OVERVIEW OF 2010 CIEMAT ACTIVITIES INVOLVING THE MELCOR CODE

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1. CIEMAT activities during 2010 with MELCOR code

- **Fuel degradation in the presence of air.**

  OECD-SFP project → MELCOR 1.8.6 YV 3084

- **Containment thermal-hydraulic and aerosol behavior.**

  LWR → Phebus-FP project → MELCOR 1.8.6 YT

  SFR → ESFR project → MELCOR 1.8.6 YT

1. CIEMAT activities during 2010 with MELCOR code

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5. Further work

- OECD-SFP project: extension to PWR fuel assemblies
- Phebus-FPT3 Benchmark (Sarnet 2)
- Extension of validation against SFR available data (source term)

- Analysis of SGTR scenarios
- Applications to BWR accident analysis

THANK YOU FOR YOUR ATTENTION

2. CIEMAT activities OECD-SFP: MELCOR 1.8.6 YV

SFP tests:

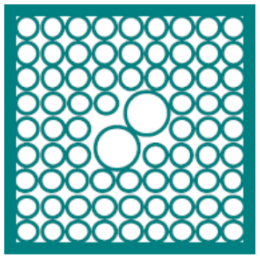
- Complete LOCA in SFPools
- Fuel oxidation in the presence of air
- Key hydraulic data

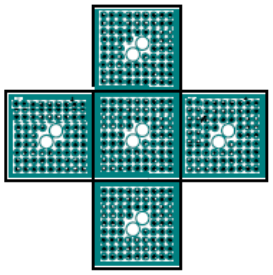
Objectives:

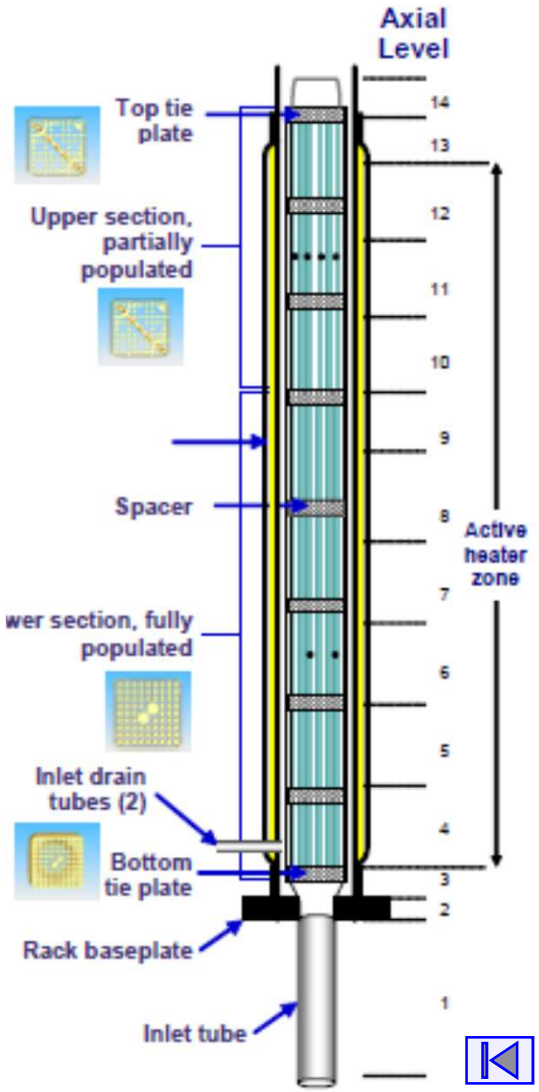
- Get familiar with the MELCOR ad-hoc version.
- Get familiar with the experimental scenario.

→ Prepare analysis of PWR fuel assemblies

2 Scenarios modeled:



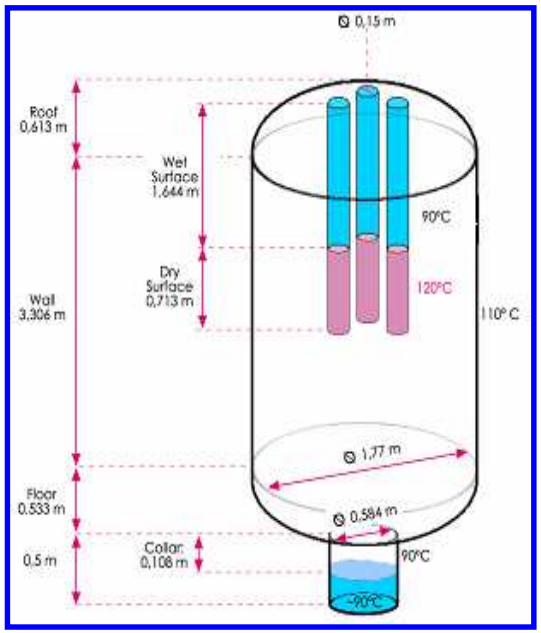




3. CIEMAT activities Phebus-FP: MELCOR 1.8.6 YT

FPT3 test:

Flow	Fuel	Containment
Steam poor (steam starvation)	BR3 24.5 GWd/tU B_4C control rods	Evaporating acidic sump Recombiners



Objective

- Explore sensitive variables in the Th's and aerosol modeling of FPT3 (first steps towards the FPT3 benchmark)

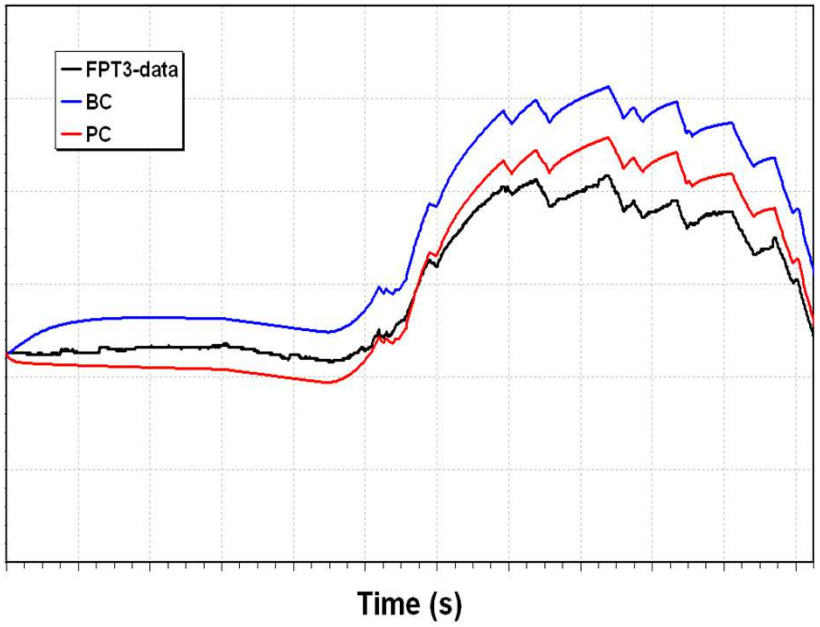
Th's

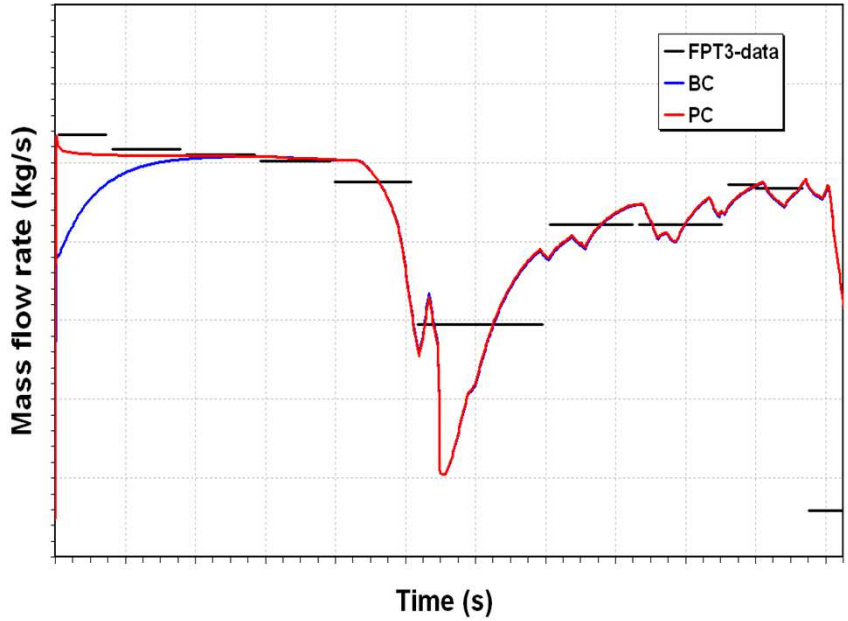
- Rh_o
- $T_{wet\text{-}cond}$

Aerosols

- *Iodine source*
  - $\dot{m}_{iodine}$
  - m_{iodine}
- *Particle size* → $d_p(t)$
- *Density* → ρ_p

Thermal-hydraulics:



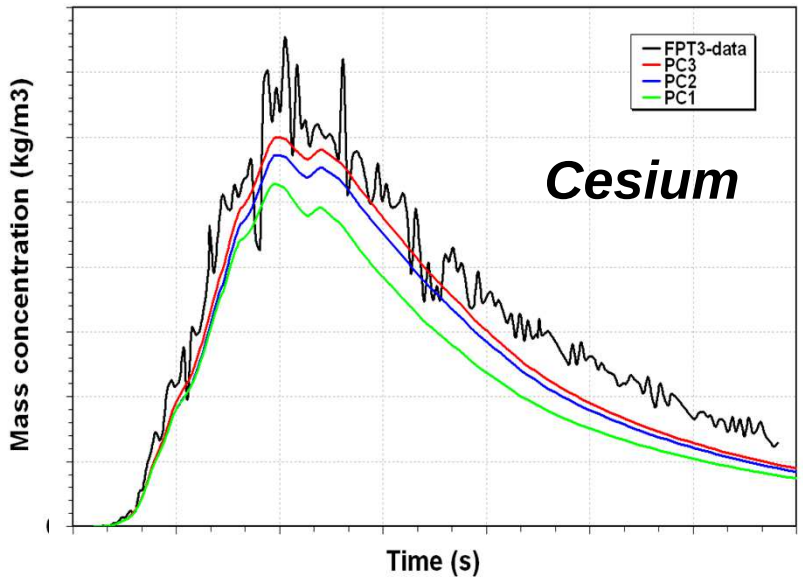


$$T_{wet\text{-}cond} = T_{wet\text{-}cond} - 1.0$$

A slightly lower temperature on wet condenser surfaces fits notably better the Th's scenario.

Aerosols:

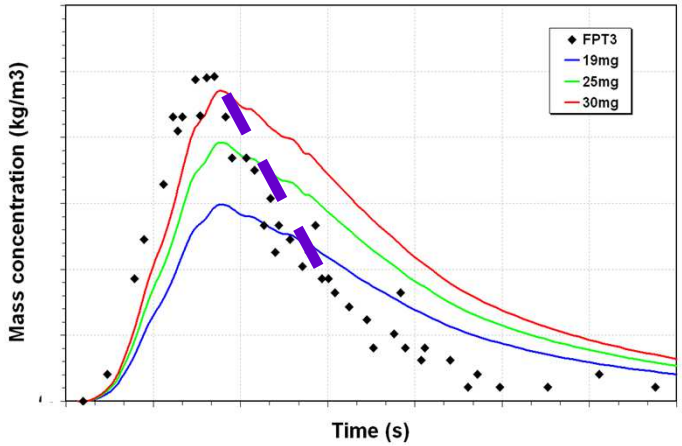
Overall behaviour well captured, even when size distribution uncertainties are considered



HOWEVER …

Aerosols: iodine

Iodine behaviour is tough to be modelled.



- Explotaroy studies indicated that injected iodine mass is higher than what suggested in the final report (i.e. 19 – 24 mg vs ~ 24 mg)
- Unsucessful attempt to model vapour – particles interaction

Surface adsortion of I2 → *•Class transfer* *•Class reaction*

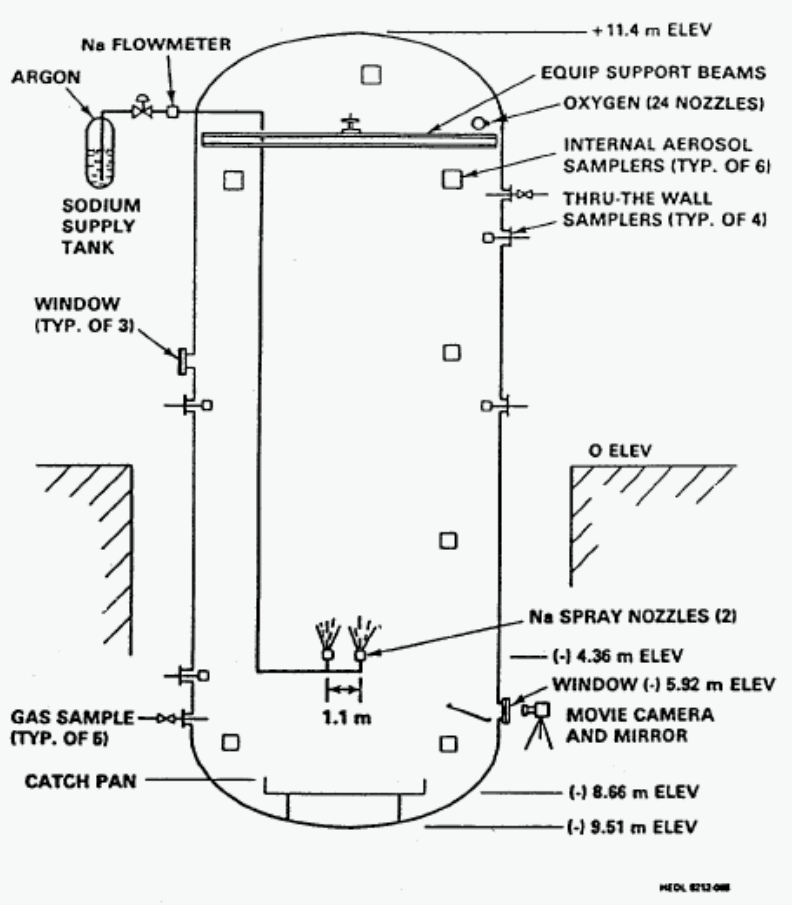
- Searching for a way to model two aerosol populations with different DENSITY

4. CIEMAT activities ESFR: MELCOR 1.8.6 YT

- Scoping calculations with MELCOR 186 and ASTEC-v2.0 to assess the capabilities of current codes for simulating in-containment aerosol behaviour of Sodium Fast Reactors (SFRs).

- ABCOVE program (Aerosol Behavior Code Validation and Evaluation): 3 tests performed in the Containment System Test Facilities (CSTF) vessel (850 m^3) at HEDL.

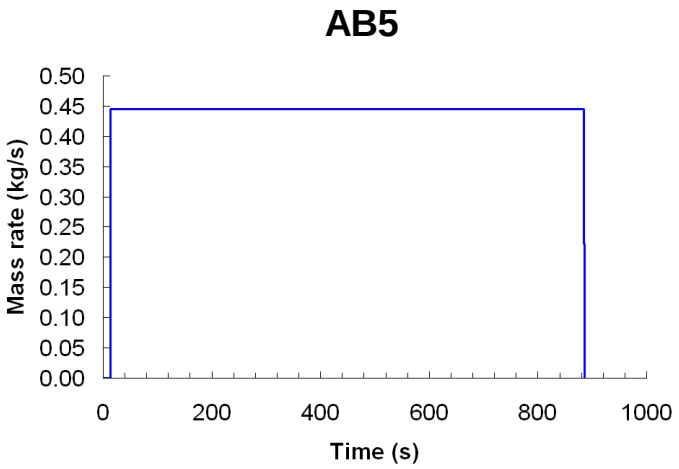
Test	Description
AB5 (1982)	A single-species aerosol generated by **spraying sodium** at high rate into an air atmosphere.
AB6 (1983)	**NaI** aerosol released in the presence of a **sodium spray fire.**
AB7 (1984)	**NaI** aerosol released after the end of a small **sodium pool fire.**

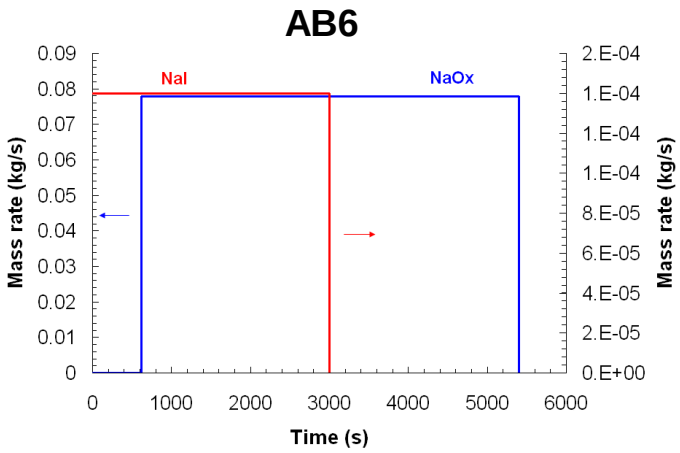


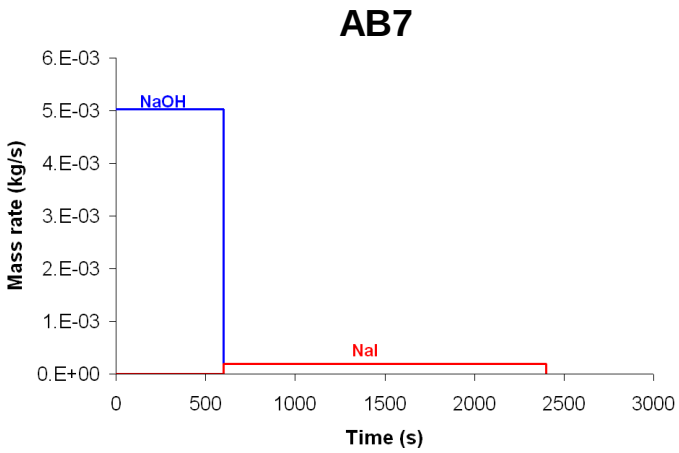
CSTF Vessel Arrangement – Test AB5

4. CIEMAT activities ESFR

Mass balance





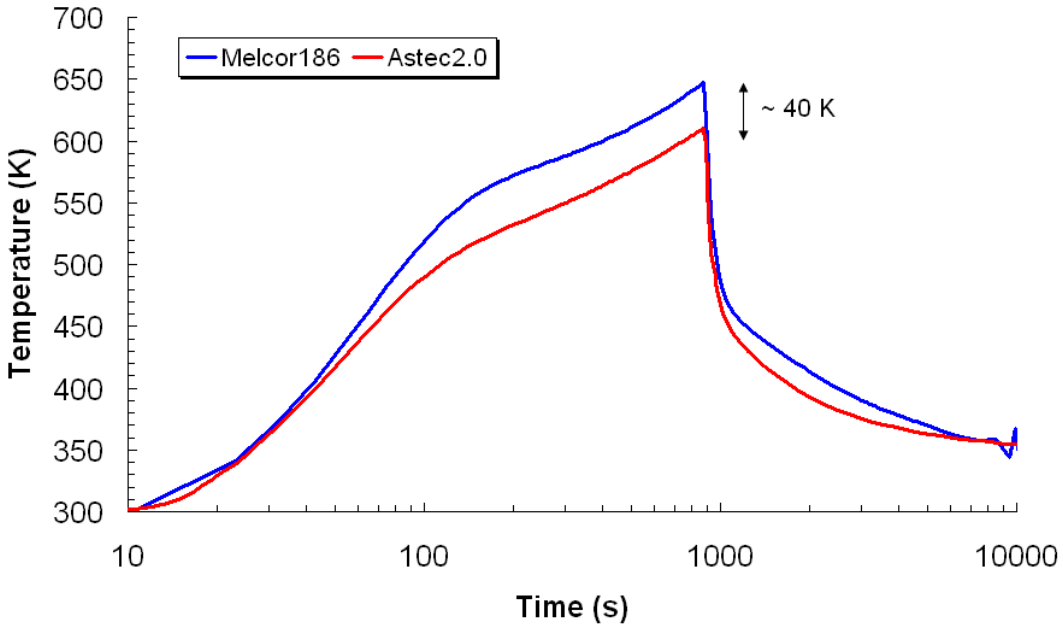


kg	AB5	AB6	AB7
Input deck	388.04	372.36	3.372
MELCOR 186	391.25	377.73	3.373
ASTEC-v2.0	388.23	372.81	3.375

?

4. CIEMAT activities ESFR

Thermal-hydraulic conditions



CSTF atmosphere temperature in Test AB5

$$\frac{dT}{dt}$$

$\dot{q}$ **OK**

$\dot{m}$ **OK**

C_p **OK**

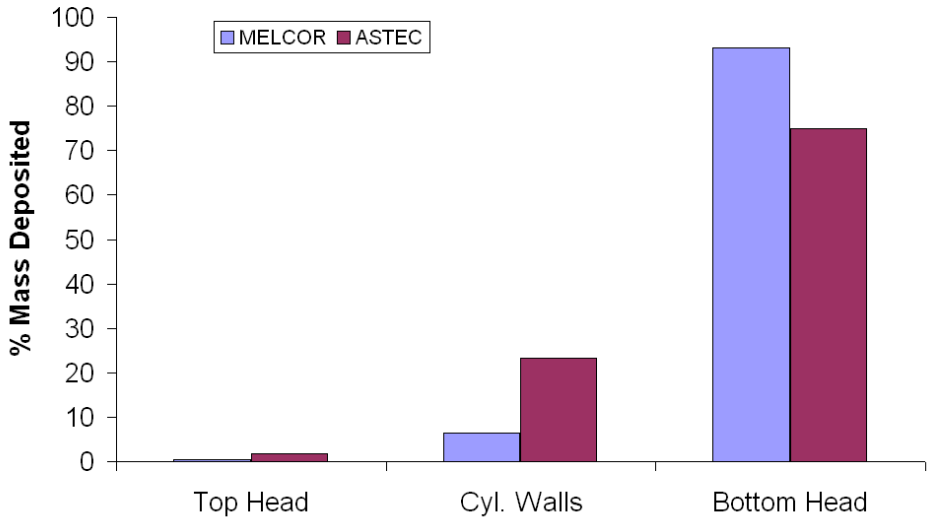
$\dot{q}_{source}$ **OK**

$\dot{q}_{removal}$

- Radiation **Negligible**
- Convection

4. CIEMAT activities ESFR

Mass deposition

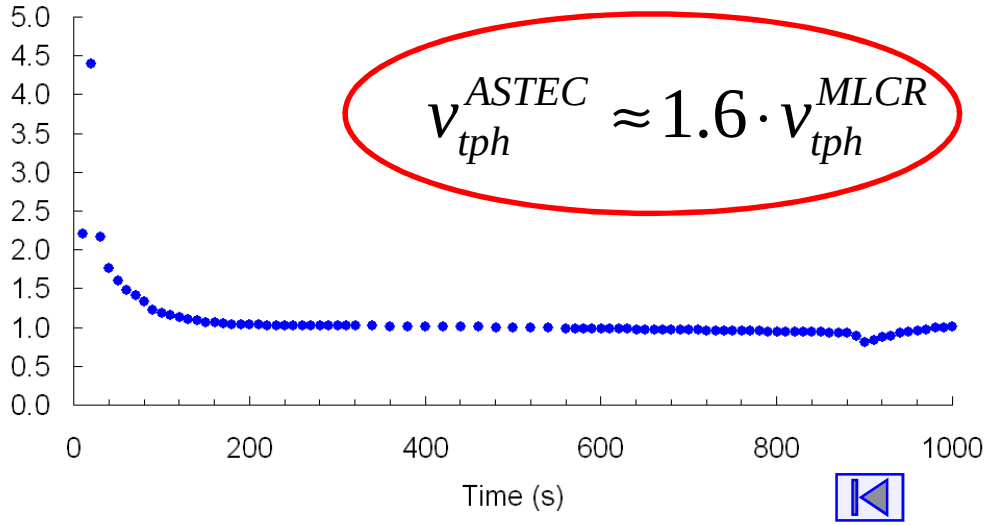


CSTF mass deposited in Test AB5

Thermophoresis

$$\frac{v_{tph}^{ASTEC}}{v_{tph}^{MLCR}} \propto \frac{\nabla T^{ASTEC}}{\nabla T^{MLCR}}$$

vtph(ASTEC/MELCOR)



$$v_{tph}^{ASTEC} \approx 1.6 \cdot v_{tph}^{MLCR}$$

→ Analysis ongoing