Deimos and other HALEU Critical Experiments at NCERC

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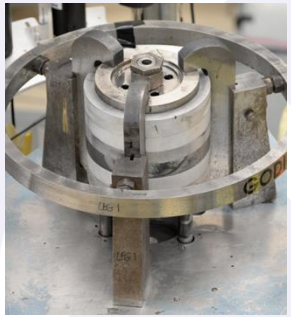
NCERC Overview

- National Criticality Experiments Research Center – NCERC
- Perform subcritical, critical, and above prompt critical experiments
- Large inventory of nuclear materials and highly configurable machines allow for
- Many experiments are performed for the Nuclear Criticality Safety Program
- Recently there has been more nuclear energy related work, including Deimos



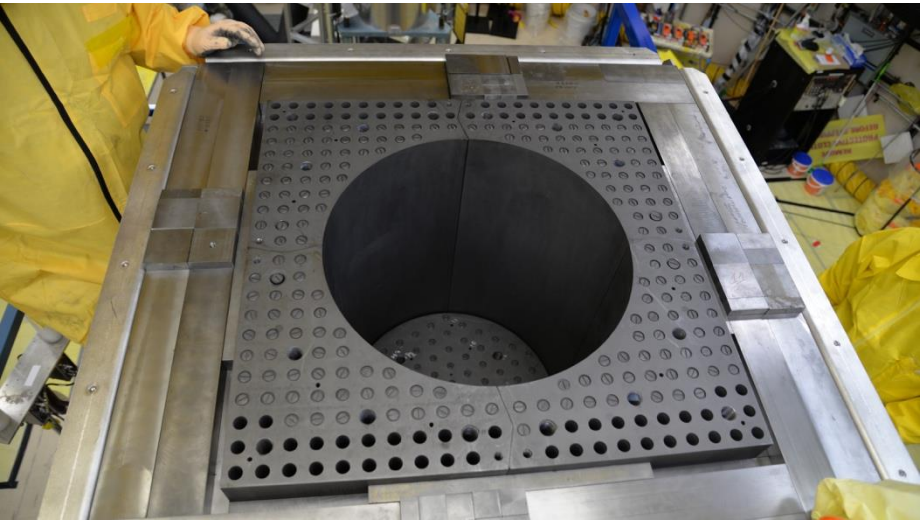




Nuclear Data Need

- Very few HALEU benchmarks in ICSBEP, even fewer that use HALEU TRISO
- Only 21 benchmarks have 10-20 w/o fuel, only two have HALEU TRISO
  - ICT010/HTR10-GCR-RESR-001 – Chinese HTR10 Pebble Bed reactor
    - C/E is ~1200 pcm over experimental value
  - ICT008 – Russian Pebble Bed critical experiment
    - C/E ranges from 900 pcm under experimental value to 60 pcm over for different cases
  - Both are ‘older’ benchmarks (2006 and 2007)
- Draft report from ORNL showed only two benchmarks with a c_k over 0.8 for HALEU TRISO particles in an infinite graphite lattice
- Need new benchmarks that are representative of HALEU transportation, storage, handling, and operations

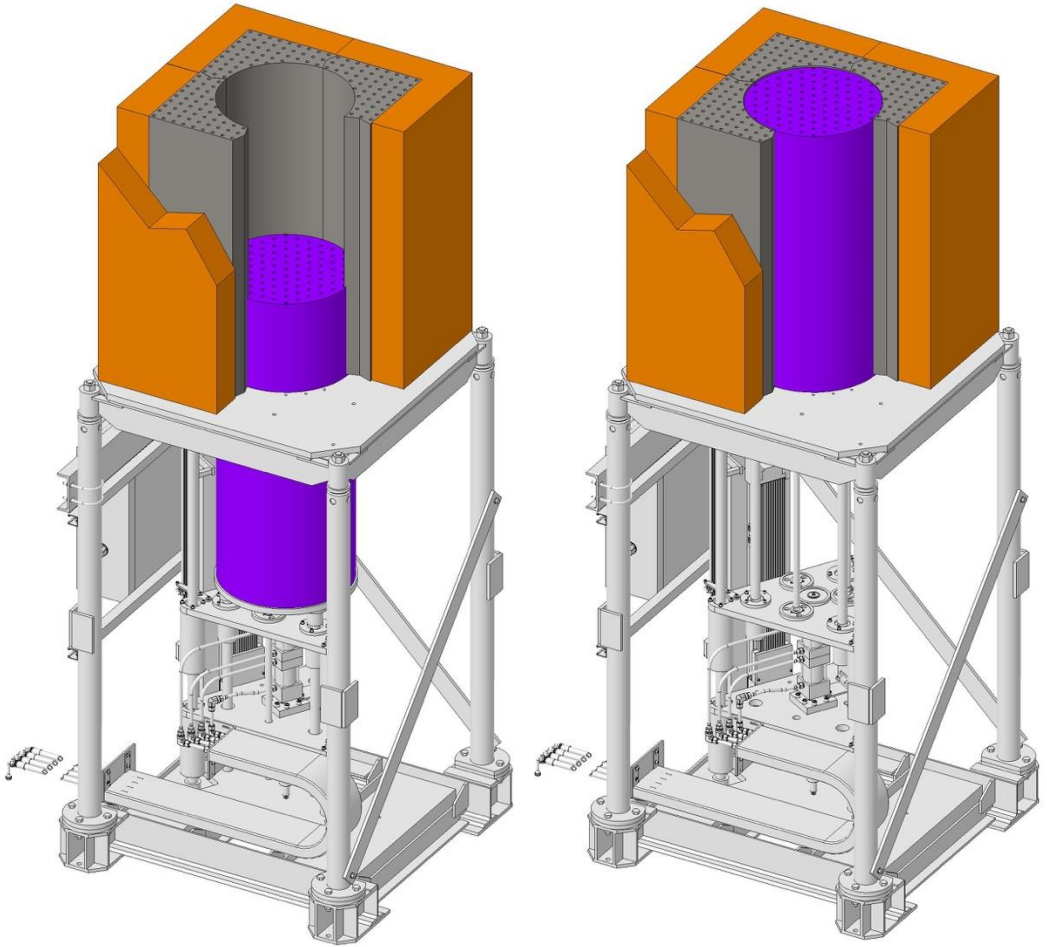
Deimos Overview

- Deimos was funded by LANL LDRD as a micro-reactor test bed
- Graphite moderated, HALEU TRISO fueled, outer Be reflector
- On the Comet critical assembly at NCERC



Deimos Overview

- Reactivity is controlled by inserting the core block into the reflector.
- Included heated experiments
  - Core and reflector electrically heated independently
- Benchmark measurements were performed which will be analyzed as a benchmark for inclusion in the ICSBEP



Deimos Overview

- HALEU TRISO fuel is from the Compact Nuclear Power Source (CNPS) experiments – performed at LANL (TA-18) from 1987-1991
- Packing fraction is >60% - much higher than TRISO produced today

DNCSH Overview

- DOE/NRC Collaboration for Criticality Safety Support for Commercial-Scale HALEU for Fuel Cycles and Transportation (DNCSH)
  - Authorized in the Energy Act of 2020, Section 2001, “Advanced Nuclear Fuel Availability”
  - Specifically called for DOE and NRC to develop “criticality benchmark data” to assist in licensing and regulation of fuel fabrication/enrichment and transportation of HALEU
  - Appropriated $100 million in the 2022 Inflation Reduction Act
- DNCSH first call was ~April 2024, awards were announced mid 2024
- NCERC had three proposals accepted
  - Kairos, Terrapower, and Westinghouse

Westinghouse - eDeimos

- Based on the Deimos platform
- Will take the center platen region and replace it with geometry representative of the eVinci microreactor
- Using sensitivity tools / c_k values to determine similarity between microreactor and critical experiment
- Will also have a heated chamber which will allow for measurements of temperature coefficients of reactivity

Fuel Procurement

- For the eDeimos experiment, we are procuring new HALEU TRISO
- Procurement funded by the DNCSH program
- Working with INL, NNSS, DNCSH, and a commercial fuel fabricator
- Fuel will be based on a modern specification from Westinghouse
  - One big change, packing fraction is much lower than CNPS
- Fuel will become part of NCERC inventory following the Westinghouse/DNCSH experiments for use in future experiments
- New fuel will allow for experiments that are much more representative of HALEU TRISO applications today

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