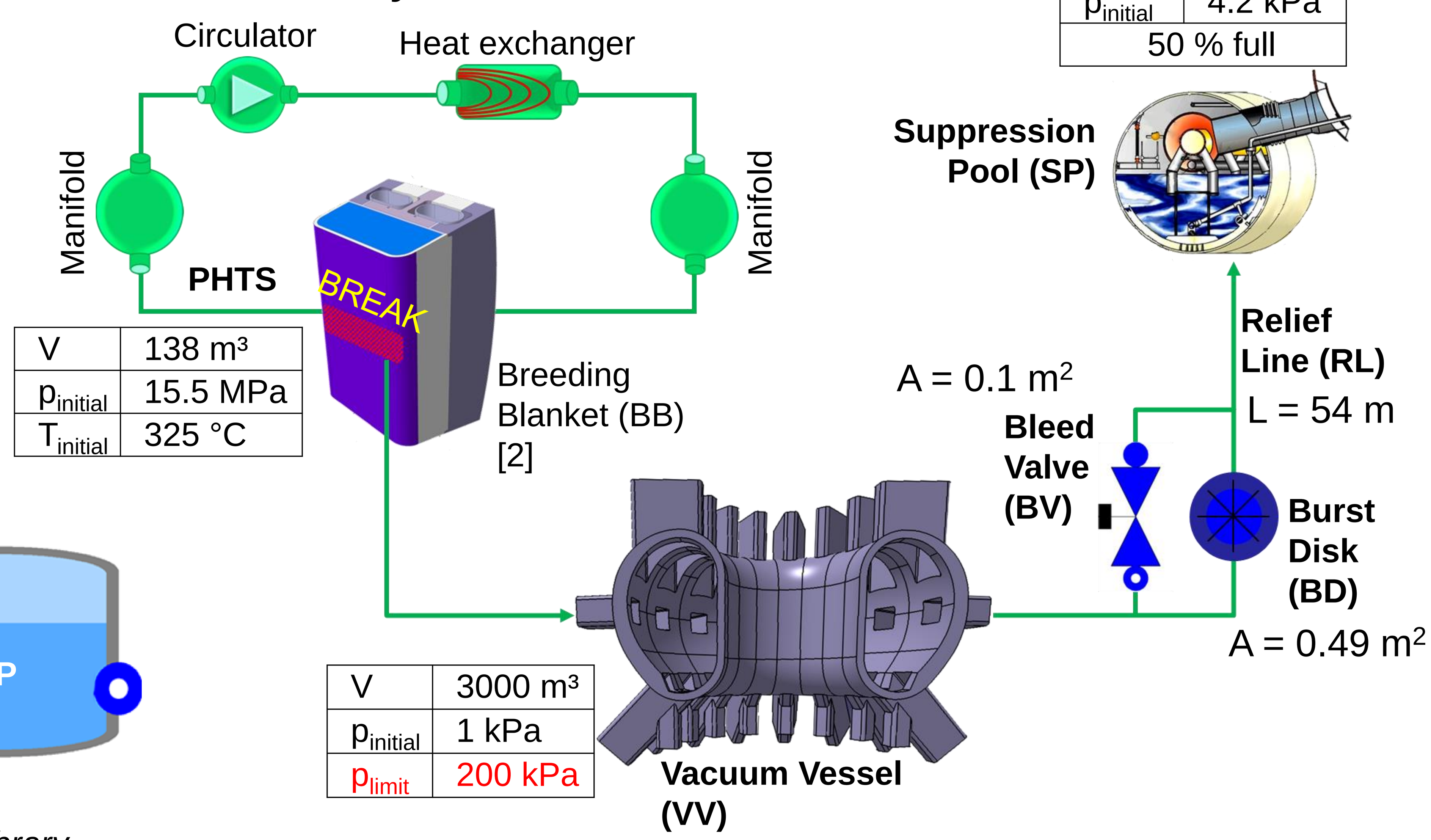
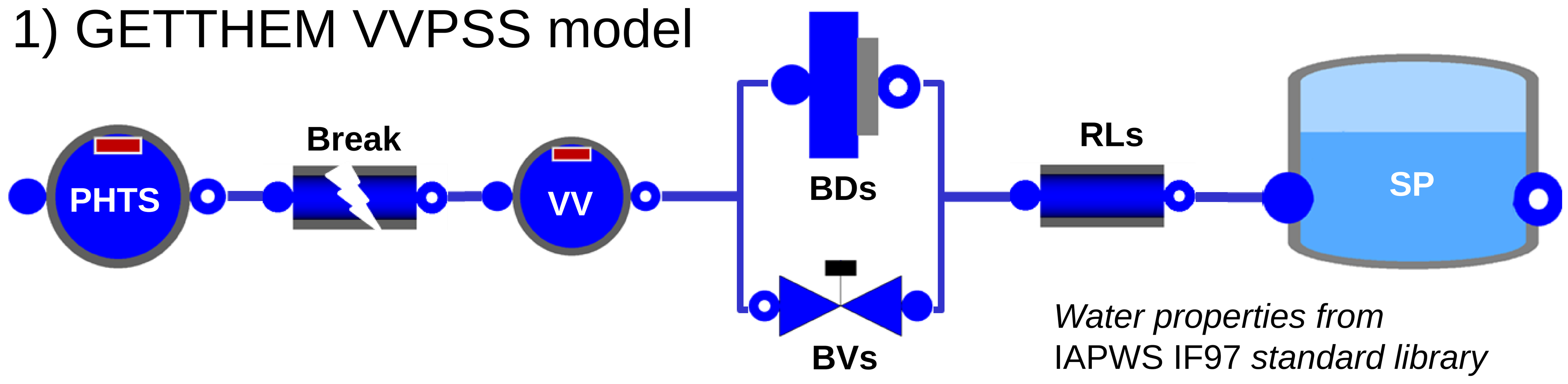
AIM OF THE WORK

1. Define a simplified model of the EU DEMO VVPSS (to be included into the GETTHEM code [1], under development at Politecnico di Torino) for the evaluation of pressure evolution after a in-Vessel Loss of Coolant event.
2. Validate the model components by means of existing LOCA experiments results.
3. Perform a parametric study on break size (and propose possible mitigation solutions).

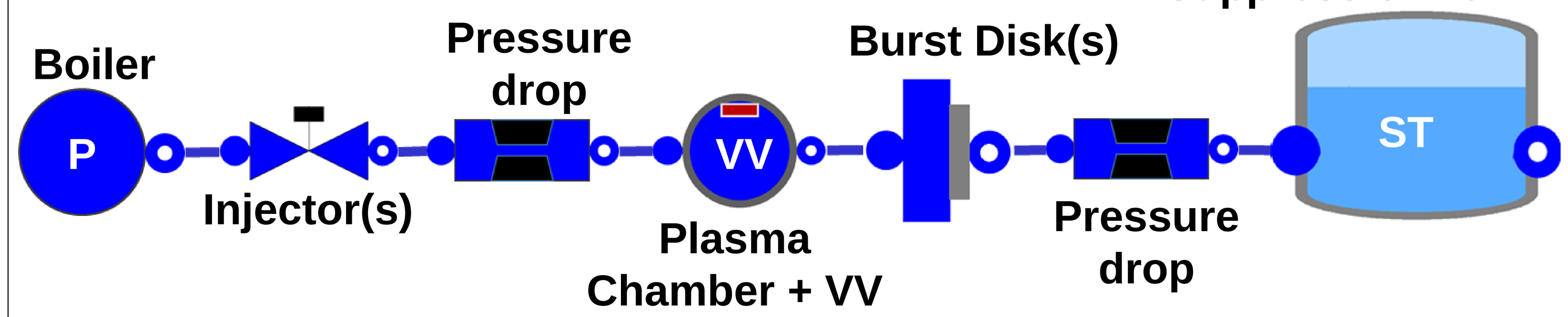
EU DEMO layout of the VVPSS

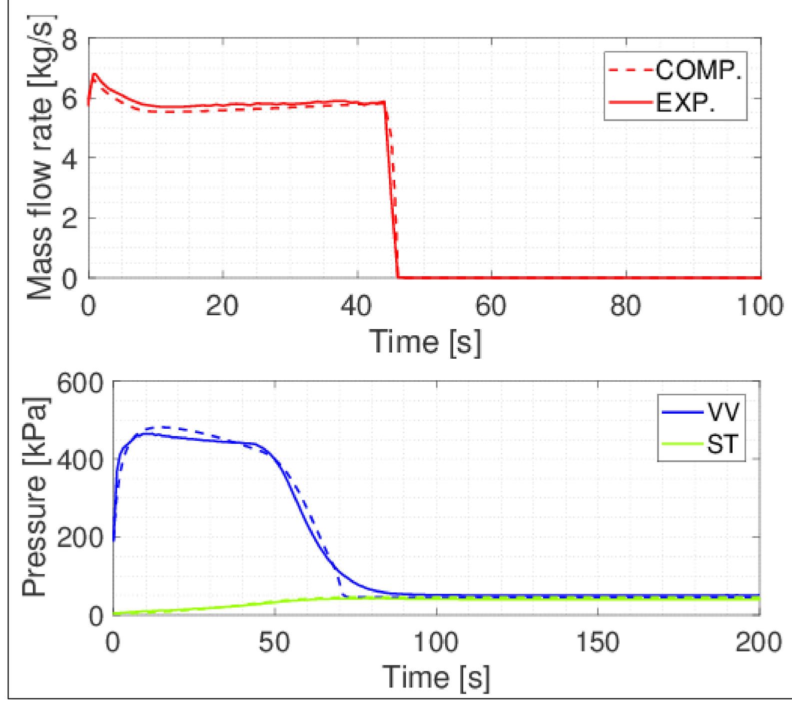


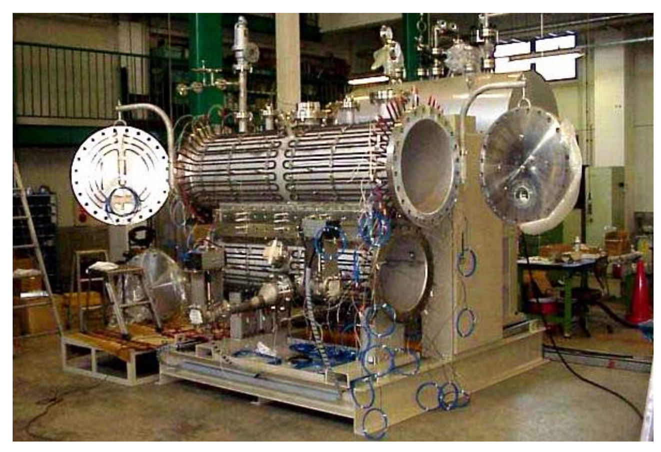
1) GETTHEM VVPSS model



2) Validation: ICE test facility model

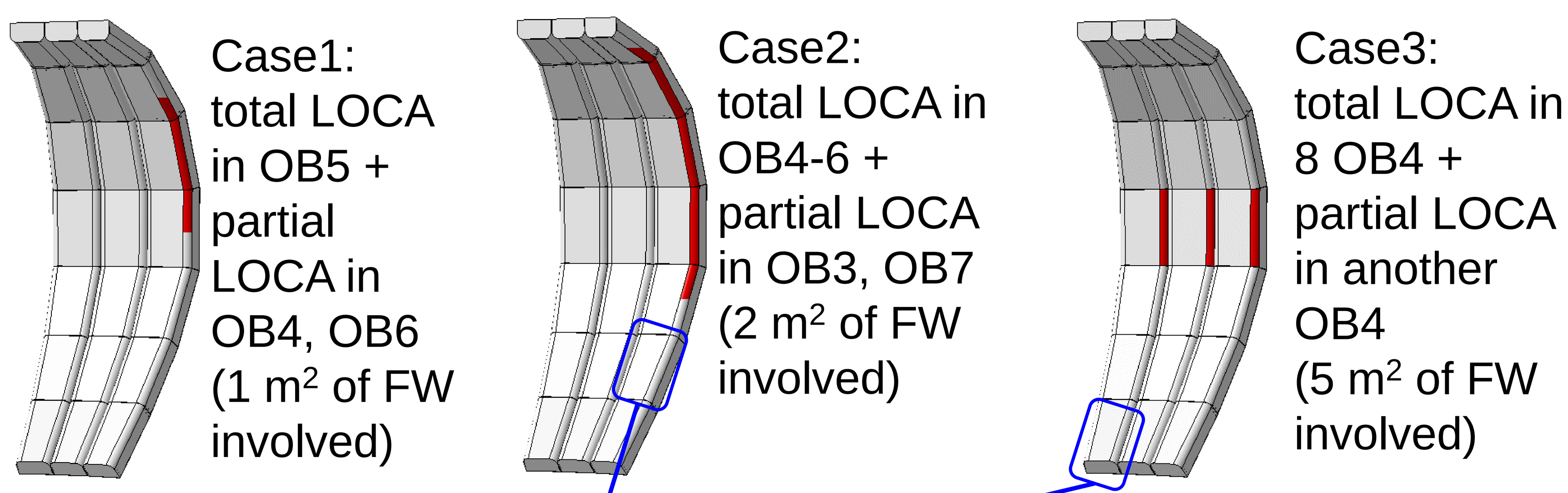


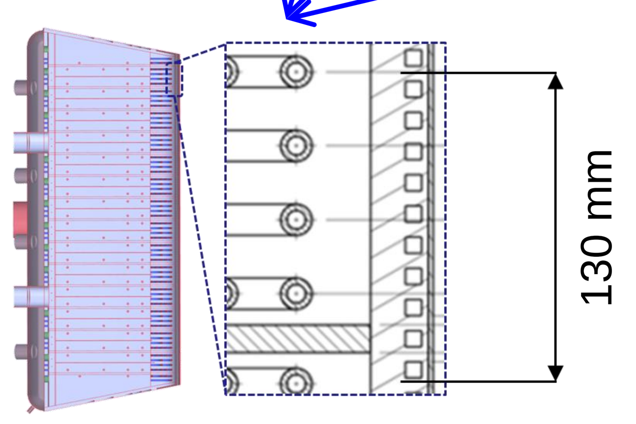




[K. Takase, Photos of the ICE facility, November 1999, JAERI, Japan]
[M. T. Porfiri and P. Meloni, ISAS validation against ICE Experimental campaign 2000 – Pre-test calculations, 2000]

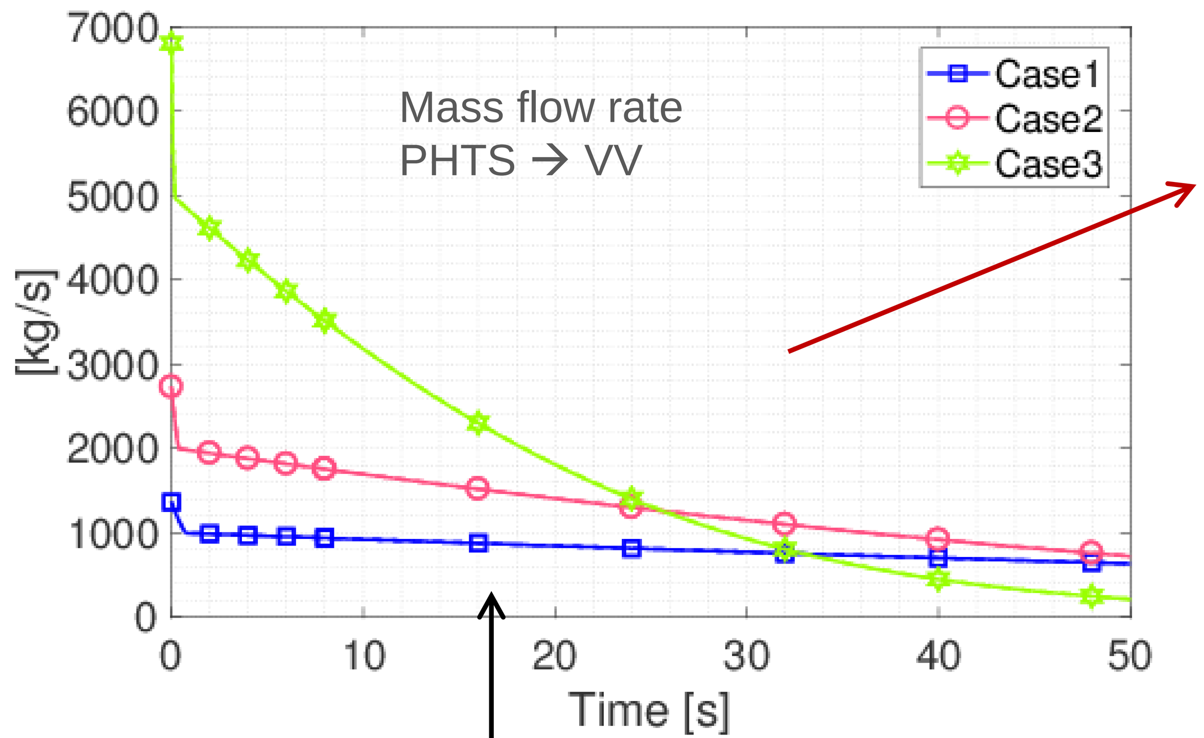
3) Parametric study on **break size** and **number of RLs**



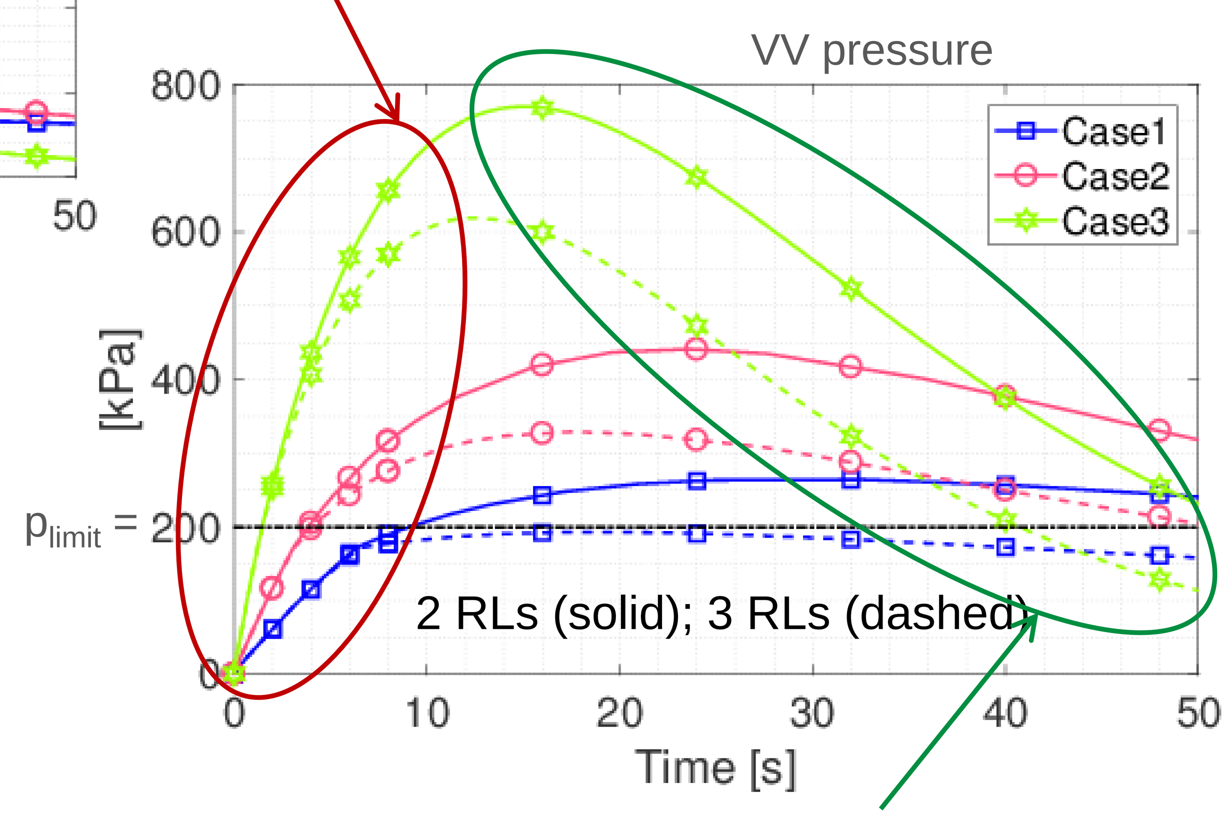


10 channels involved ($\sim 10^{-5}$ m² of leak size) every 130 mm of FW in poloidal direction

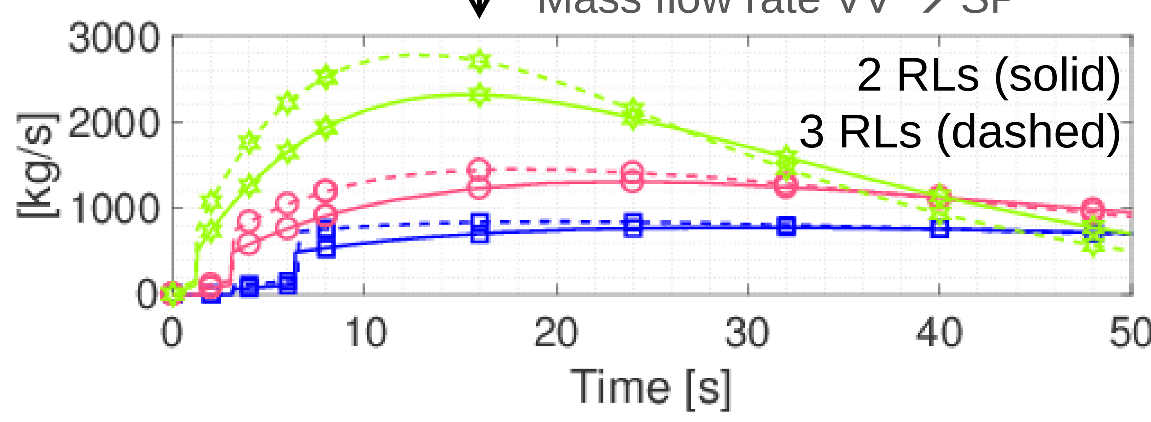
Case	Leak size [m²]	t_{open} BV [s]	t_{open} BD [s]	p_{max} [kPa] 2RLs/3RLs
1	$\sim 2.6\times10^{-2}$	~3	~6.5	264 / 193
2	$\sim 5.1\times10^{-2}$	~1.6	~3	441 / 329
3	$\sim 1.3\times10^{-1}$	~0.63	~1.2	770 / 619



Large value of mass flow rate entering the VV during the first instants → fast increase of VV pressure



Mass flow rate removed from BDs is a negligible fraction of that entering the VV in cases 2 and 3 → overpressure mitigation is ineffective



- Long-term overpressure mitigation thanks to BD intervention
- 3 RLs more effective than 2 in reducing p_{max}

CONCLUSIONS and PERSPECTIVE

✓ Validation of the model against ICE facility experiment (Japan, 2000) → excellent agreement for the variables of interest.

✓ Simulations on DEMO: for FW break > 1 m² → p_{limit} inside VV is exceeded with the current VVPSS parameters.

- BDs act only on long-term overpressure mitigation;
- 3 RLs more effective in mitigating p_{max} in the VV.

→ The GETTHEM VVPSS model will be linked to the 1D model of the PHTS, already present in the GETTHEM library, to evaluate the effects of this transient also on the cooling system.

[1] A. Froio, F. Casella, F. Cismondi, A. Del Nevo, L. Savoldi, R. Zanino, Dynamic thermal-hydraulic modelling of the EU DEMO WCLL breeding blanket cooling loops, *Fus Eng Des* 2017
[2] A. Del Nevo, et al., WCLL breeding blanket design and integration for DEMO 2015: status and perspectives, *Fus Eng Des* 2017

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