

WP2 Experimental tests: SMR-specific phenomenology to be addressed in EASI-SMR

EASI-SMR Workshop 1 on scaling issues
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WP2 leader

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nuward SMR



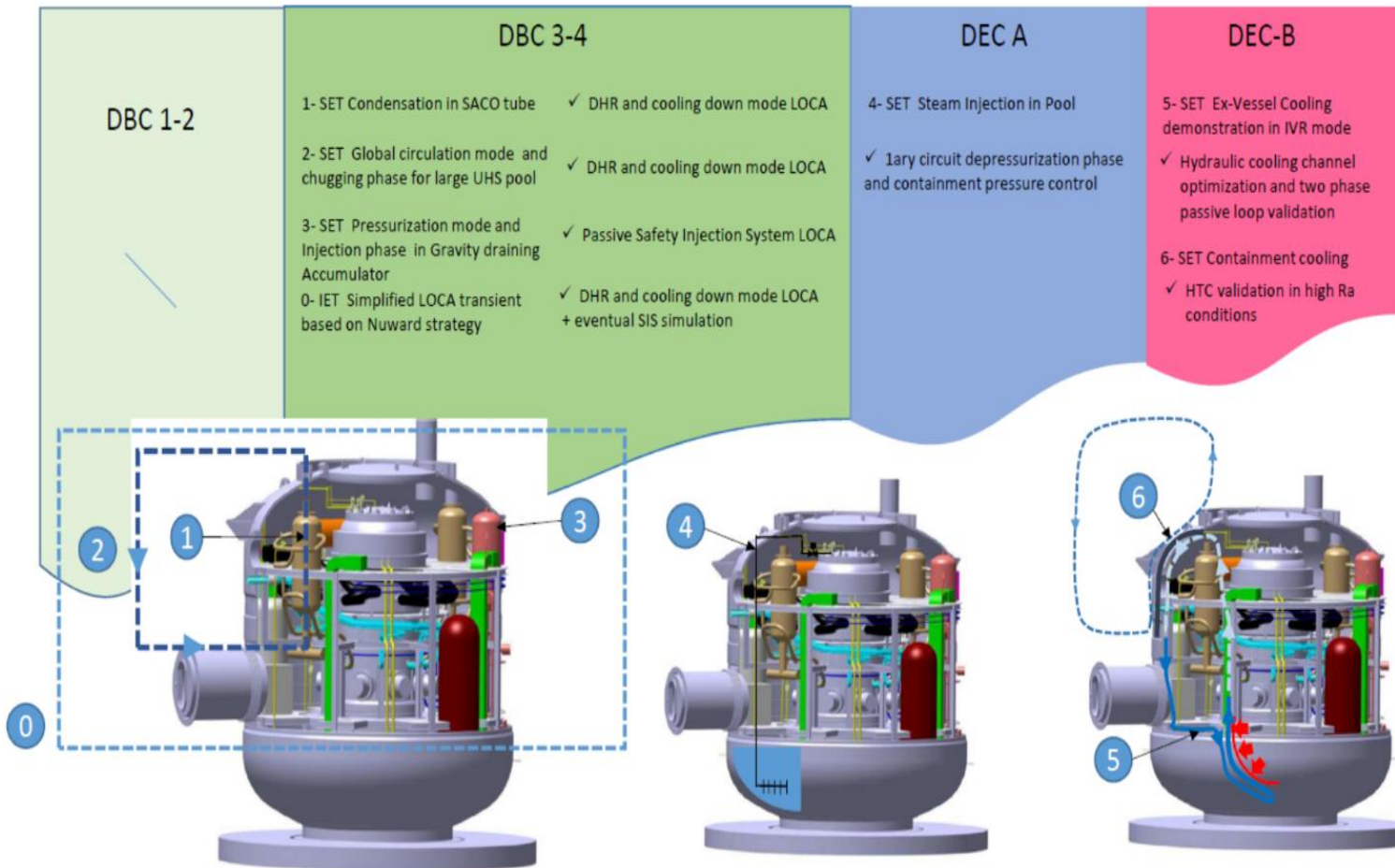
Steady
Energy

01 | Context

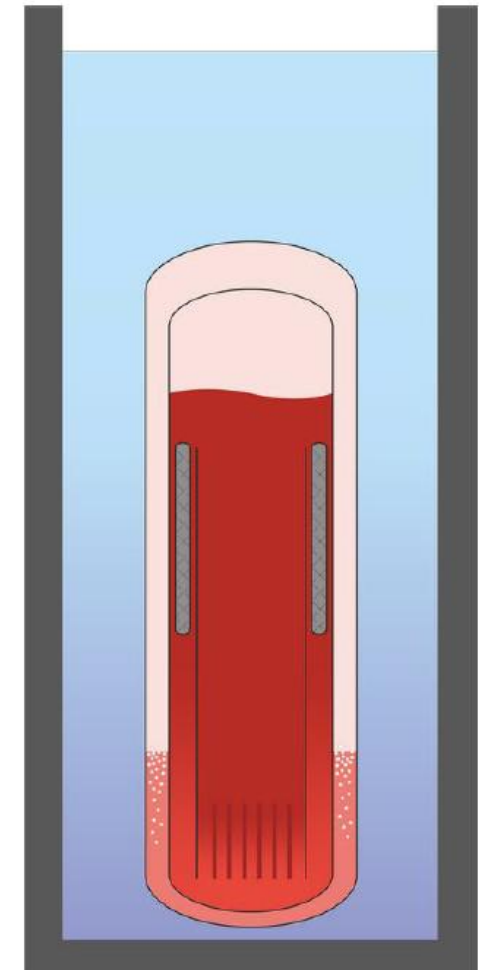
Context

Experimental tests requirements for characterizing passive systems, informed by past European projects and code

CODE VALIDATION ELEMENTS FOR SAFETY DEMONSTRATION



Decay Heat Removal Passive Strategy



LDR50

Context

Experimental tests requirements for characterizing passive systems, informed by past European projects and code

CODE VALIDATION ELEMENTS FOR SAFETY DEMONSTRATION

COSAC
PRECISE
ALCINA
ECRINS
ELSMOR II

DBC 3-4

- 1- SET Condensation in SACO tube ✓ DHR and cooling down mode LOCA
- 2- SET Global circulation mode and chugging phase for large UHS pool ✓ DHR and cooling down mode LOCA
- 3- SET Pressurization mode and Injection phase in Gravity draining Accumulator ✓ Passive Safety Injection System LOCA
- 0- IET Simplified LOCA transient based on Nuward strategy ✓ DHR and cooling down mode LOCA + eventual SIS simulation

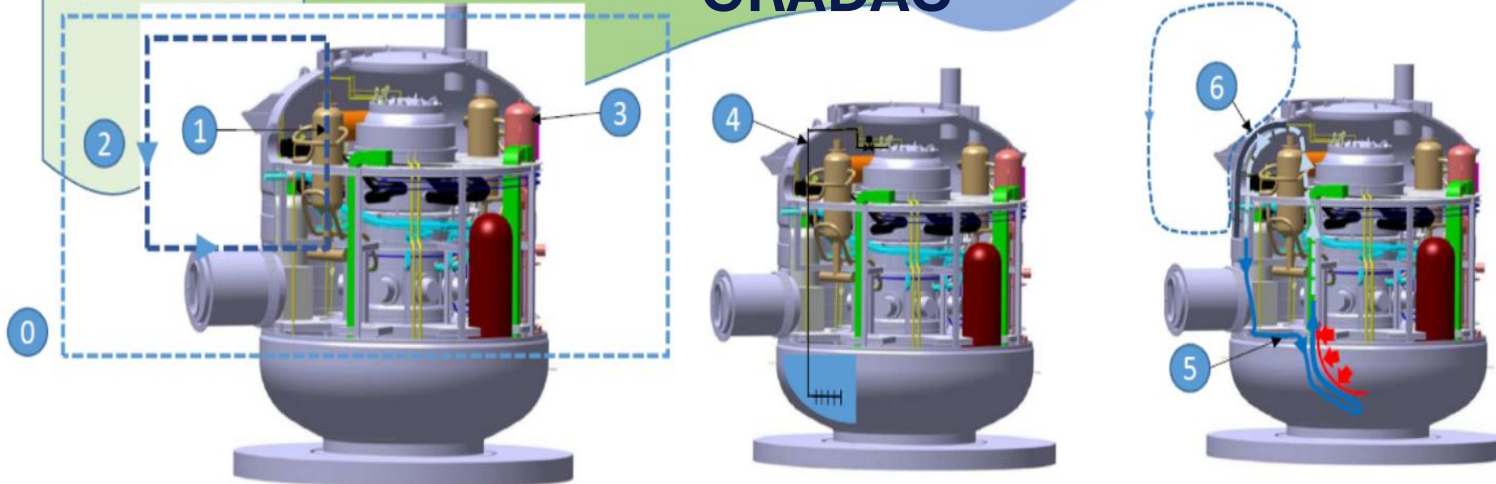
DEC A

- 4- SET Steam Injection in Pool ✓ 1ary circuit depressurization phase and containment pressure control

DEC-B

- 5- SET Ex-Vessel Cooling demonstration in IVR mode ✓ Hydraulic cooling channel optimization and two phase passive loop validation
- 6- SET Containment cooling ✓ HTC validation in high Ra conditions

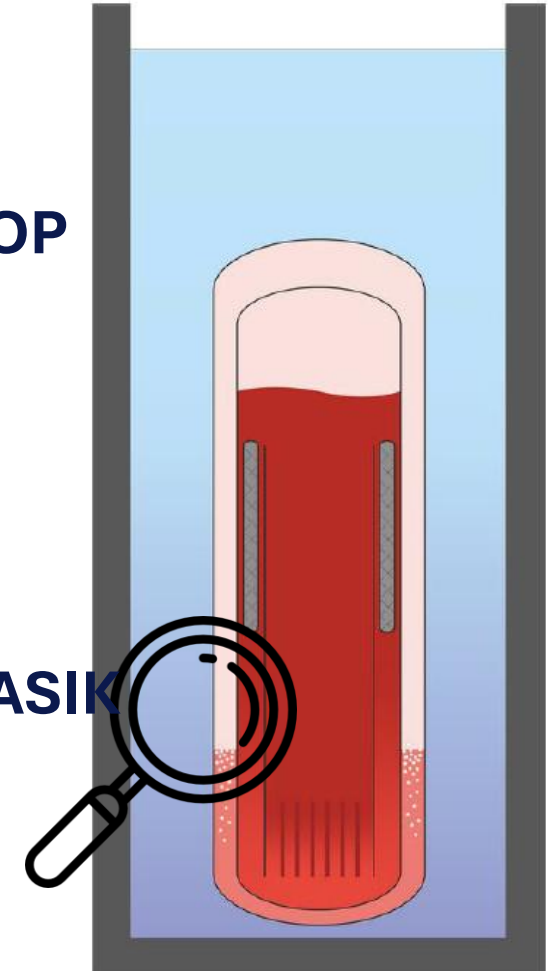
GRADAC



Nuward v1

IVR LOOP
PANDA

FHEASIK



LDR50

Safety Condenser component studies

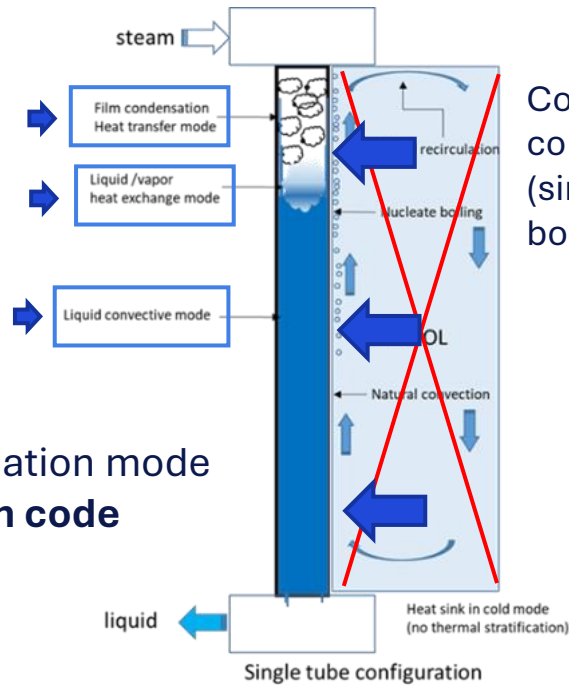
Inner Condensation in vertical tube

PERSEO
ELSMOR
PASTELS

HTC validation still remain due to previous semi or integral test inducing error combination in both inner and outer heat transfer coefficients, and the different condensation regime (film, liquid/steam inter phase, sub cooling)

COSAC

FRA GmbH

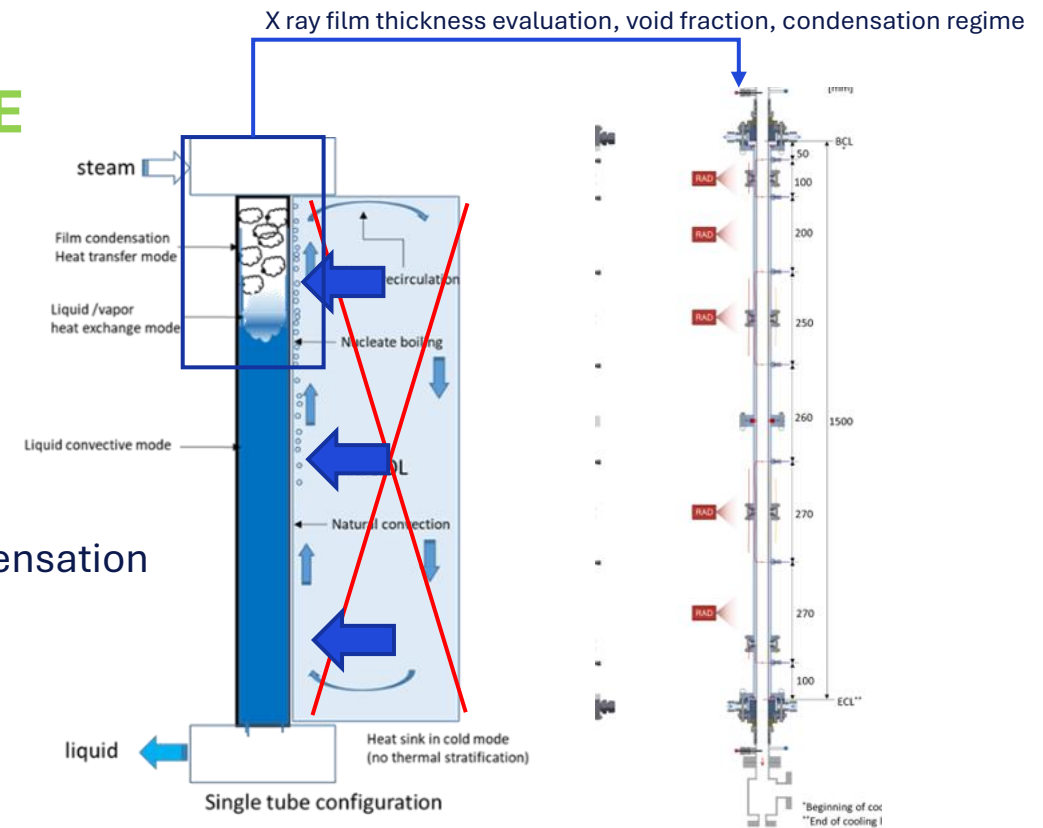


SET
HTCs condensation mode
For TH system code

PRECISE

ETHz

SET
HTCs film condensation
For CFD code



Safety Condenser loop studies

Characterization of pressure drops and heat transfer performance in a SACO loop

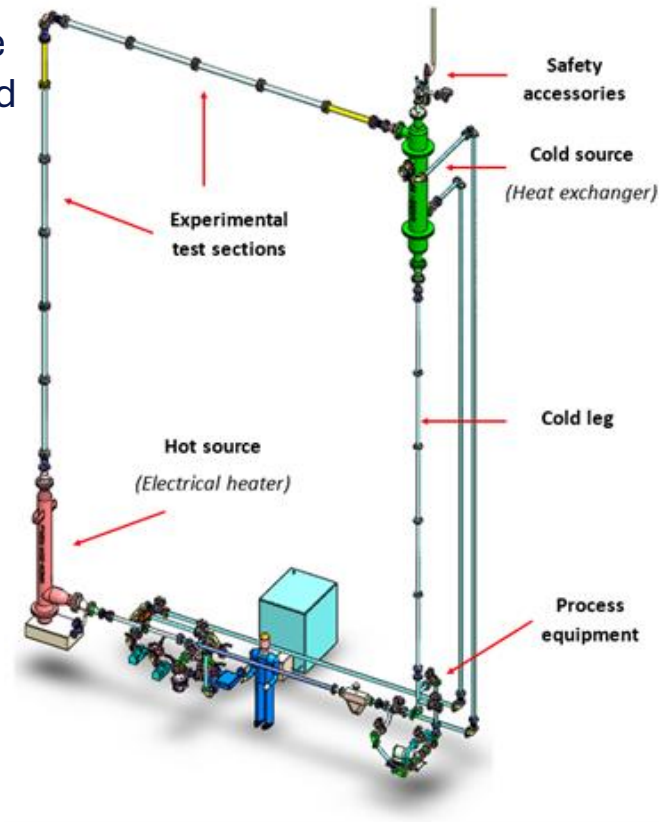
Characterization of condensation regime in a compact plate heat exchanger (thermo siphon mode in LOCA situation)

ALCINA

ASNR

SET SACO Loop

- Regular and singular pressure drops effects on nat.circulation performance
- Heat flux characterization from hot and cold source

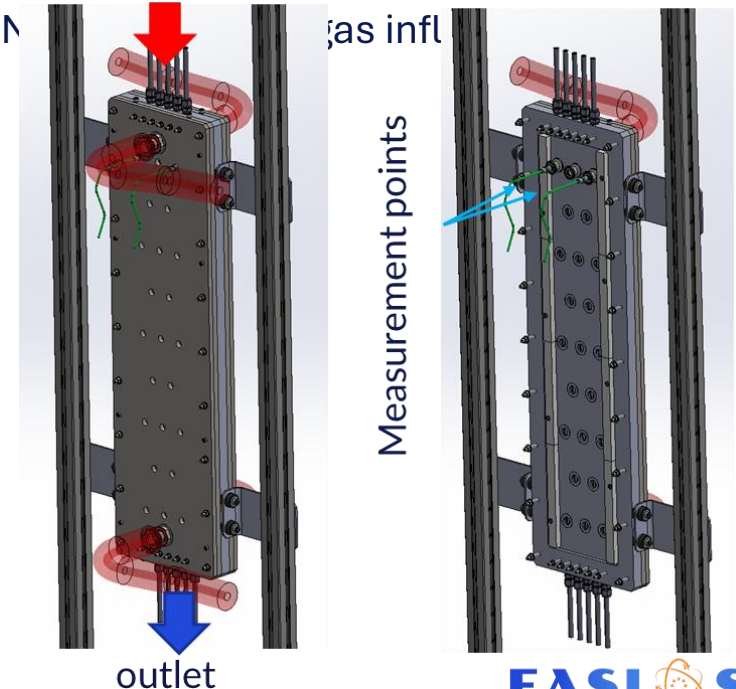


ECRINS

CEA

SET Compact HX condensation mode

- Specificity of condensation in millimetric channels (compact plate HX)
- N



Safety Injection System component studies

Safety Passive Injection Systems:

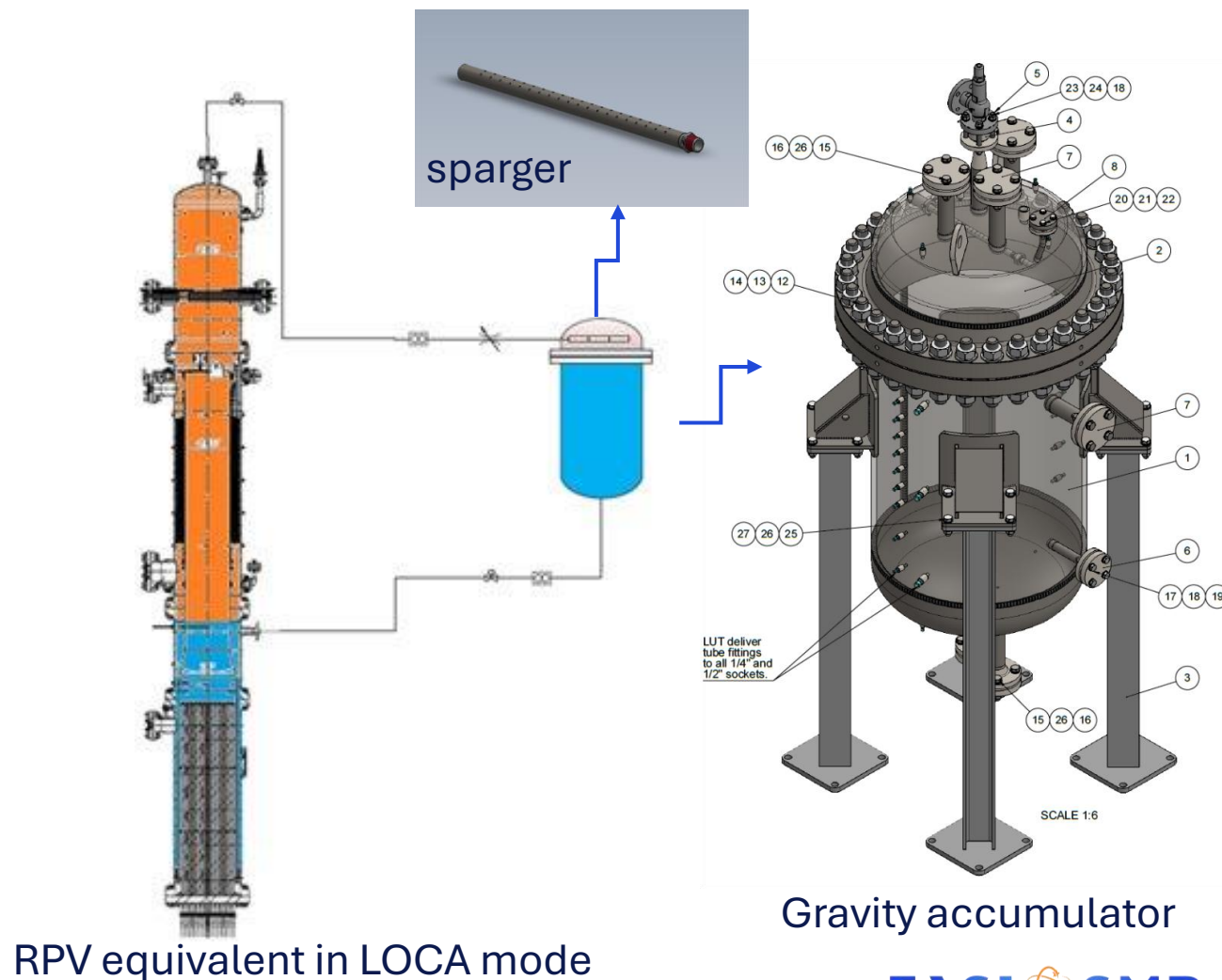
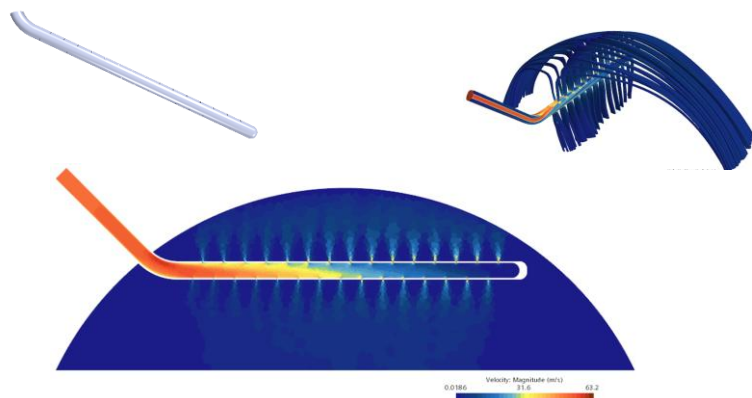
Core Makeup Tank (P_{PCS}), Accumulators (P_{N_2}), Gravity tank (P_{atm}), **Gravity Accumulator** ($P_{atm} \rightarrow P_{PCS}$)

GRADAC

LUT

SET Gravity accumulator

- Pressurization phase study with steam/liquid and steam/wall condensation effects
- Gravity injection performance and steam condensation perturbation impact



Containment Cooling Safety System studies

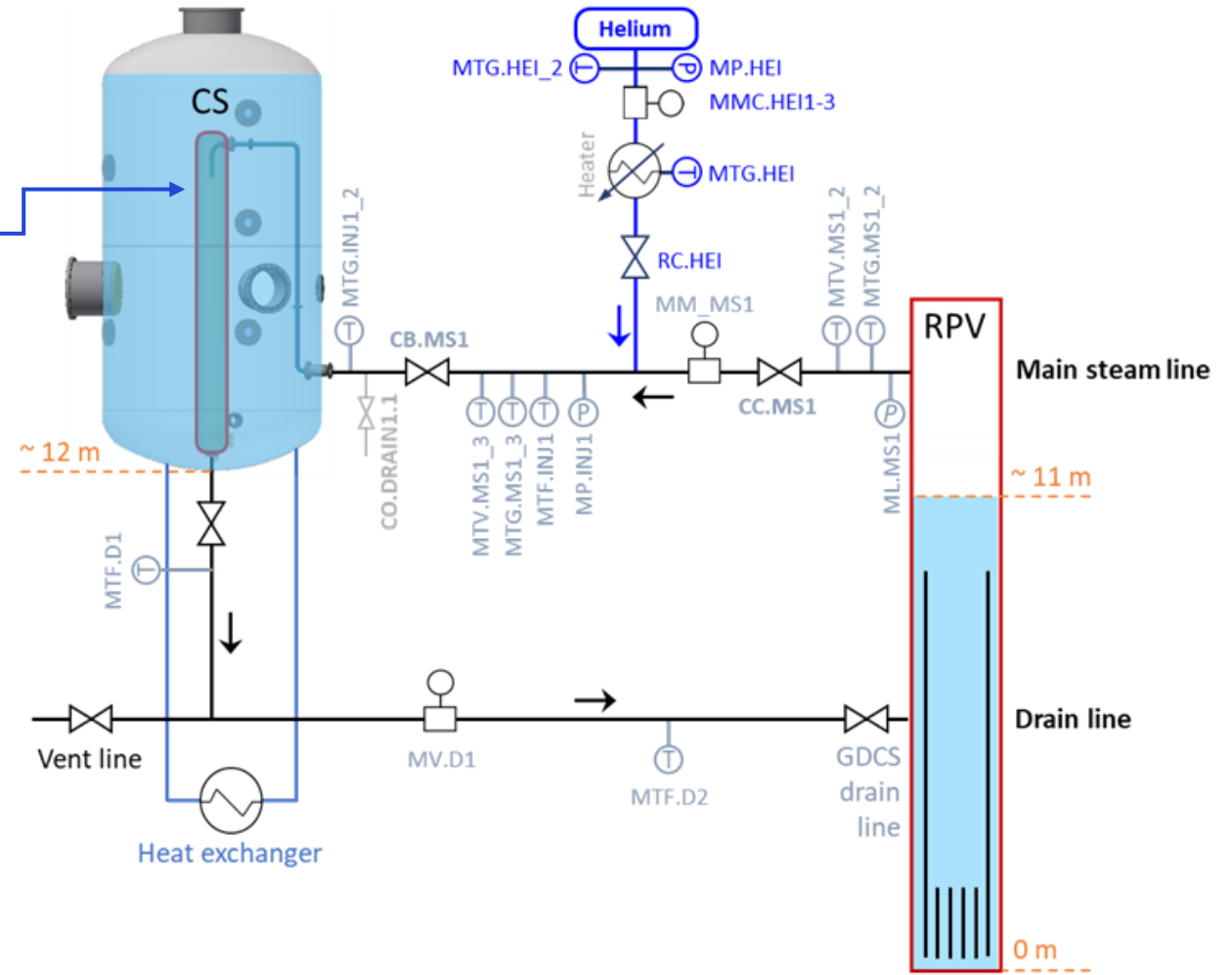
Passive containment cooling in a pool

PANDA

PSI

SET HTC natural circulation in High Reynolds
Nusselt mode

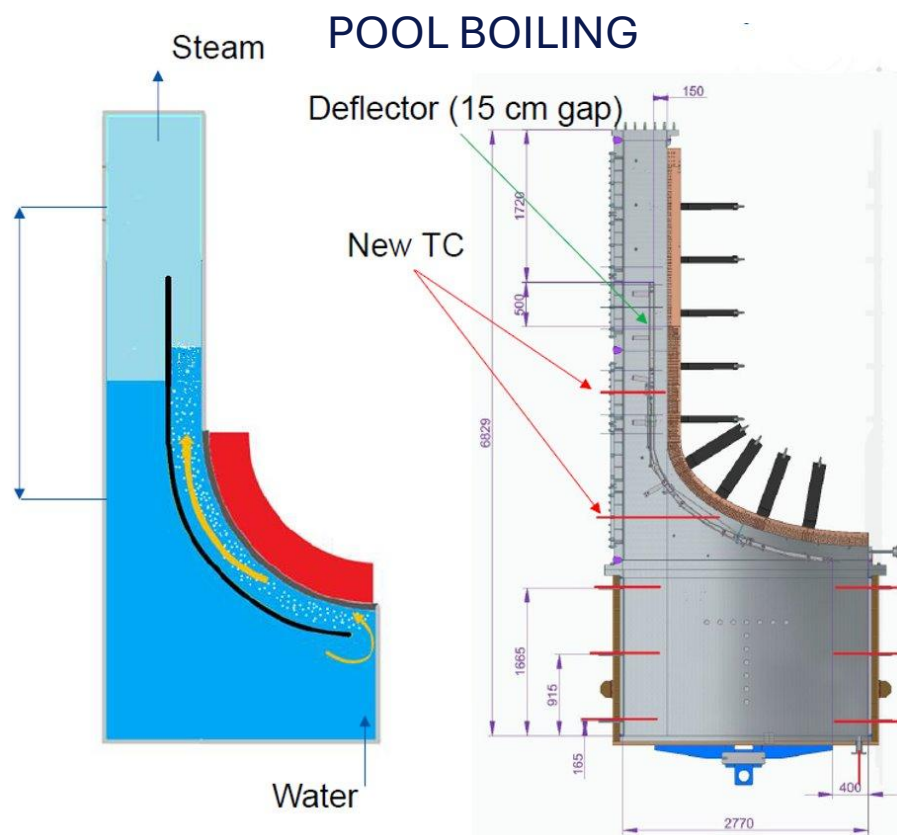
Support for both system code and CFD model,
under various stratified pool conditions



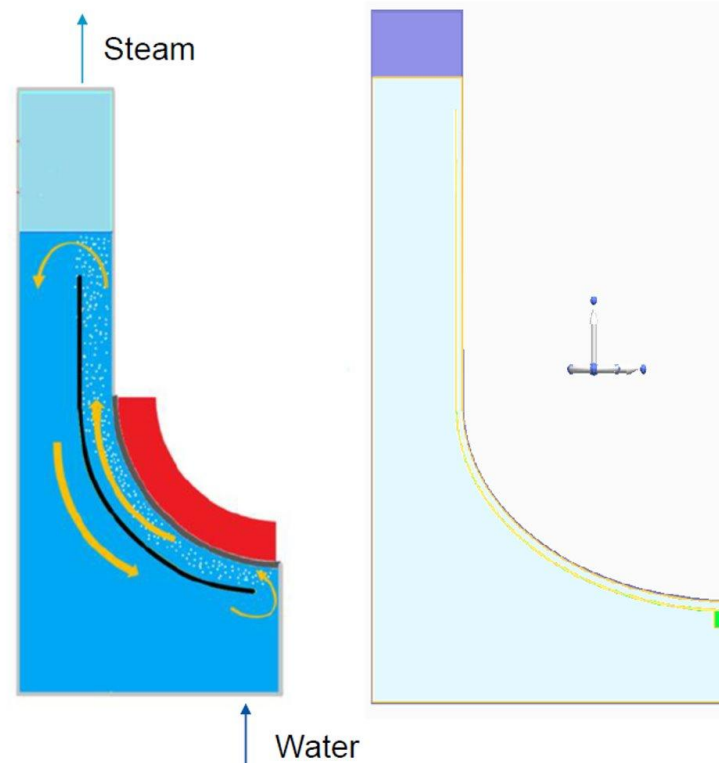
In Vessel Retention demonstration studies

Qualification of Ex Vessel Reactor Cooling performance in : **IVR LOOP**
UJV

- SET Pool boiling mode : **CHF limits** according to Heat Flux profile and reactor bottom vessel shape
- SET (liquid) Thermo siphon mode : Characterization of **natural circulation performance** according to the hydraulic heated channel



THERMO SIPHON



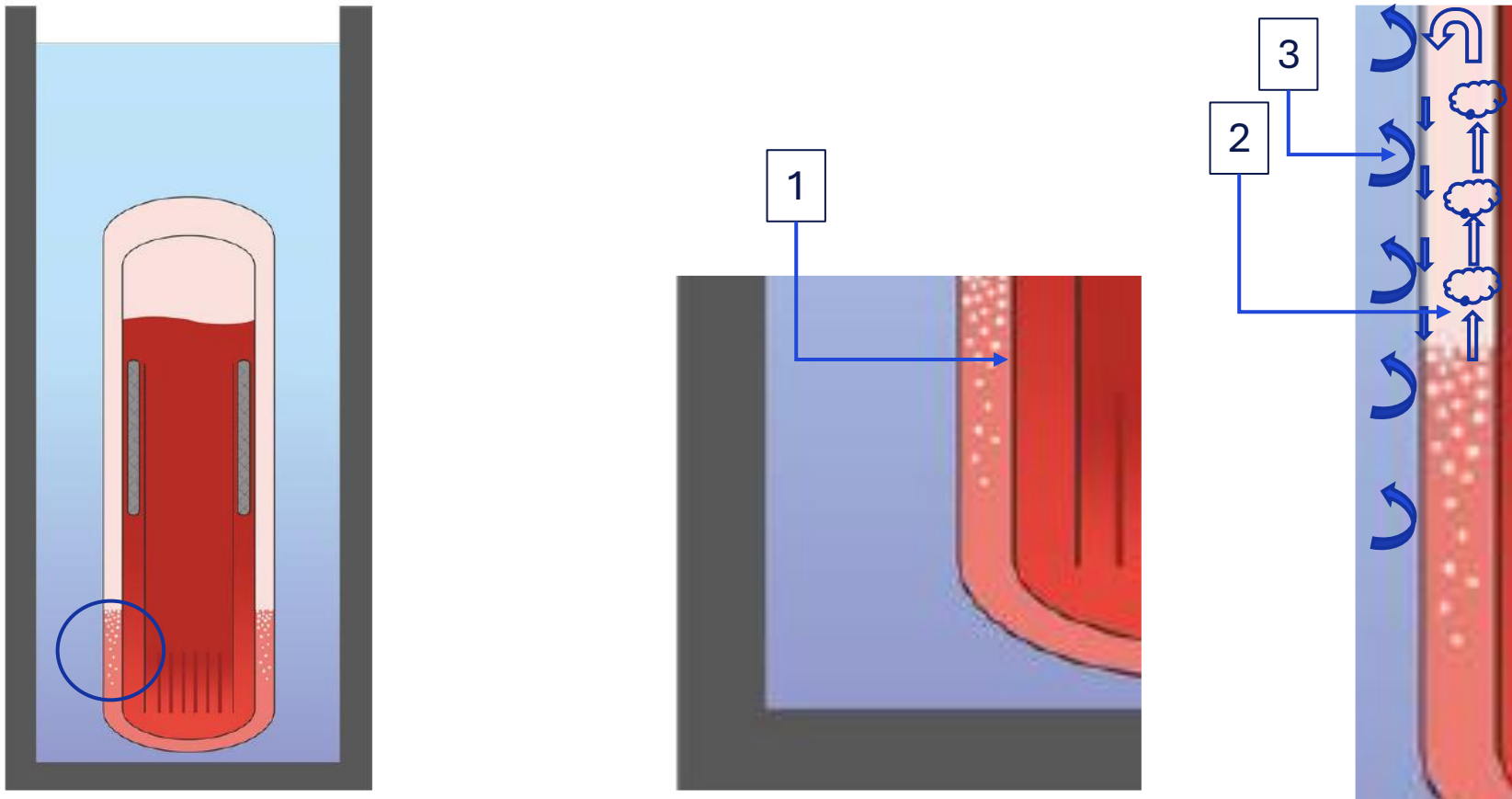
Passive DHR strategy for LDR 50

FHEASIK

LUT

Qualification of heat power transfer chain in passive DHR strategy (semi IET):

- 1- Ex Vessel Reactor cooling mode for RPV (boiling mode) ➔ *Connection with IVR LOOP (pool boiling)*
- 2- Heat Pipe or caloduc recirculation in annular gap ➔ « small » *Connection with IVR LOOP (thermo siphon)*
- 3- Containment cooling in stratified pool ➔ *Connection with PANDA*



Partners



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Thank you

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