WPSA Code Management Area Progress Meeting

François Bonne
Mercedes Parody Guzmán
Louis Zani

Summary of the work

Task 2024 consist of the thermal-hydraulic modeling of loop2 SC+CRYO

- Bath modeling (input temperature of loop 2)
- Loop 2 modeling (+ reminder of loop 1)

Deliverables of the task:

Deliverable	Description
SA-SE.CM.OP.06-T003 - D001	Model the loop 2 of JT-60SA from the thermal-hydraulics point of view with simcryogenics in the same spirit than the loop 1 was. The goal of this modelling is to provide predictions of the behavior of the loop for operation. If some heat loads and experimental data are provided, comparison between experiment and simulation could be provided

Allocated resources:

ID	Title	Start Date	End Date	RU	Del. Owner	AWP2024 PM 50% standard
SA-SE.CM.OP.06-T003 - D001	Simcryogenics model development for JT-60SA operation	01-Jan-24	31-Dec-24	CEA	Francois Bonne	4.000
					TOTAL:	4.000

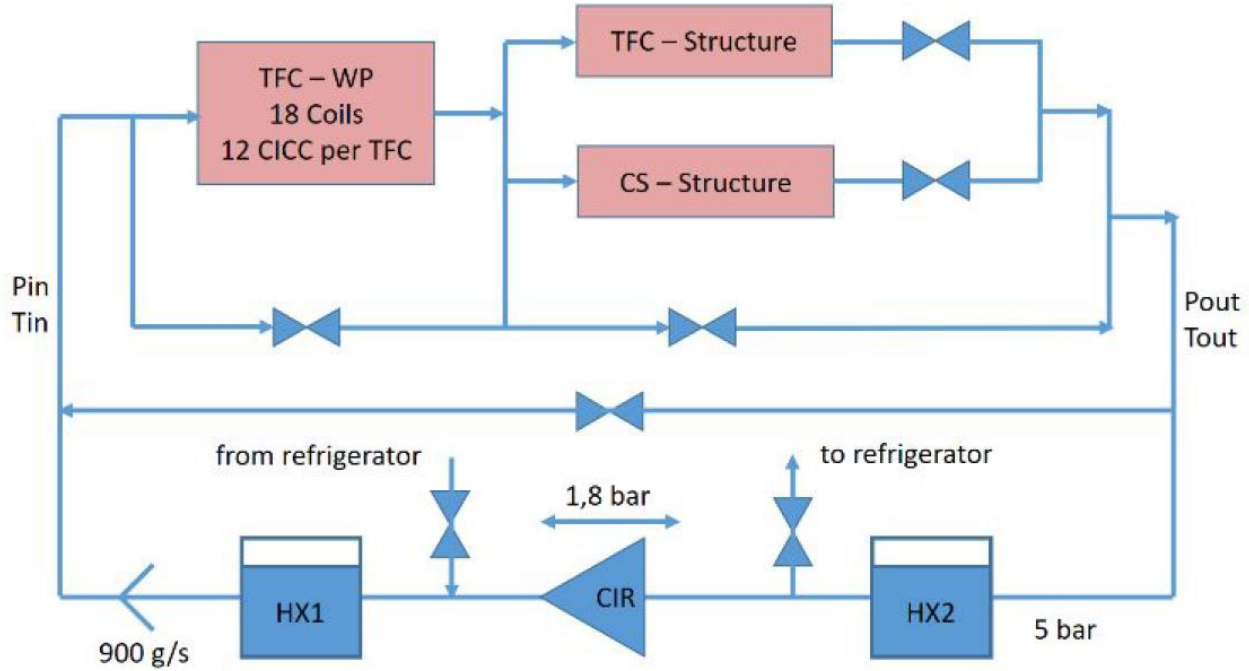
Reminder – cryo magnetism JT60

Magnets are feed with 4,5 K supercritical helium through 2 loops

- Loop 1 is dedicated to the TF and the structures
- Loop 2 is dedicated to the CS and the EF

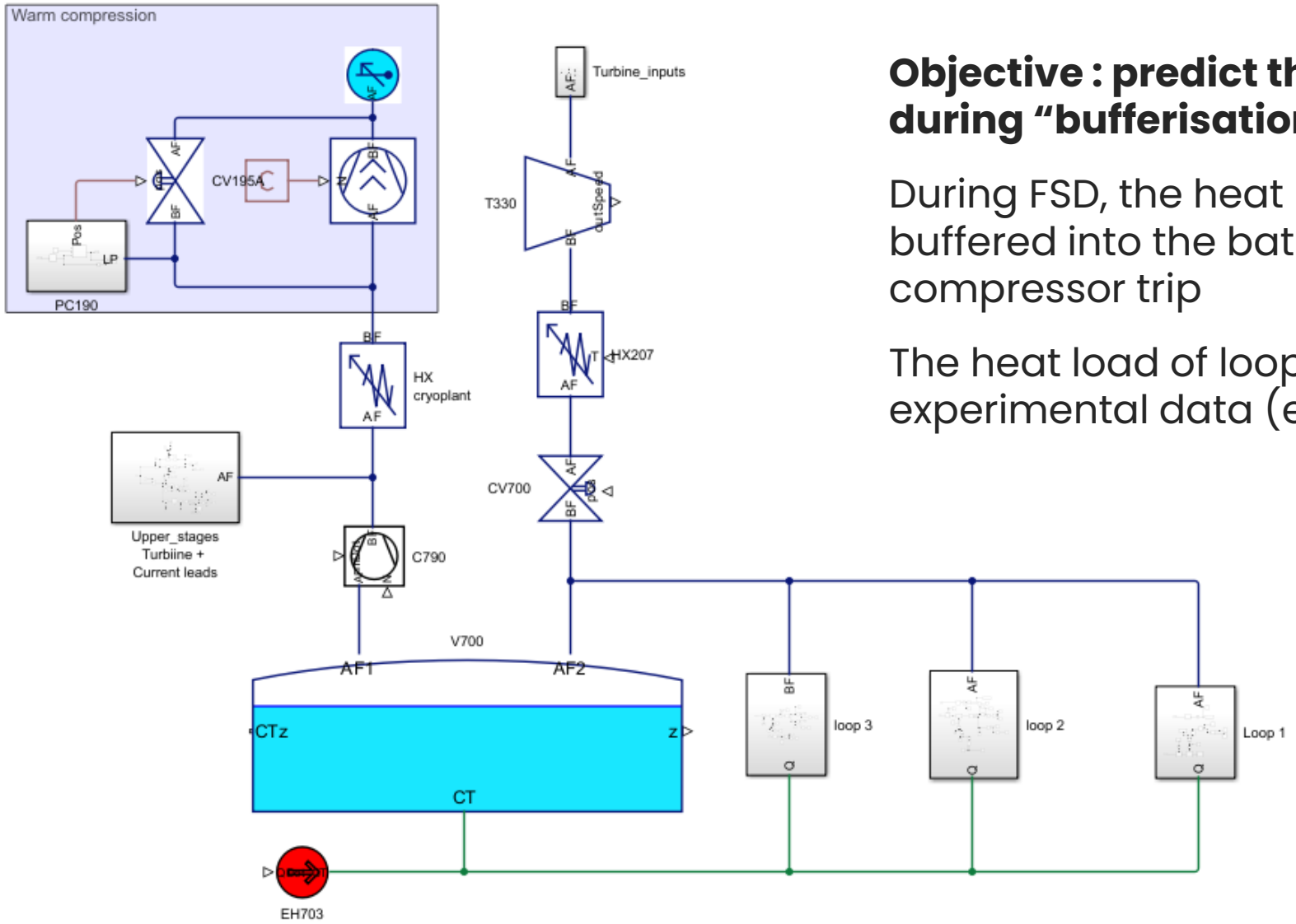
Helium flow is ensured by cold circulators generating ~ 1kg/s flow each to be shared by the magnets

Het is remove via heat exchangers plunged into a liquid helium bath



The goal of this work is to model cryo + magnets from the thermal hydraulic point of view

Model of the thermal dumper BATH V700



Objective : predict the pressure rise of the bath during "bufferisation"

During FSD, the heat load is high and must be buffered into the bath to avoid the warm compressor trip

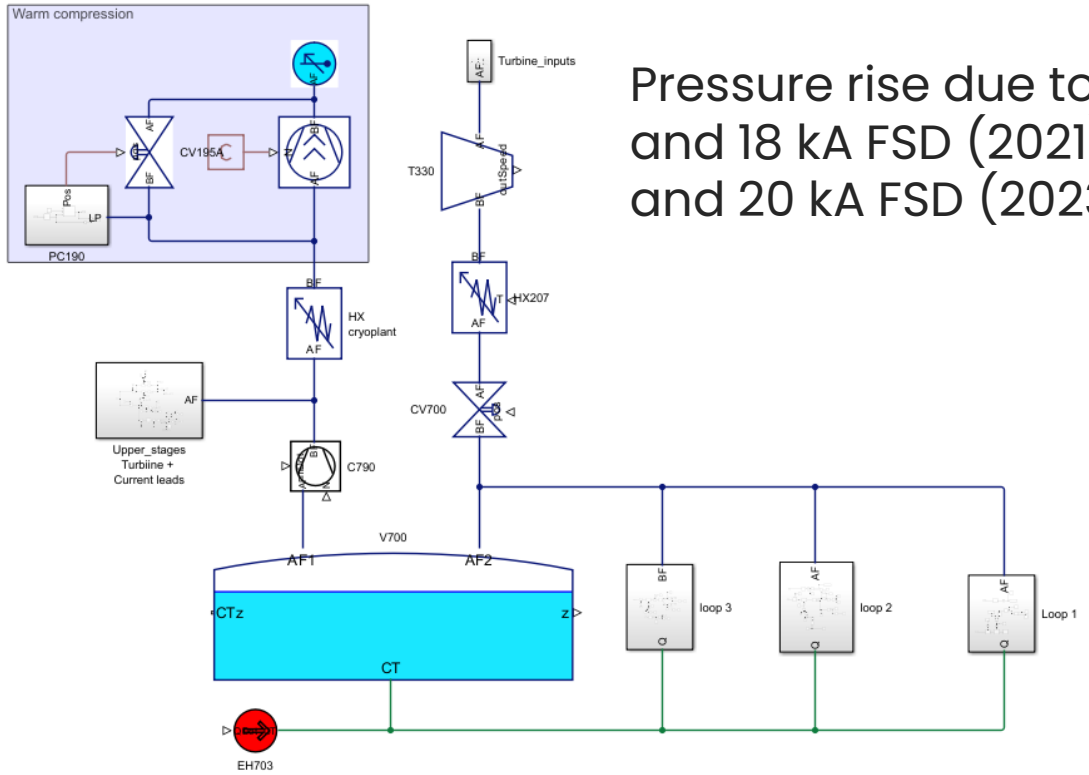
The heat load of loop 1, 2 & 3 is imposed with experimental data (enthalpy balance)

Model of the thermal dumper BATH V700

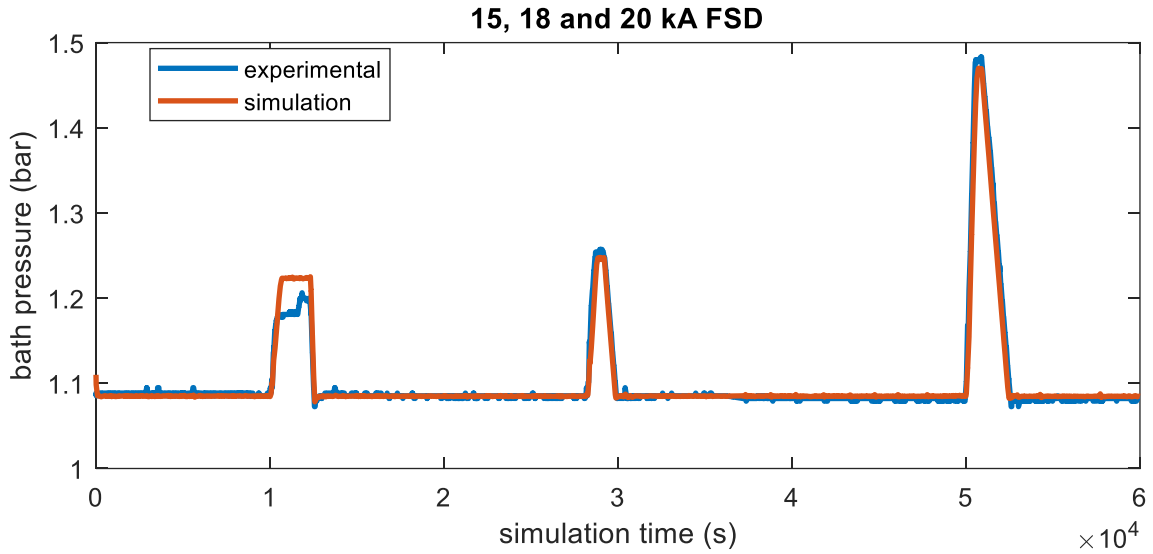
Objective : predict the pressure rise of the bath during "bufferisation"

During FSD, the heat load is high and must be buffered into the bath to avoid the warm compressor trip

The heat load of loop 1, 2 & 3 is imposed with experimental data (enthalpy balance)



Pressure rise due to 15 and 18 kA FSD (2021) and 20 kA FSD (2023)



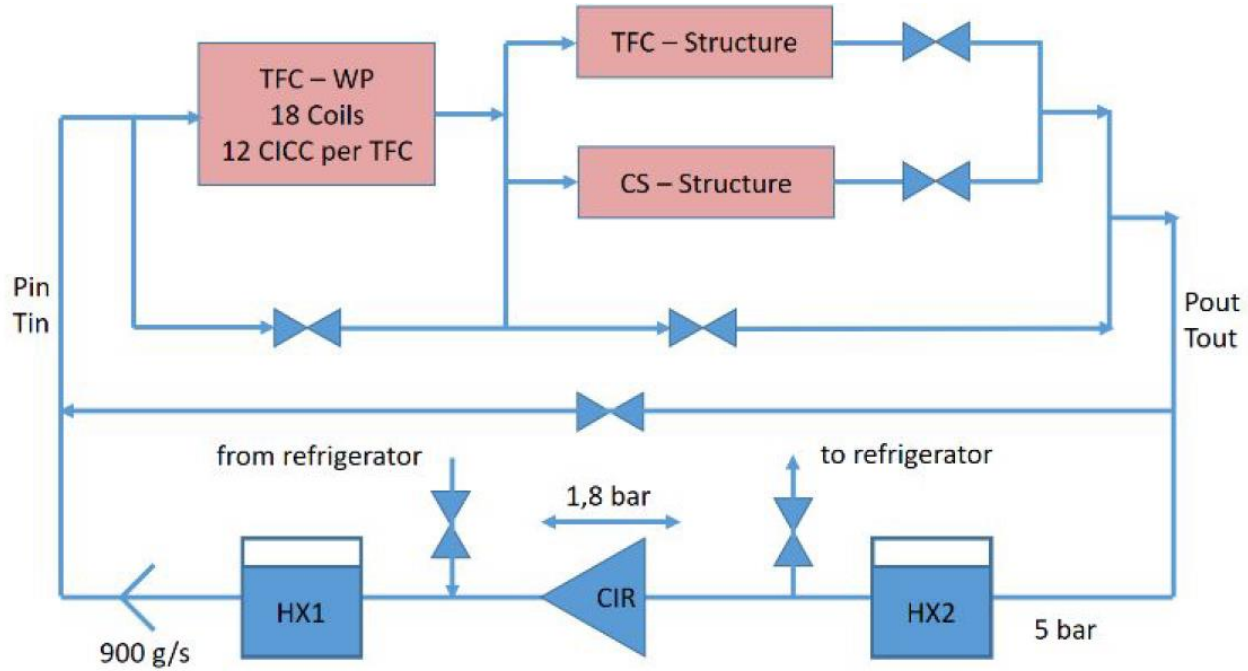
Pressure rise in the bath due to FSD is reproduced using the load recorded during experiments.

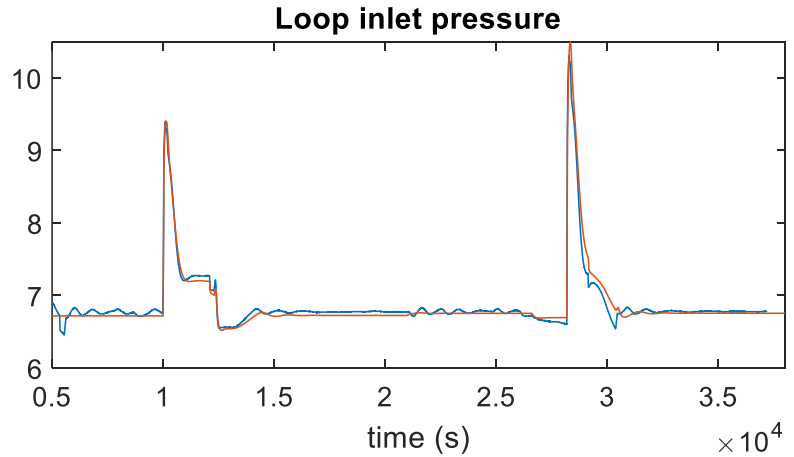
Next step is to use prediction of the het load using loop models to predict the 25,7 kA FSD

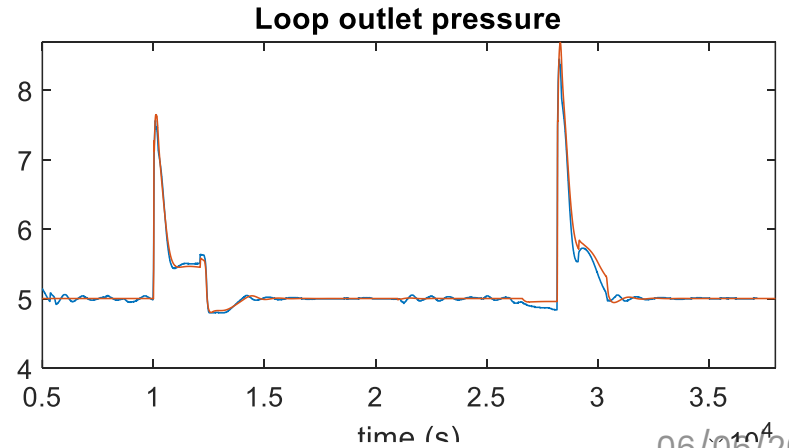
Model of loop 1

Model of loop 1 has been done in 2023

It has been used to predict the loop behaviour during the integrated commissioning







Published at MT28

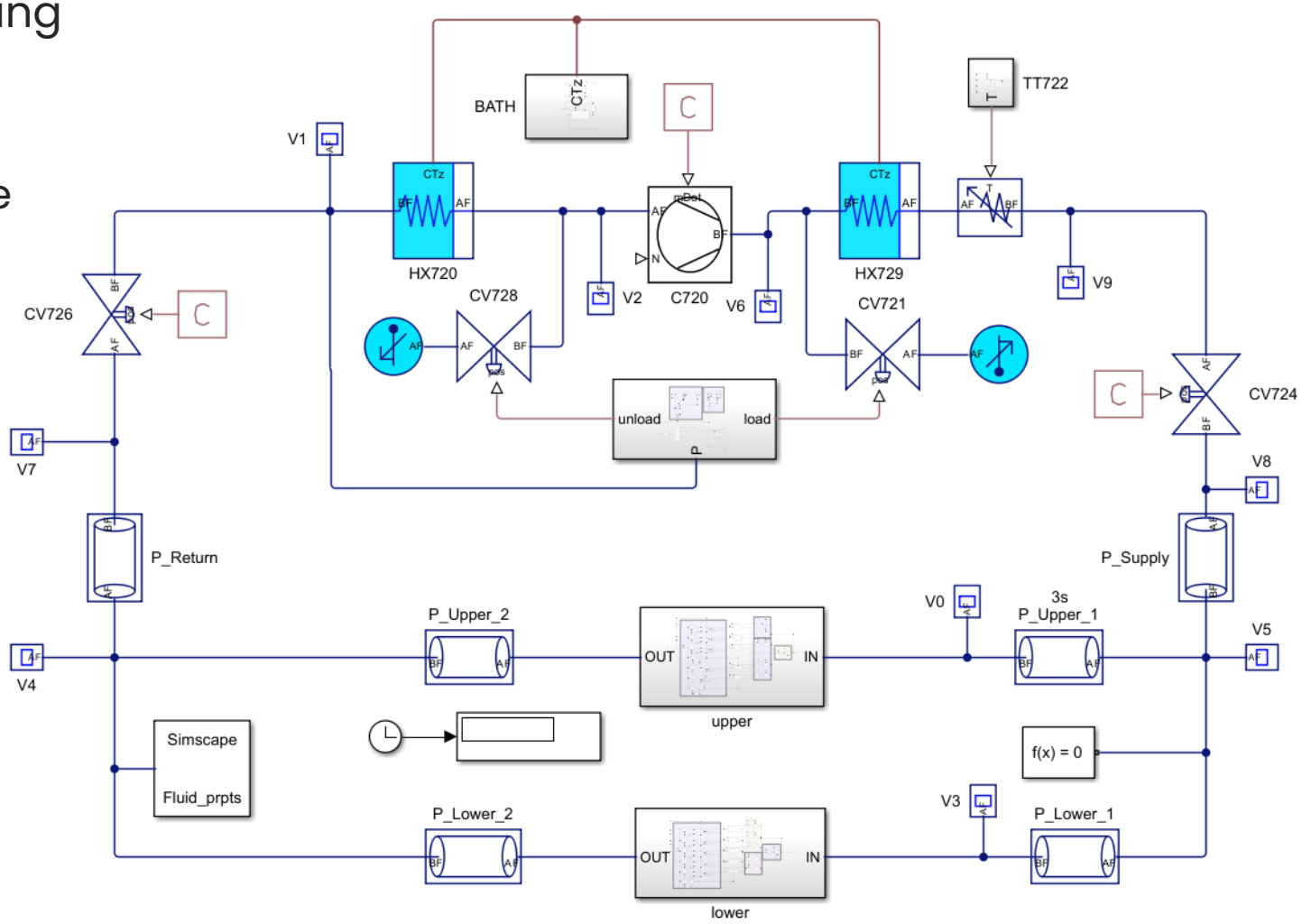
Model of loop 2

Model development of loop 2 is ongoing

Model consist of the circulator feeding the magnets with supercritical helium

Details of cryogenic circuit next slide

To be published at ICEC 2024

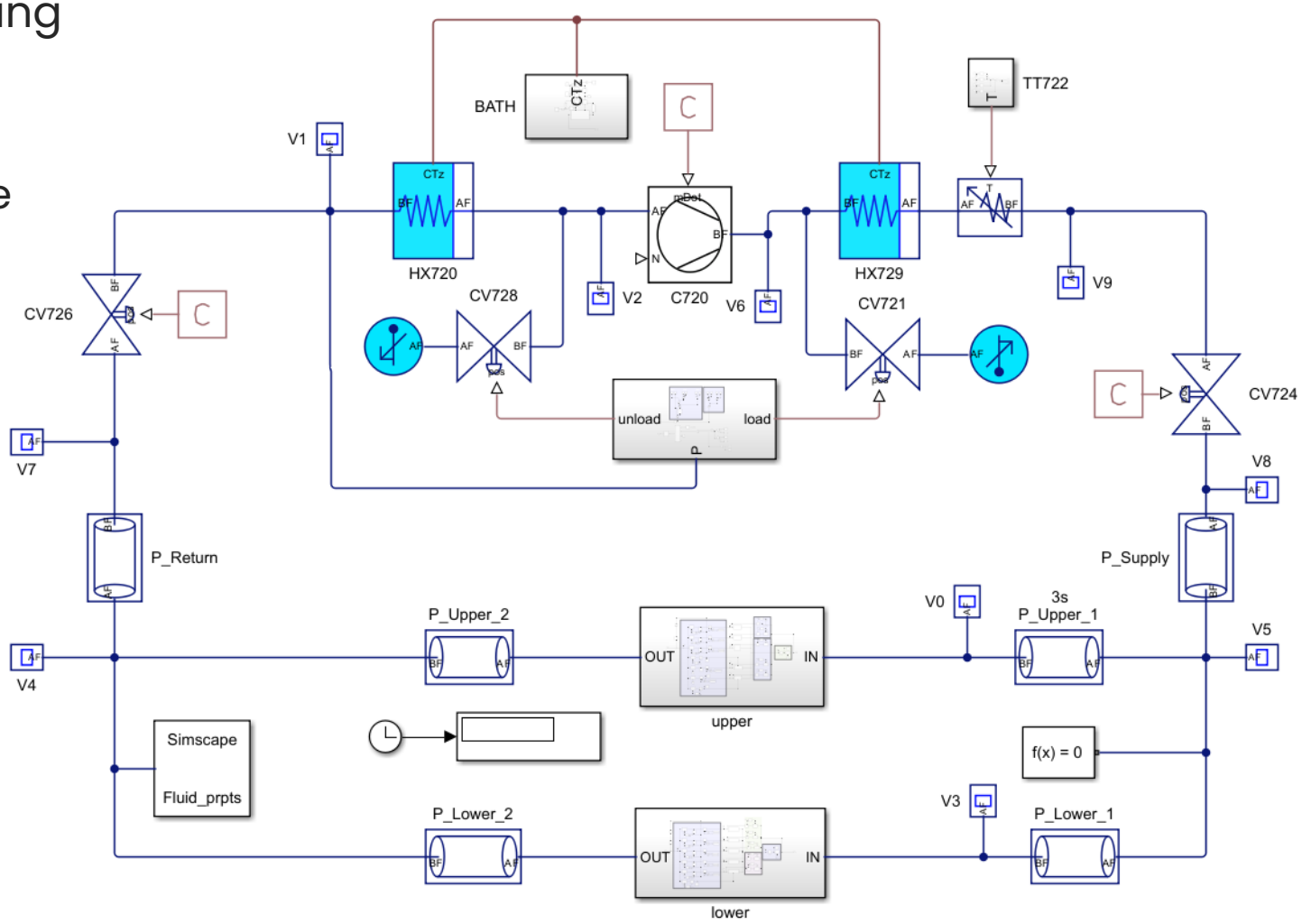


Model of loop 2

Model development of loop 2 is ongoing

Model consist of the circulator feeding the magnets with supercritical helium

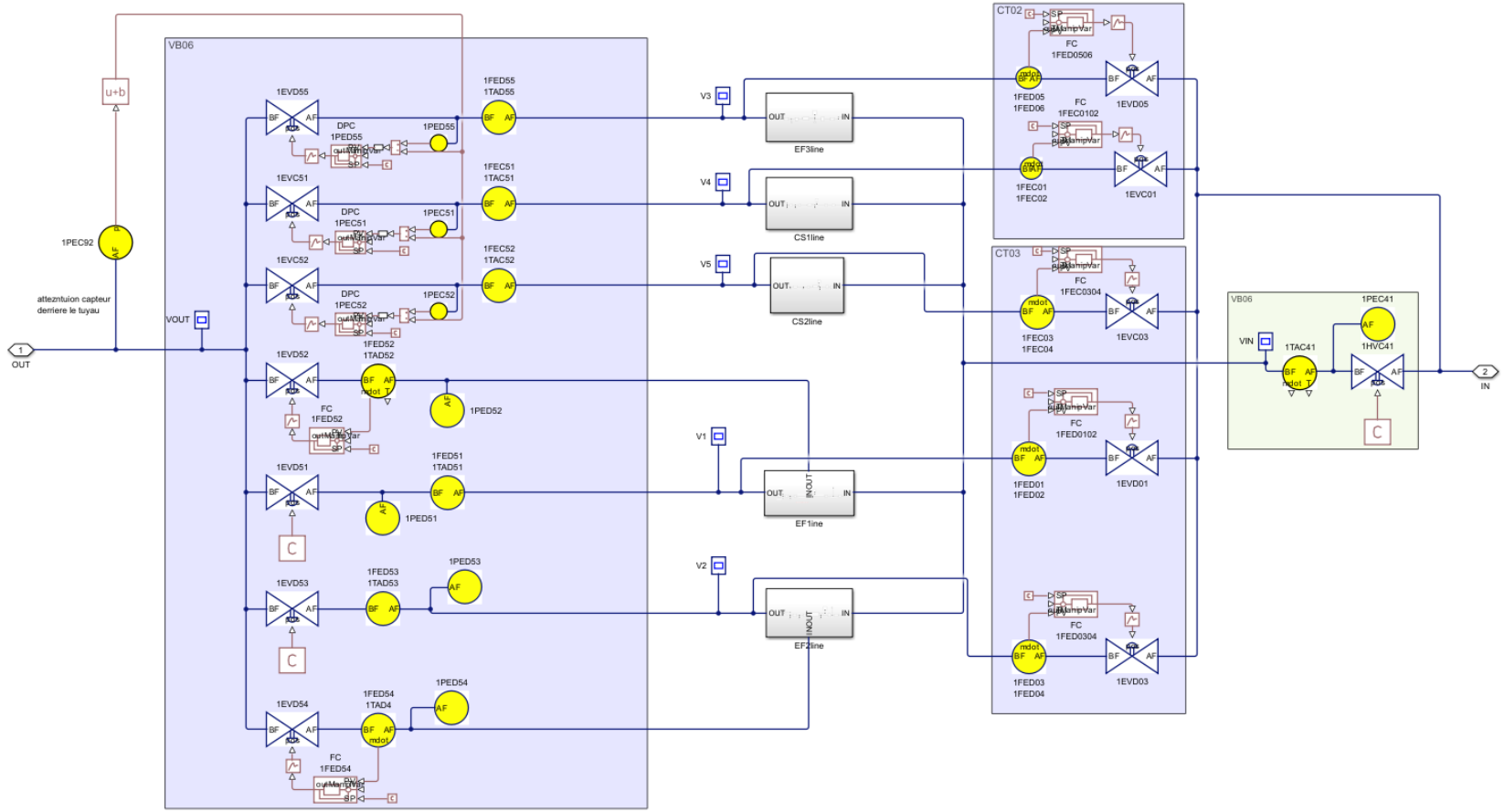
Details of cryogenic circuit next slide



Model of loop 2

Upper part (same for lower part)

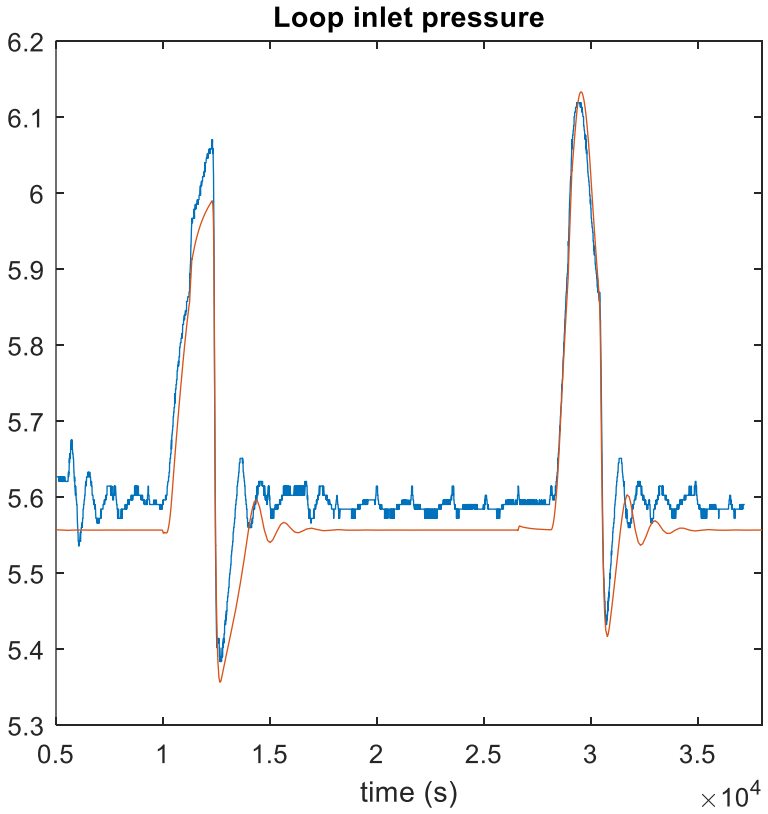
Valves, 1D pipes and CICCs has been used to model the loop 2

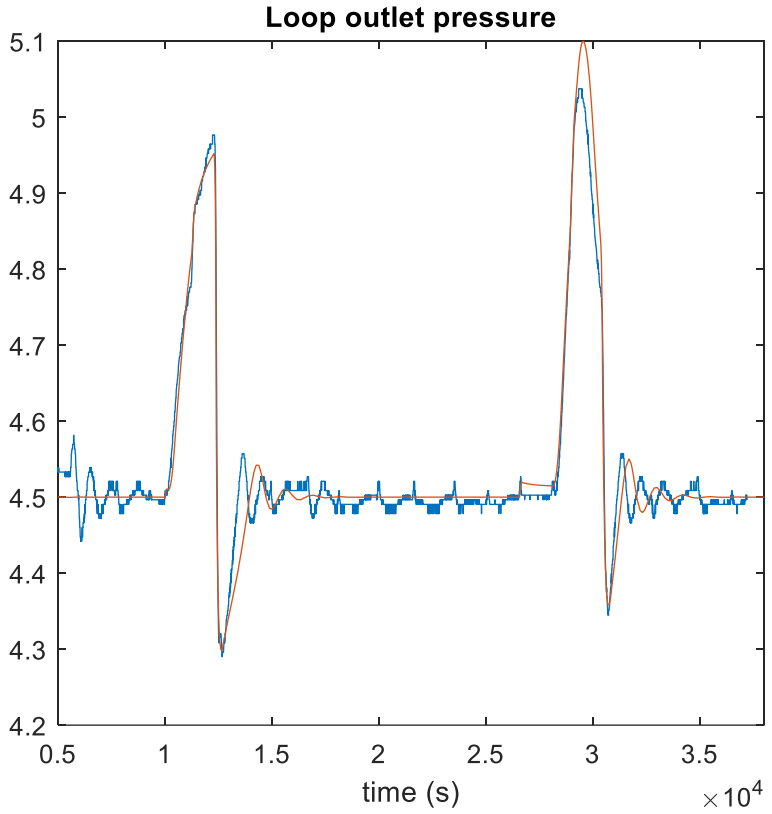


Model of loop 2

First result : the pressure rise induced by the FSD of loop 1

red simulation; blue experimental





Conlusion

Thermal hydraulic model is available for loop 1, loop 2 and the bath

Prediction can be made with it, separately

As been used during the 2023 integrated commissioning to predict the pressure rise during FSD

Perspectives

Validate the model of loop 2 against more experimental data

Gather the models into one to make it a global circulator