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ASSAS project: Optimization of the PWR-1300 dataset. SOPHAEROS module

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ASSAS project summary

ASSAS - Artificial Intelligence for the Simulation of Severe AccidentS

- November 2022 – October 2026
- 14 partners
- €3.7 million budget
- Coordinator: Bastien Poubeau, bastien.poubeau@asnr.fr

Goal – develop a prototype severe accident simulator for a Western-type PWR

To achieve this goal, significant acceleration of ASTEC code is required

- Input deck simplification and efficient programming
- Using machine-learning (surrogate models) to substitute parts of the code of parts of the reactor model (vessel, primary circuit, etc.)

Optimization task description

Goal: Check the SOPHAEROS module performance and variability of the results due to the variation of the:

1. T_EQUIL parameter
2. mass of the given component (COMP)

T_EQUIL - minimal temperature above thermodynamic equilibrium is enable in vapour phase. Located in CHEMISTRY structure.

'M' BASE: VESSEL: COMP 366 - the mass of a component in the lower plenum

- All simulation made with ASTEC 3.1.2
- Input of the ASSAS project is used

Optimization task description

Performed tests:

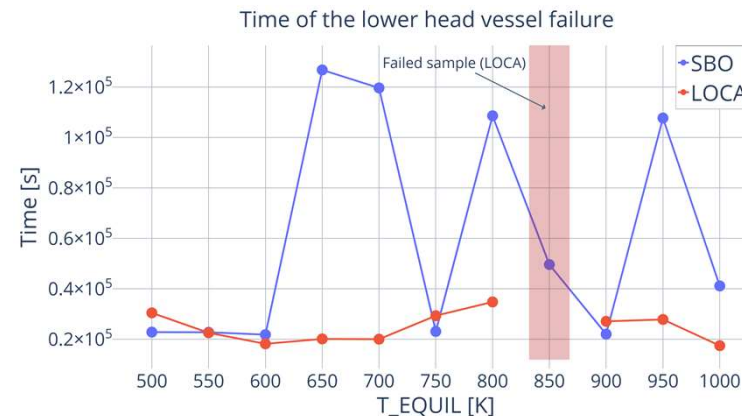
- 1) Varying the value of T_EQUIL parameter in SBO and LOCA scenarios
- 2) Changing T_EQUIL parameter along with the mass of the given COMP

Output of the interest:

- SA progression: for example, time of the lower head vessel failure
- SOPHAEROS module performance (absolute and relative time)
- Activity from different elements in the containment and environment

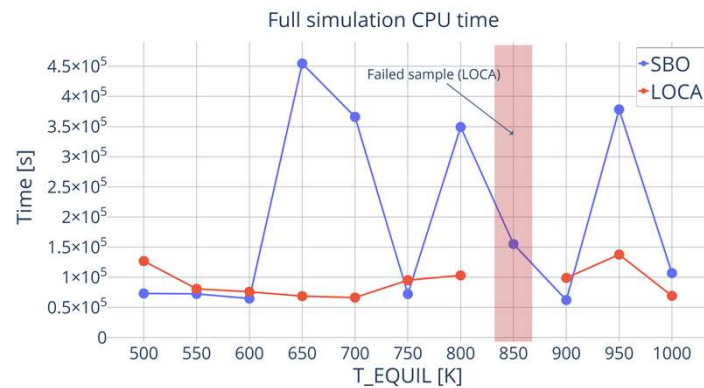
Simulation results

- Changing only T_EQUIL parameter value – from 500 K to 1000 K with 50 K step
- In total 11 runs for SBO scenario and 11 runs for LOCA scenario
- One simulation for the LOCA scenario failed

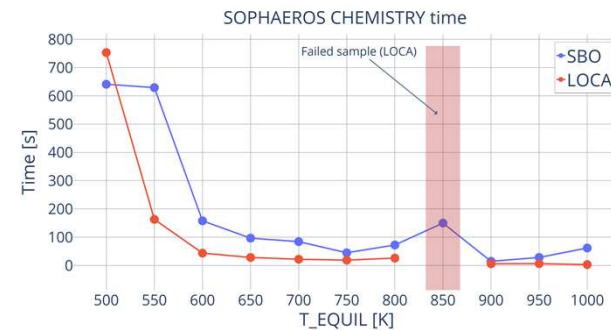
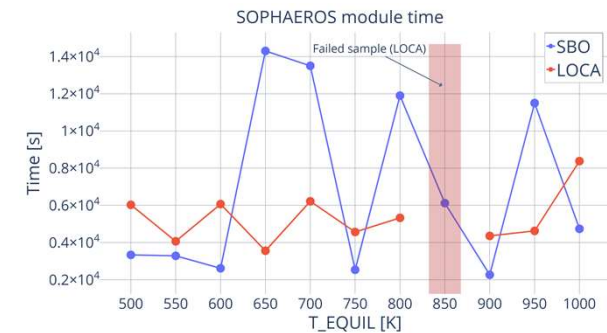


Simulation results

Changing only T_EQUIL parameter value – from 500 K to 1000 K with 50 K step

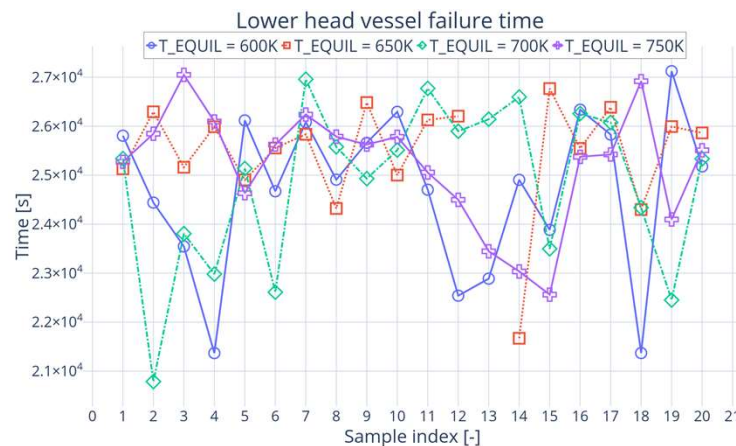


Full simulation time is significantly bigger than any gain from CHEMISTRY module



Simulation results

In this simulations both T_{EQUIL} and the mass '**M**' BASE: VESSEL: COMP 366 were modified. For all simulations the SBO scenario was modelled.

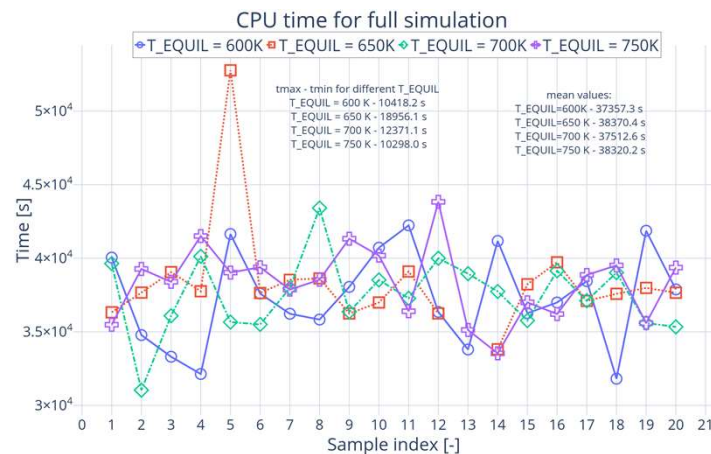


- 4 sets, 20 runs each
- $T_{EQUIL} = 600, 650, 700, 750$ K
- Each set has the same changes in the mass 'M'
- One sample from the third set ($T_{EQUIL} = 700$ K) failed

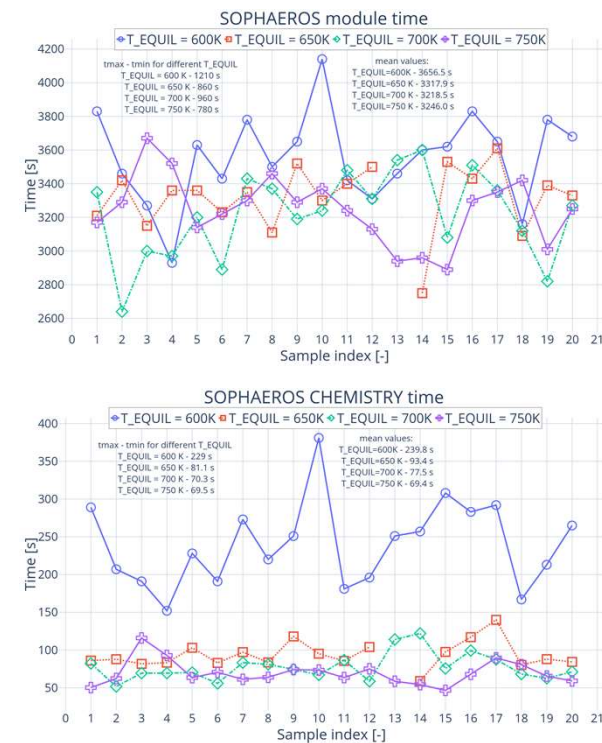
'**M**' changes from
1225.6984642**02**998 to
1225.6984642**23**998

Simulation results

Changing 'M' BASE: VESSEL: COMP 366
and T_EQUIL

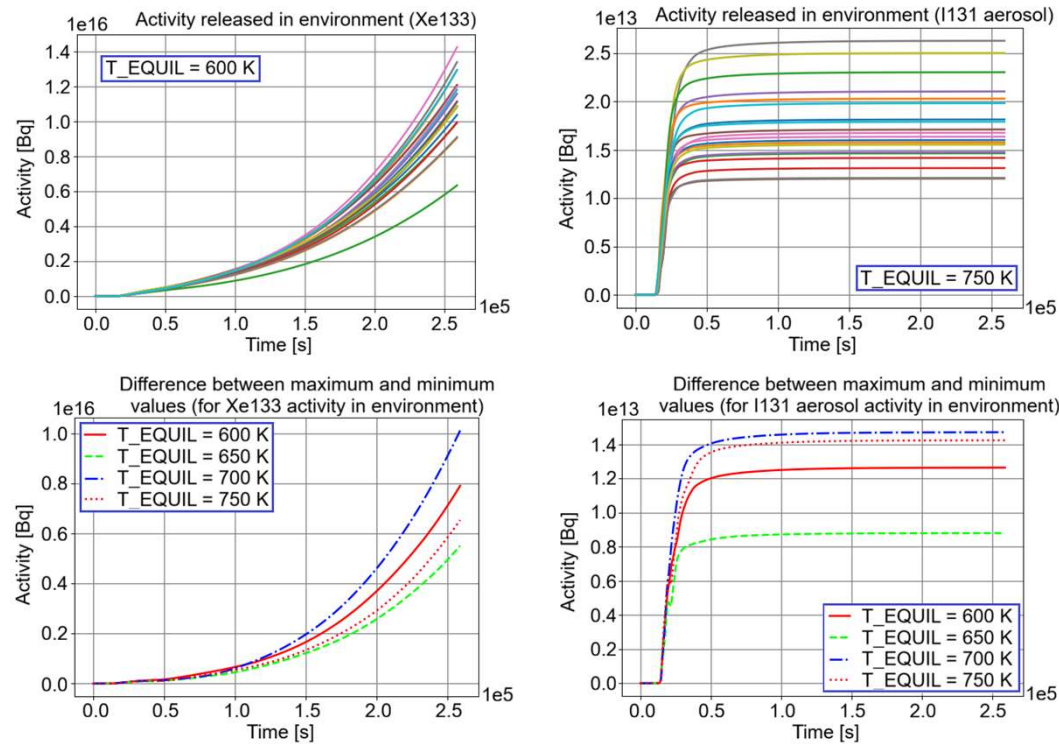


Full simulation time is significantly bigger than any gain from CHEMISTRY module



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Simulation results



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Conclusions

- ✓ For all performed calculations full simulation time is significantly bigger than any gain in speed from the CHEMISTRY module
- ✓ Spread of the activity values is quite significant for such small changes in the component mass (changes $\sim 1.e-9$)
- ✓ Difference (max - min) in activity values doesn't have clear trend with changing T_EQUIL value.

Thank you for your attention!



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