

# Session IV : Thermo-hydraulics and Cryogenics (1/6)

- 3 presentation about the modeling of thermo-hydraulics of large machine in Fusion domain, JT60, ITER and DEMO
- 1 presentation about the modeling of the dynamic and thermal behavior of tube pulsating heat pipe
- **Adaptation of the nuclear safety code CATHARE3 to supercritical helium flow.**  
*Sulayman Shoala*
- **Simulation of a cryogenic capillary tube: thermodynamic behavior subjected to heat load**  
*Maria Barba*
- **An update of dynamic thermal-hydraulic simulations of the JT-60SA Cryogenic system for preparing plasma operation**  
*François Bonne*
- **Parametric study and optimization of the cryo-magnetic system for EU DEMO at the pre-conceptual design phase**  
*Christine Hoa*

## Session IV : Thermo-hydraulics and Cryogenics (2/6)

- First presentation, given by Sulayman Shoala, concerned the adaptation of the nuclear safety code CATHARE3 to the problematic of thermo-hydraulics of the supercritical helium flow in CICC fusion machine
- The conclusion is that the CATHARE3 code is suited for these computations and comparison with THEA is really encouraging
- The CATHARE3 code has been used also to model cryogenic safety relieved valve. CATHARE3 shows that it can reproduce the experimental results given by the SOUPAPE experiment in Grenoble

## Session IV : Thermo-hydraulics and Cryogenics (3/6)

- The second presentation, given by Maria Barba, concerns the modeling of the dynamics and thermal behavior on a single capillary tube as part of an oscillating heat pipe with 2D Axis Fluent
- The code is still in a early stage development but it can reproduce the physics of the liquid film and droplets formation due to the Laplace instabilities and the shape on the vapor plugs
- More developments are necessary to implement additional dissipations to ensure periodic oscillations and move towards the modeling of the working conditions of an oscillation heat pipe

## Session IV : Thermo-hydraulics and Cryogenics (4/6)

- Later on François Bonne presented an update of the model based on SIMcryogenics for the simulation of the thermal-hydraulic JT-60SA cryogenics for its future operation
- Model was enriched with new data and some improvement on the distribution of heat load and inter-turn thermal coupling.
- The computations were compared to a Vicenta model
- A smoother profile for the heat load deposition on the thermal buffer was reached mainly due to the different friction factors (new data) for a mass flow rate of 3 g/s

## Session IV : Thermo-hydraulics and Cryogenics (5/6)

- The last presentation by Christine Hoad proposed a parametric study and optimization of the cooling capacity of the cryomagnetic system for DEMO where in this conceptual phase the cryogenics and magnet design are done at the same time
- Different Nb<sub>3</sub>Sn coil designs (CEA and ENEA) were studied and a benchmark is proposed with SIMcryogenics, THEA and CASTEM and a 1D analytical model
- The study shows that this parametric study is able to modify the design of the coils to improve the cryo system and save refrigeration power

## Session IV : Thermo-hydraulics and Cryogenics (6/6)

- The essential keyword of this session is : comparison
- One can see the strong need for comparison with experimental results or benchmarks among different codes as these studies involved multi-physics modeling and measurements
- Concerning our materials data base, please see one proposal from the FUSUMATECH initiative (<http://fusumatech.web.cern.ch/> )