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**Monte Carlo
Burnup Calculations
with Power Oscillation
Reduction**

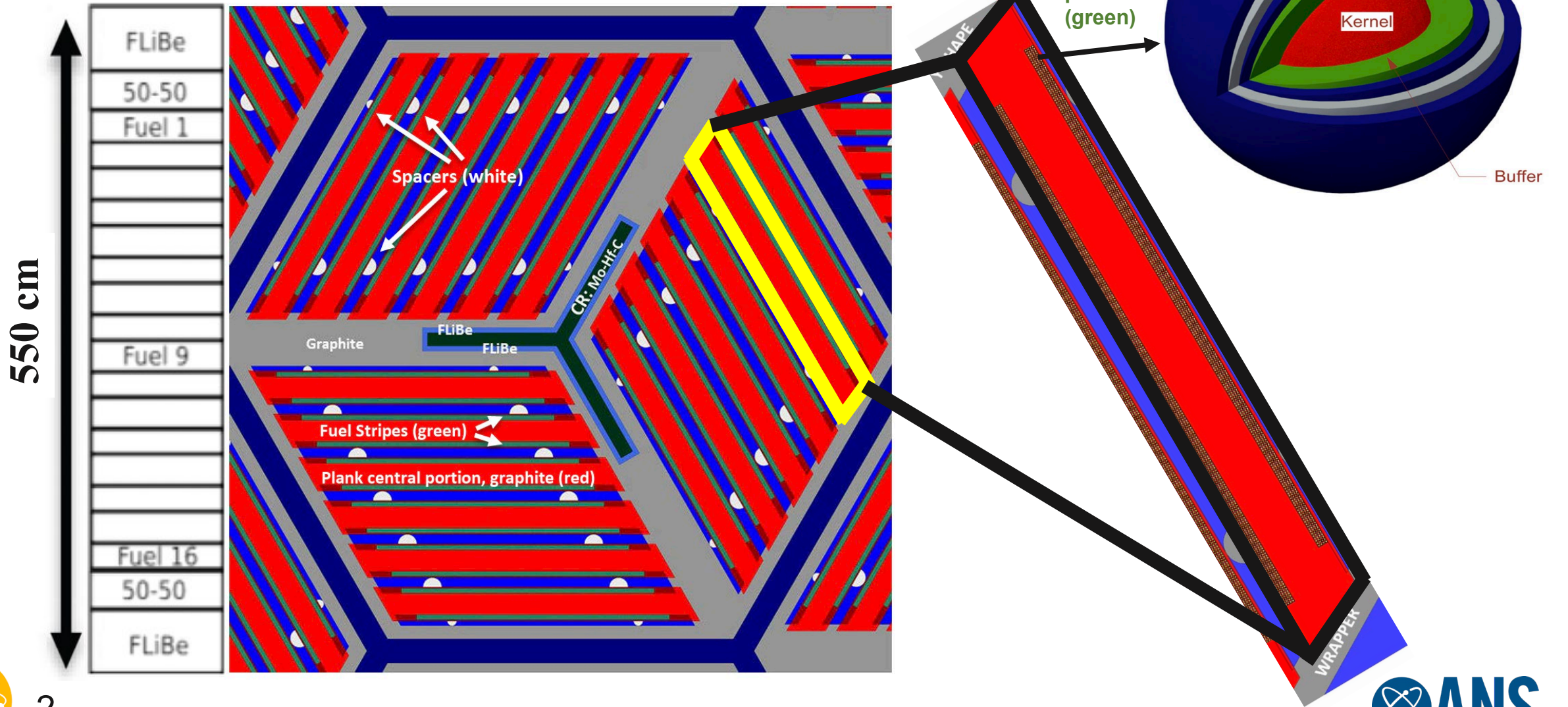
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FHR Reactor Concept

Florida Salt Cooled High Temperature Reactor (FHR)



Collaborative Benchmark

- Phase 1-C: Completed 3D fuel assembly modeling with depletion
- Monte Carlo Code: Serpent (VCU)

Project leads:   **NEA**
NUCLEAR ENERGY AGENCY

Participants:



University of
Zagreb



CVŘ | Research
Centre Řež

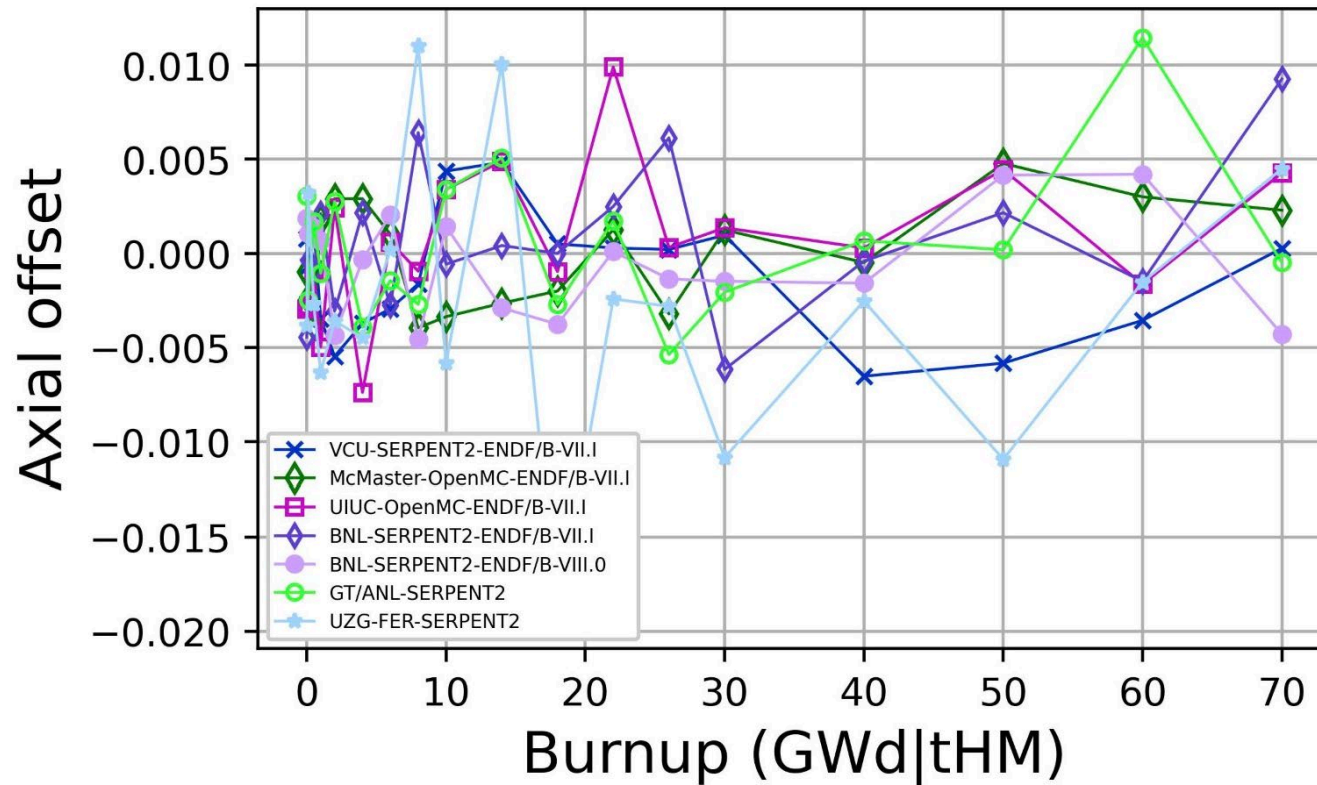


Brookhaven[™]
National Laboratory



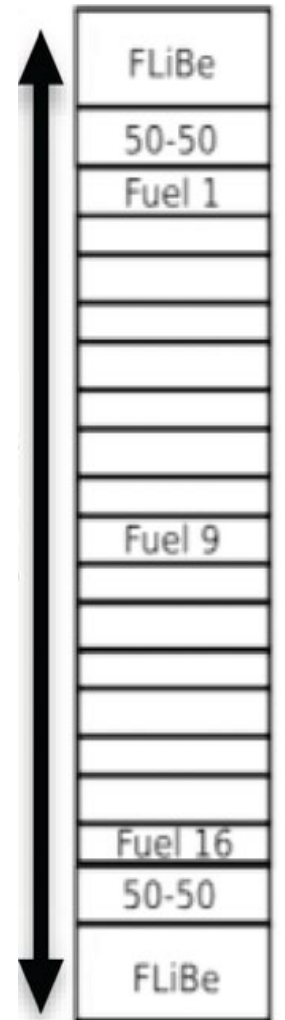
Burnup Power Oscillations

3D fuel assembly burnup axial power oscillations



Axial Offset (AO) :

$$AO = \frac{\sum P_{T_i} - \sum P_{B_i}}{\sum P_{T_i} + \sum P_{B_i}}$$



Model Parameter Variation

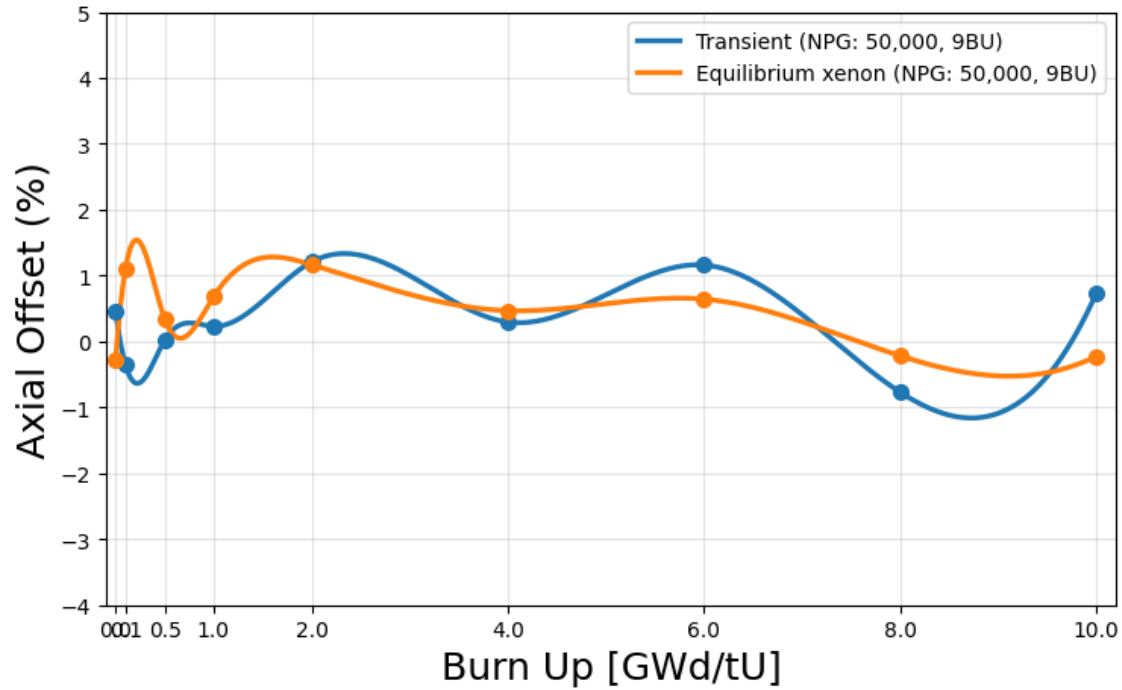
To investigate AO reduction test:

1. Equilibrium/Transient Xenon
2. Particle Histories
3. Intermediate Burnup Steps

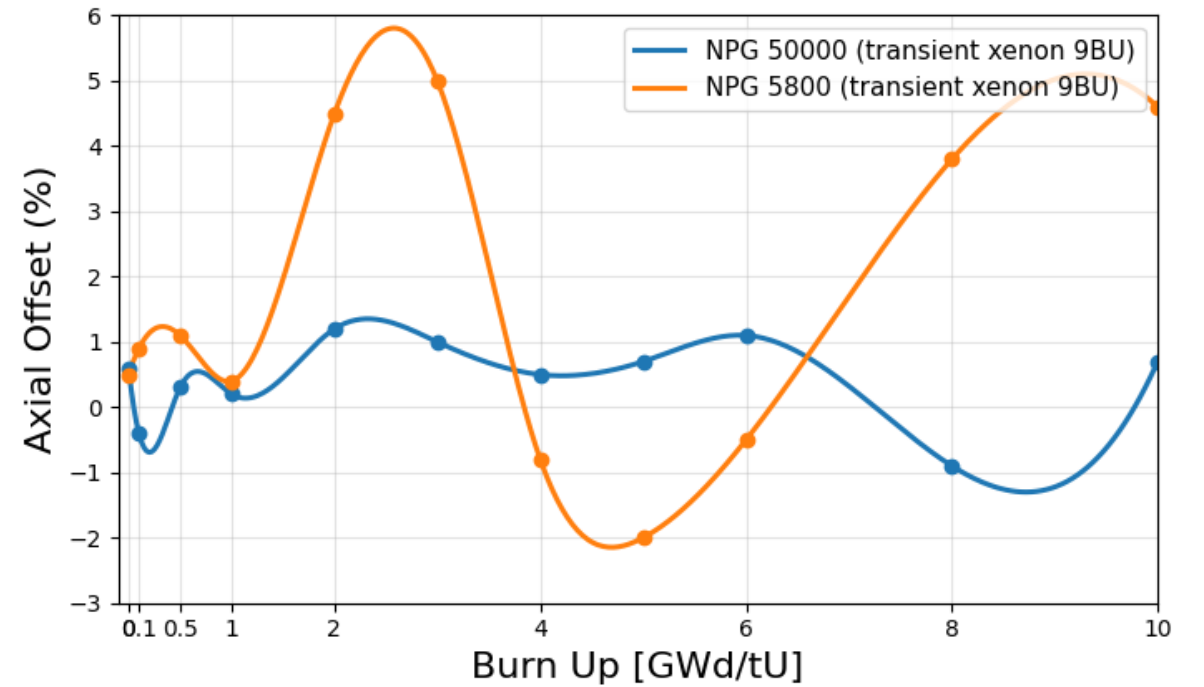


Results

Effect of Equilibrium/Transient Xenon

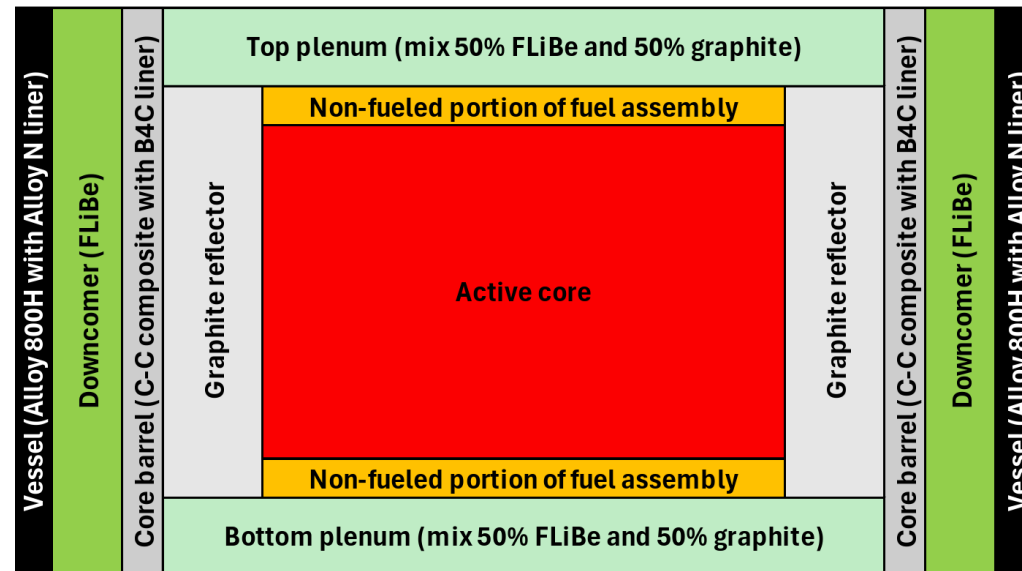
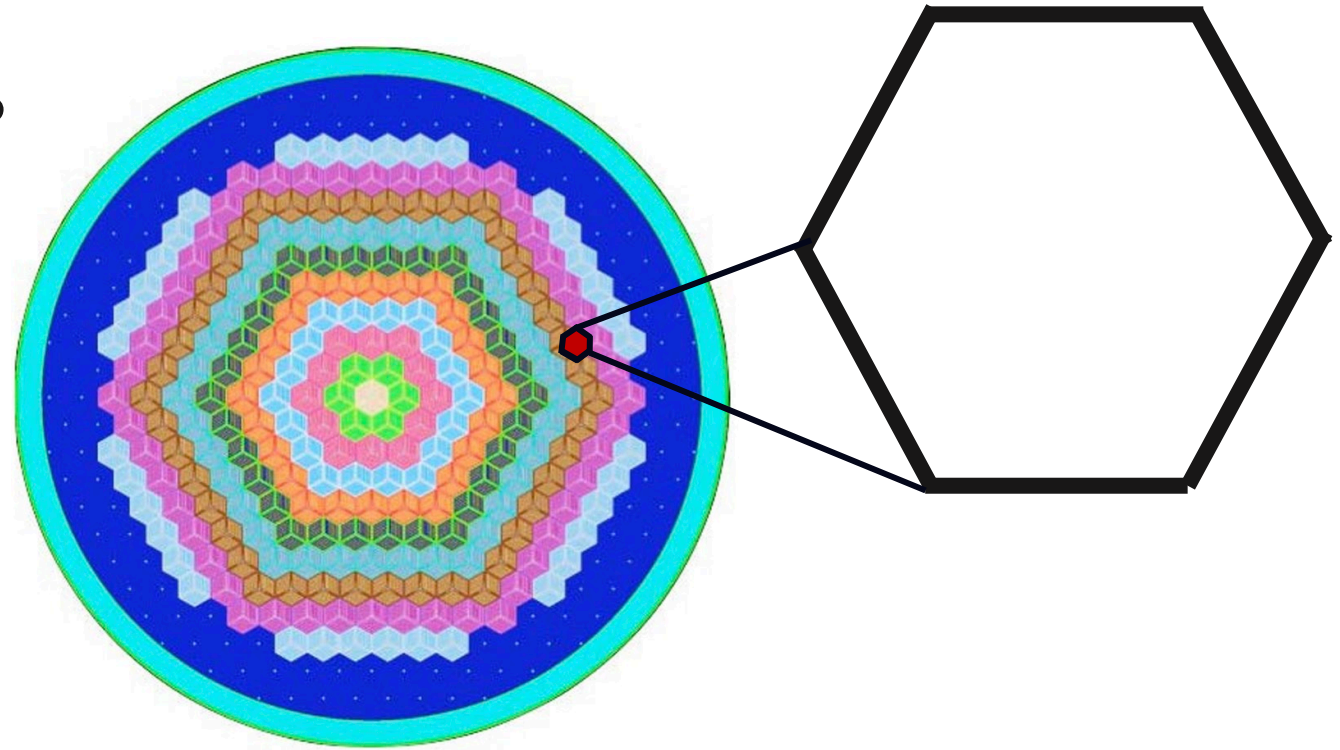


Effect of Particle Histories



Future Benchmark Efforts

- Full core expansion (current)
- Core depletion calculations
- Investigation of full core axial oscillations
- Multiphysics coupled thermal hydraulic modeling



Acknowledgements

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References

- [1]. B. Petrovic et al., Benchmark Specs for FHR Reactor Physics Calc., Phase I-A/I-B), NEA/NSC/R(2020), Paris, Mar. 2021.
- [2]. B. Petrovic et al., “Examining Xe-Induced Oscillations in Monte Carlo Depletion Simulations,” Proc. MC25, 2025, doi:10.13182/MC25-47305.
- [3]. B. Petrovic et al., FHR Reactor Physics Calc. Benchmark: Pseudo-2D Fuel Assembly Results (Phase I-A/I-B), NEA/WKP(2024)2, OECD, Paris, Oct. 2024.
- [4]. Leppänen et al., “The Serpent MCcode: Status, development and applications in 2013,”, Finland, 2014.
- [5]. B. Petrovic and J. Faulkner, “FHR NEA Benchmark Phase I-C: Fuel Element 3D,” Proc. M&C 2023, ON, Canada, Aug., 2023.
- [6]. A. Isotalo et al., “Preventing xenon oscillations in Monte Carlo burnup calculations by enforcing equilibrium xenon distribution,” Ann. Nucl. Energy, vol. 60, pp. 78–85, 2013.



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Thank you!

Questions?

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