NUMERICAL ANALYSES OF THE CIRCE-THETIS FACILITY BY MEAN OF STH AND CFD CODES

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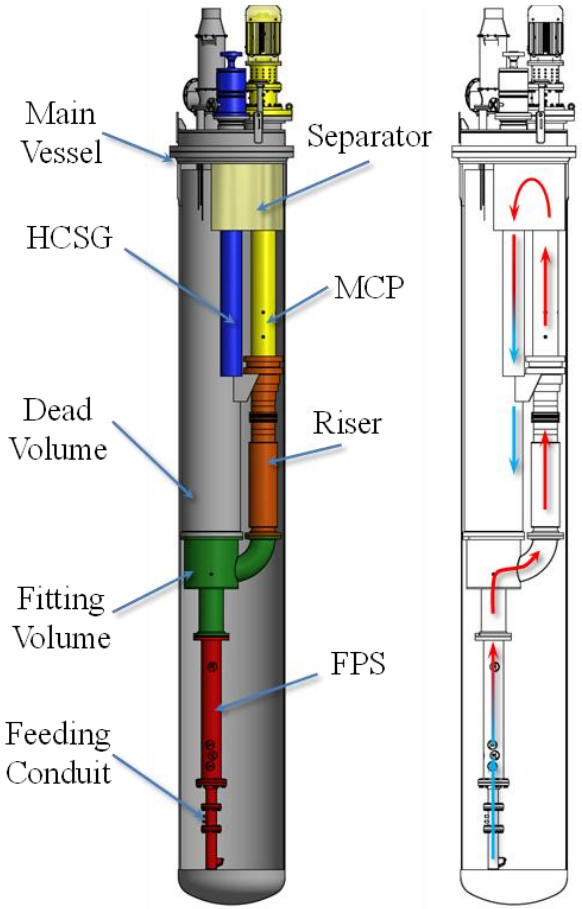


CIRCE-THETIS will be an **integral facility** aiming to investigate behaviour of **LBE cooled reactors** and give valuable experimental data for the code validation. Will be built **updating** the previous facility **CIRCE-HERO.**

The facility is composed by a stainless steel vessel which host the primary loop. The LBE flows inside the **primary loop**, it is heated in the **FPS**, it reaches the **separator** and flows inside the **HCSG** where it is cooled by pressurized water flowing in the secondary loop.

In this work, **preliminary analyses** of the pool are focused manly on **thermal stratification** of the LBE for the reference steady state and for a postulated transient.

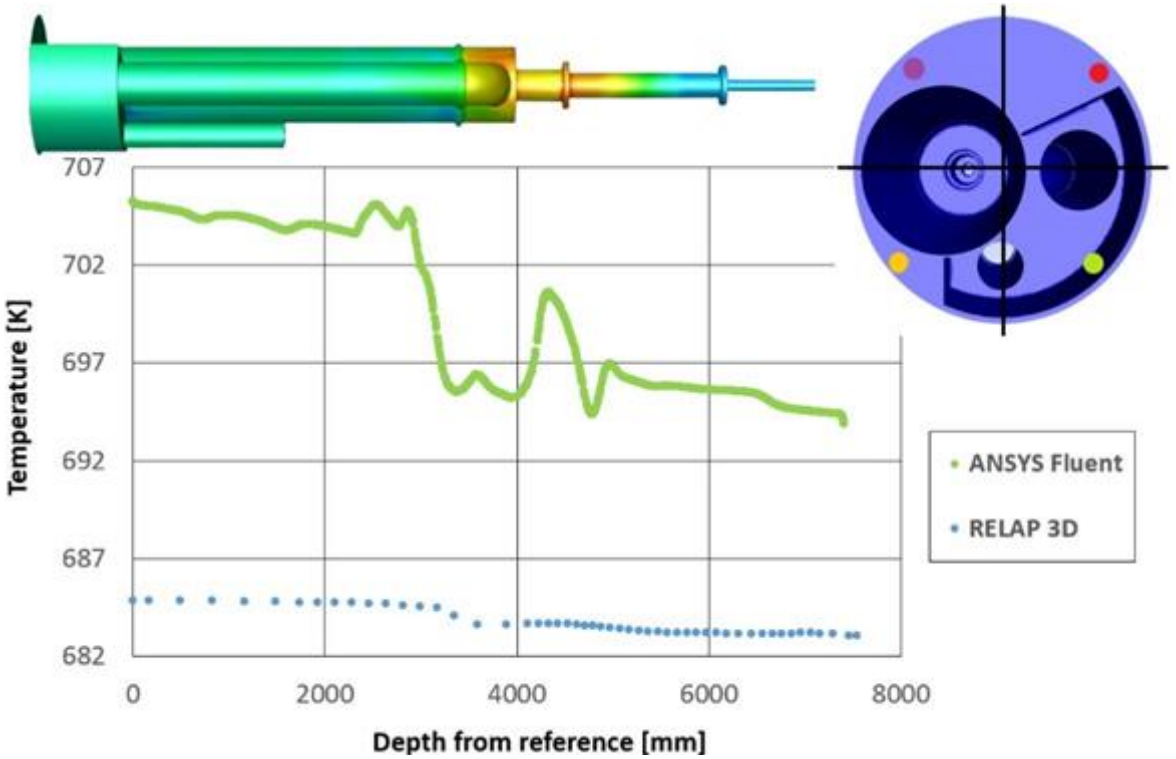
Reference case	unit	Value
T_{pool}	°C	400
FPS power	kW	450
$mflow_{LBE}$	kg/s	35.17
$mflow_{water}$	kg/s	0.26
Pressure H_2O	bar	180
T_{h2o}	°C	335

Transient	Time starts	Time end	Final value
Scram	0 s	240 s	5%*
Feed water reduction	0 s	3 s	10%
MCP reduction	1 s	11 s	0%
*The reduction follows a postulated decay heat curve			

Method

Both **STH** (RELAP5-3D) and **CFD** (ANSYS Fluent) approaches were used in this work.

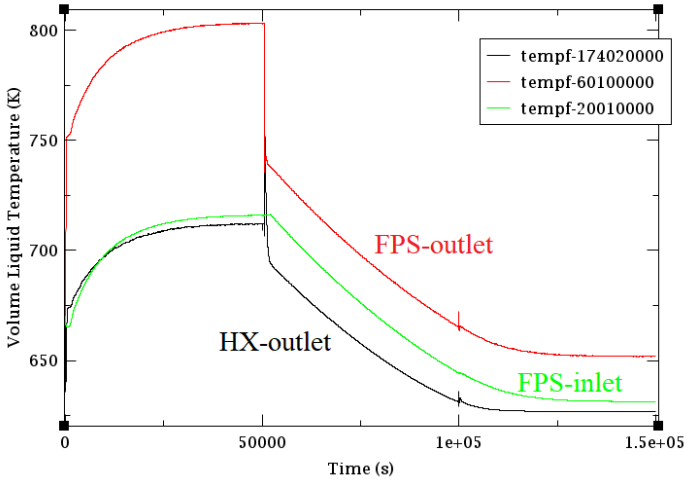
The developed models were checked simulating the previous CIRCE-HERO configuration and comparing the results with experimental data, and subsequently adopted for the present case.

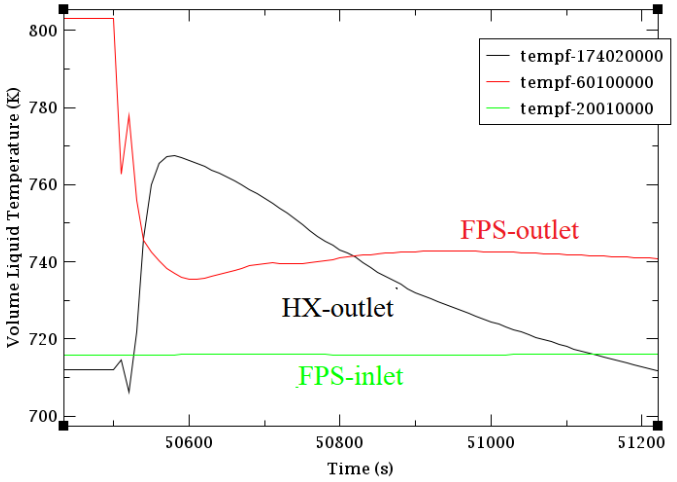


Results

The obtained results show a **mild thermal stratification** along the vertical axis of the pool. According to CFD The temperature raise is about 15°C from the bottom to the top pool while for the STH code the raise is less than 5°C.

The postulated **transient** shows a **temperature peak**, about 50°C, **at the HCSG-outlet**, due to a delay in time between feedwater reduction and the "cold" wave of LBE coming from the FPS.

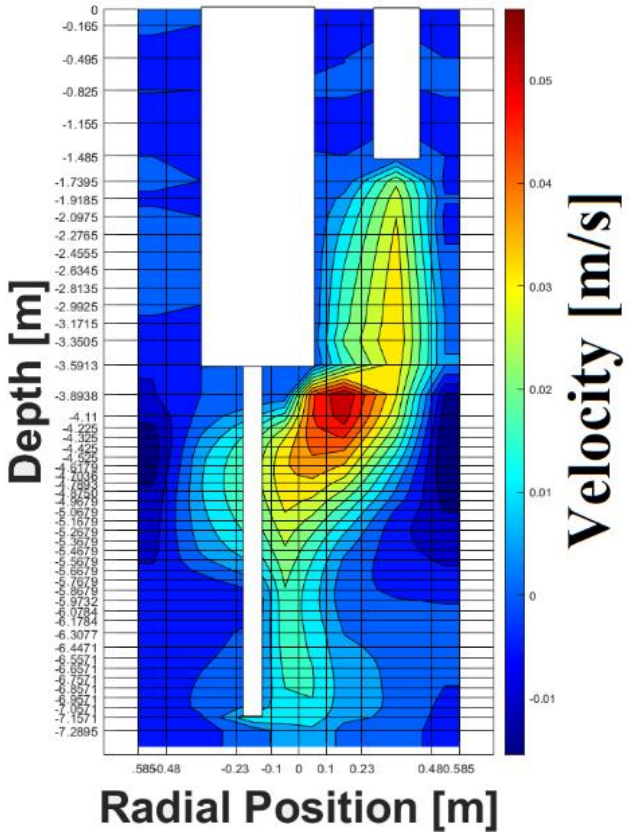


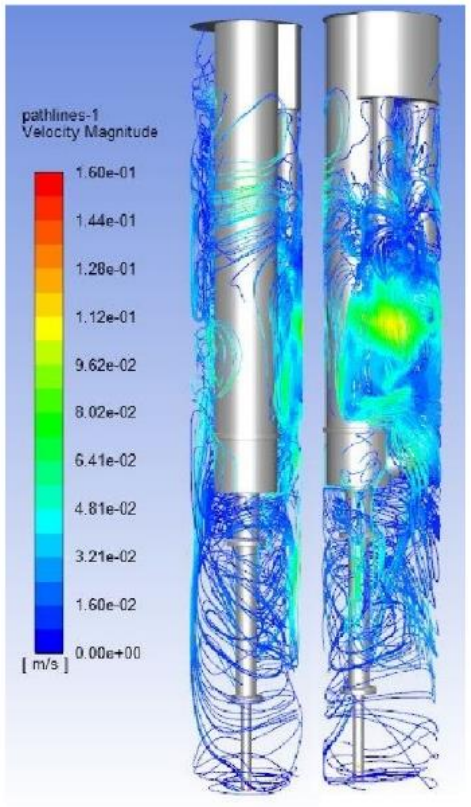


Conclusion & Future work

As final remarks it can be noted that the **high** elevation of the SG **outlet** enhances the LBE mixing **lowering thermal stratification**.

Large **heat losses from the FV** were estimated: in accordance with the experimentalists, the **facility will be updated** considering a **better insulation** of the FV region.





The predicted velocity fields suggest that **STH** approach is **not able** to manage any kind of **turbulence**, and this bring to a different pool temperature distributions with respect to CFD.

The **entire transient** was simulated only **with a STH** approach, while only the **final steady** state is simulated adopting **CFD**.

For the **future**, a more **detailed model** will be developed for the **CFD**, reducing the number of boundary conditions imposed by the user.

In addition, the **whole transient** will be simulated with **coupled calculations**, providing a better representation of the physics and of the involved phenomena.