FY 22 ORNL Integral Experiment work

Mathieu Dupont

Douglas Bowen

Riley Cumberland

ORNL Integral Experiment work during FY 22

Three NCSP funded tasks:

- IE1: CeDT support
- IE2: Provide Safety Committee Support at DAF/NCERC (John Ford)
- IE4: Funding to support U-233 ZPPR Plate Shipments to DAF/NCERC (Doug Bowen)

IE2: Provide Safety Committee Support at DAF/NCERC

- NCERC/DAF support: critical assembly safety committee at NCERC
- SPRF/CX (SNL) support: safety analysis review for IER-518, IER-395 and IER-305

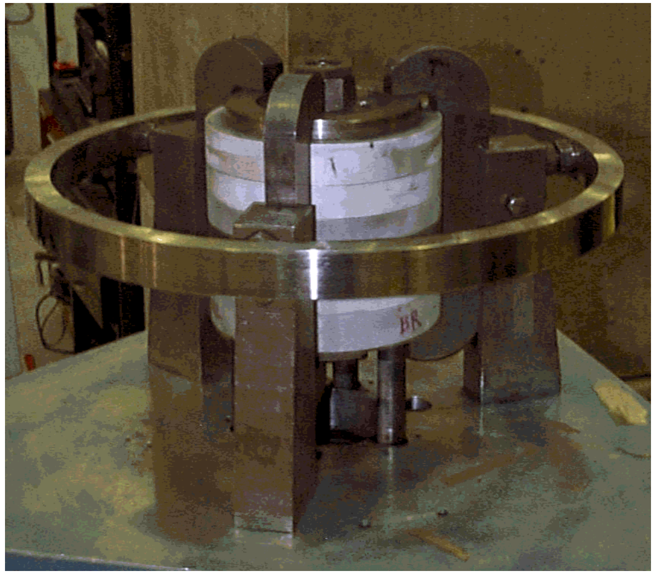
IE4: Funding to support U-233 ZPPR Plate Shipments to DAF/NCERC

- Meetings between SRS, ISOTEK, LANL, and NNSA to organize the plate shipment
  - Bowen/Henley visited ORNL Bldg. 3019 for meetings with ISOTEK staff
- Delays in the shipment because the plates integrity must be checked before shipment
- Cost estimate could not be created yet because ISOTEK did not have priority from DOE-EM to provide it
- Official Rough Order of Magnitude (ROM) cost estimate requested by Angela Chambers for FY23 Q2 budget summit

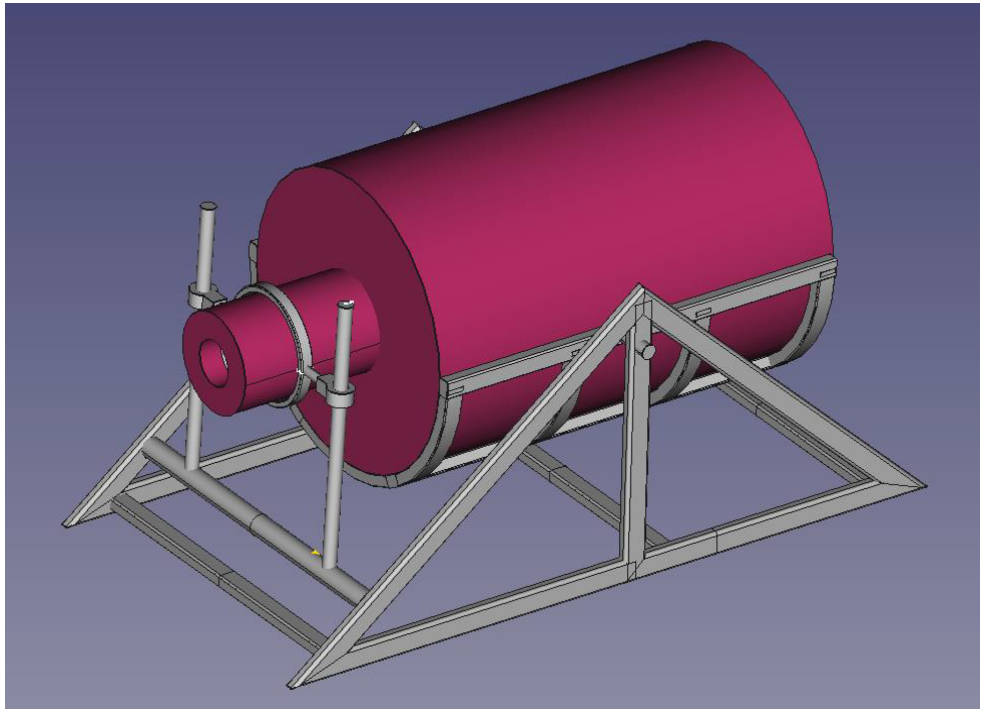
IE1: Integral Experiment Design leads from ORNL

- IER-498: Godiva IV CAAS Shielding Benchmark
  - CED-2 completed in FY21 [**1**], noting further characterization was needed for CED-3
  - Support to associated IER-557: GODIVA Pulse Repeatability
- IER-554: Neutron Absorber Plates in SPRF/CX
  - CED-1 completed [**2**]

IER-498: GODIVA CAAS Shielding Benchmark



The Godiva IV assembly [3]



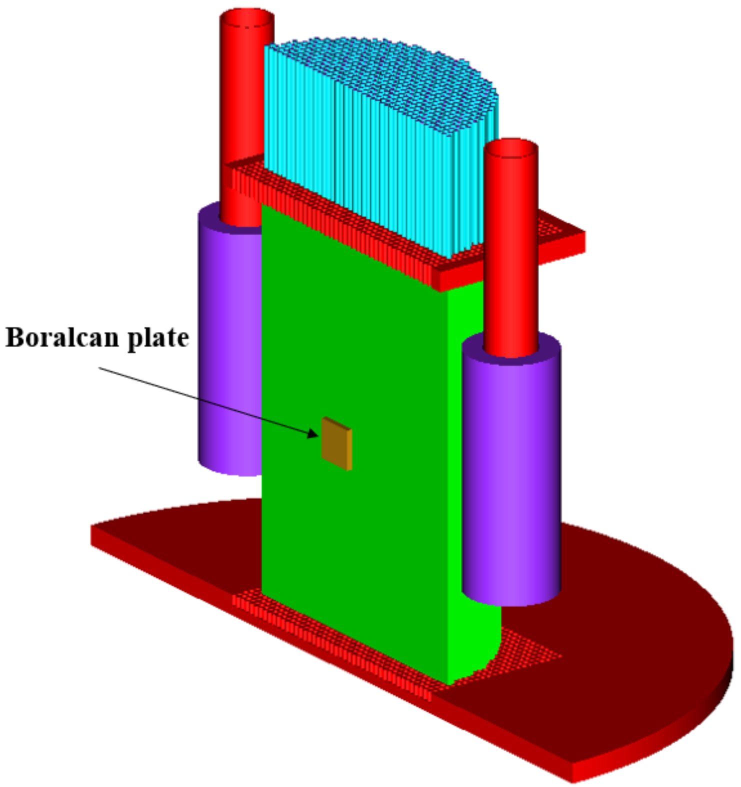
Conceptual rendering of room return shield [1]

- Effects of different shielding samples on detector responses from a Godiva IV pulsed or steady-state operation

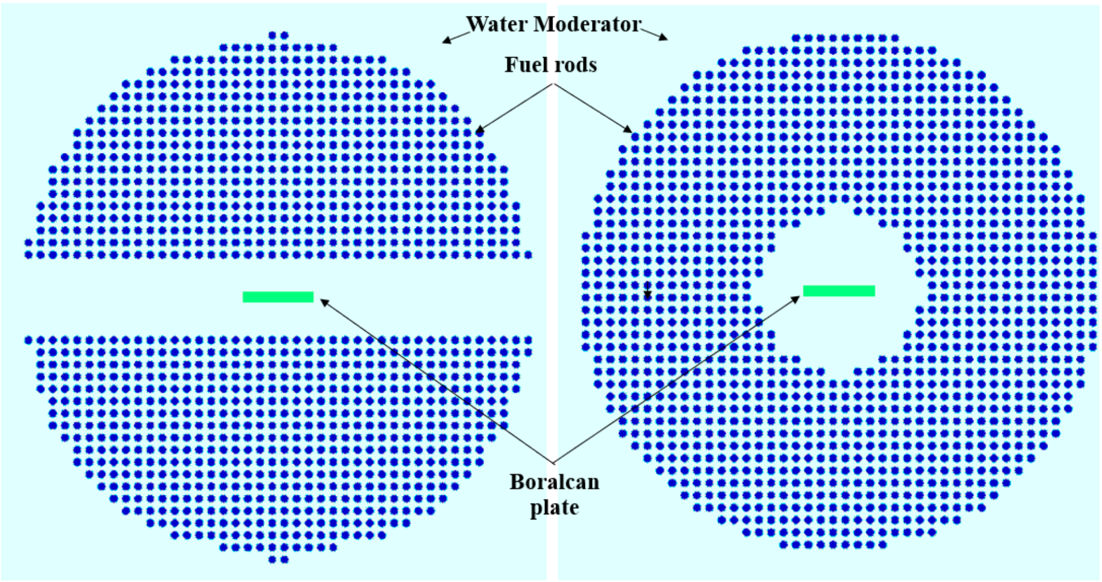
IER-498: GODIVA CAAS Shielding Benchmark

- CED-2: Final design completed
- Next steps: CED-3a
- Side task: IER-557 GODIVA reproducibility
  - Claimed ~ 3% relative uncertainty in the number of neutrons produced per burst for a same ΔT
  - This helps reduce the experimental uncertainty in IER-498

IER-554: Neutron Absorber Plates in SPRF/CX



Assembly with a neutron absorber plate in its center [2]



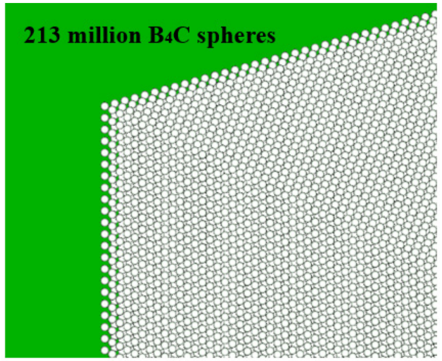
Different critical lattice configurations [2]

- Effects of commercially available neutron absorber plate insertion in light water assembly (SPRF/CX) on k_{eff}

IER-554: Neutron Absorber Plates in SPRF/CX

- CED-1: Preliminary design completed: 10 critical configurations
  - CED-2 in FY23
- Experimental uncertainty is not impacted
- Collaboration with industry to acquire poison plate samples
- Internal ORNL collaboration for plate characterization (X-ray CT)
- Initial study on explicit B_4C particles: to be continued in CED-2

Modeling method	Plate dimensions (width × length × thickness in cm)	B_4C sphere diameter (μm)	k_{eff} (sig=0.00010)
Homogeneous	5 × 5 × 0.75	N/A	1.00006
Individually modeled B_4C particles	5 × 5 × 0.75	100	0.99993
Individually modeled B_4C particles	5 × 5 × 0.75	30	0.99988



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Other contributions to IE from ORNL

- Participation to the NCERC Futures workshop (four participants, two talks given)
- National conferences papers
- IER-539: Horizontal split table: journal publication published in NSE in collaboration with LLNL
- Support to:
  - IER-304
  - IER-305
  - IER-441
  - IER-499
  - IER-532
  - IER-537
  - IER-551

Acknowledgment

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References

- [1] M. N. Dupont, D. Ames, G. Harms, W. J. Marshall, and M Pigni "Integral Experiment Request 554 CED-1 Summary Report," ORNL/2682, Oak Ridge National Laboratory (2022).
- [2] R. Cumberland, C. Celik, M. Dupont, and D. Bowen "Criticality Accident Alarm System Shielding Benchmark: Integral Experiment Request 498, Critical Engineering Decision 2 Report," ORNL/TM-2021/2172, Oak Ridge National Laboratory (2022).
- [3] R. D. Mosteller, "Godiva-IV Delayed-Critical Experiments and Description of an Associated Prompt-Burst Experiment," Los Alamos National Laboratory, NEA/NSC/DOC/(95)03/II, HEU-MET-FAST-086 (2014).

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Questions?