



American Nuclear Society Student Conference

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EGPRS Lead-cooled Fast Reactor (LFR) Benchmark

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Outline

- Overview
- Methods and Geometry
- k-eigenvalue Calculation
- Flux and Burnup Assessment
- Conclusions & Future work





Overview

- Benchmark analysis of leadcooled fast reactor (LFR) using MOX fuel in association with EGPRS
- Baseline for the neutronics and physics of this type of reactor
- MCNP is the main code of calculations and results were verified by other party's results from ININ



Source: (Alemberti, et al., 2020).







Methods and Geometry

- Built from smallest to biggest components
- Thermal expansion value
 assumed for hot cases
- Stochastic mixing was used for defining temperature that materials were at
- Density is adjusted by unit volume expansion





k-eigenvalue Calculations

- Done as baseline for the reactor
- Many different stages/ scenarios of calculations
- All compared to the ININ results

Pin-level Model Results Results from Inner Fuel Pin Difference **VCU** ININ Std Dev **k**_{eff} *k*_{eff} Std Dev $k_{\rm eff}$ 1.34412 0.00005 1.34394 0.00002 0.00018 **Results from Outer Fuel Pin VCU** ININ Difference Std Dev Std Dev **k**_{eff} *k*_{eff} $k_{\rm eff}$ 1.53004 0.00006 1.53025 0.00002 0.00021 Whole Core Model Results Condition $k_{\rm eff}$ (VCU) k_{eff} (ININ) Rod all out 1.00851 ± 0.00009 1.00273 ± 0.00002 **CR** inserted 0.96844 ± 0.00009 0.95685 ± 0.00002 Rod all in 0.95292 ± 0.00011



Flux and Burnup

- Flux done to show the actual spectrum of neutron operation
- Burn up done to see if this is a breeder reactor, and to see major actinide trends







Conclusions & Future Work



- A whole core LFR model was established by MCNP based on the detailed description of LFR benchmark specifications.
- Reactor physics baseline calculations was accomplished and the model is ready for further analysis.
- An overall good agreement of the results compared to one independent third party's calculations was achieved.
- For future work:
 - Evaluate the reactivity coefficients of fuel and coolant to better understand the transient behavior.
 - Different types of LFR fuel beyond MOX fuel can be assessed with the current model fuel cycle analysis capability.





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