



NCSP IE and T&E Activities at Sandia

Nuclear Criticality Safety Program Technical Program Review

Washington, D.C.

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**Presented by
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Sandia National Laboratories**

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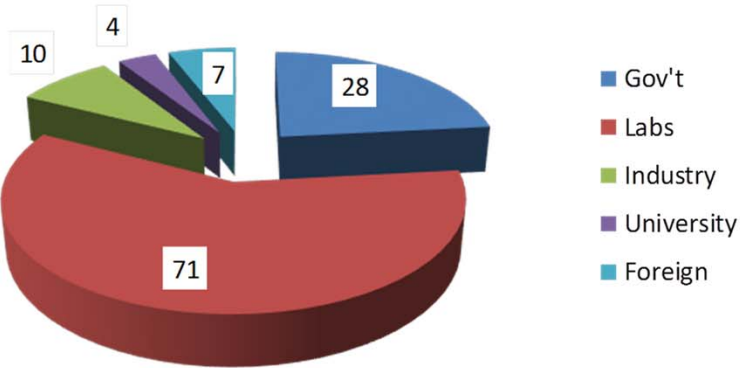
Hands-On Criticality Safety Training at Sandia

- Two hands-on critical experiment classes are currently offered.
- The first is part of a two-week class for Nuclear Criticality Safety Professionals, 1 week at LANL and one week at Sandia or at NCERC.
- The other is a one-week class at Sandia for Nuclear Material Managers.
- Information about the classes and how to register is at <http://ncsp.llnl.gov/classMain.html>

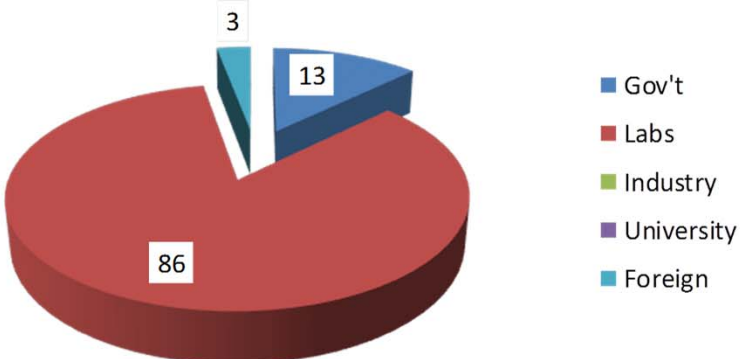


The Classes Continue to Serve a Diverse Audience

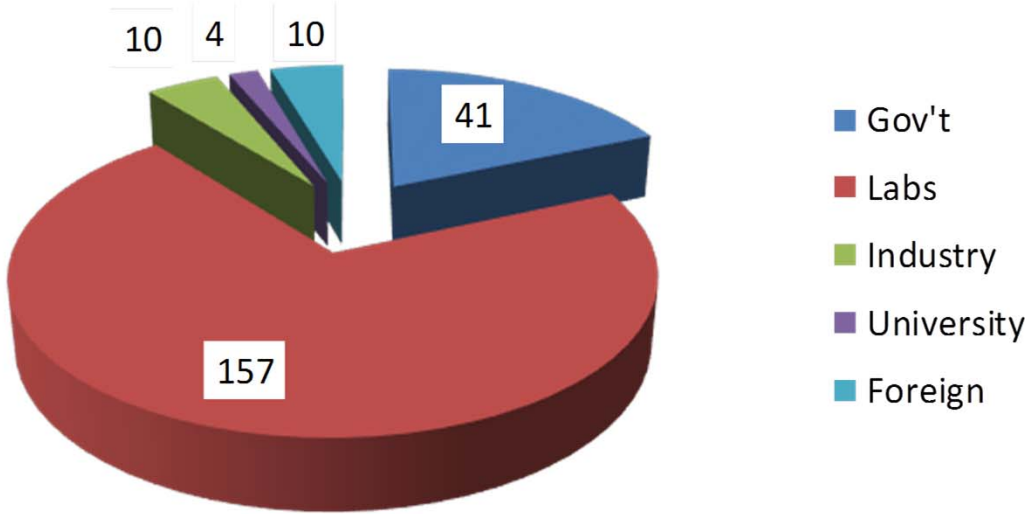
Nuclear Criticality Safety Professionals
13 Sessions, 120 Students



Nuclear Material Managers
8 Sessions, 102 Students



Both Classes
21 Sessions, 222 Students






The Sandia Classes


- **The Sandia classes are a series of four experiments**
 - Approach on fuel
 - Approach on moderator height
 - “Split table” approach
 - Fuel removal approach
- **Lectures on various subjects are integrated with the experiments**
- **Remember: <http://ncsp.llnl.gov/classMain.html>**



Sandia Integral Experiment Requests

IER	Title	Sponsor	CED
206	Re-establish the 4.3% Enriched Critical Experiment Capability at Sandia	SNL	3B
209	7uPCX 0.855 cm Pitch, Variable Depth Pure Water Moderator	SNL	3A
230	Characterize the Thermal Capabilities of the 7uPCX	SNL	2
285	Titanium Cross Sections in a Thermal Application (7uPCX)	SRNL	
304	Temperature Dependent Critical Benchmarks	ORNL	1
305	Critical Experiments with UO2 Rods and Molybdenum foils	IRSN	1
306	Critical Experiments with UO2 Rods and Rhodium Foils	IRSN	1
441	Epithermal HEX Lattices with SNL 7uPCX Fuel for Testing Nuclear Data	ORNL	1
451	Titanium Cross Sections in a Thermal Application (BUCCX)	SRNL	3B
452	Inversion Point of the Isothermal Reactivity Coefficient	SNL	Pre-1

Sandia Integral Experiment Requests

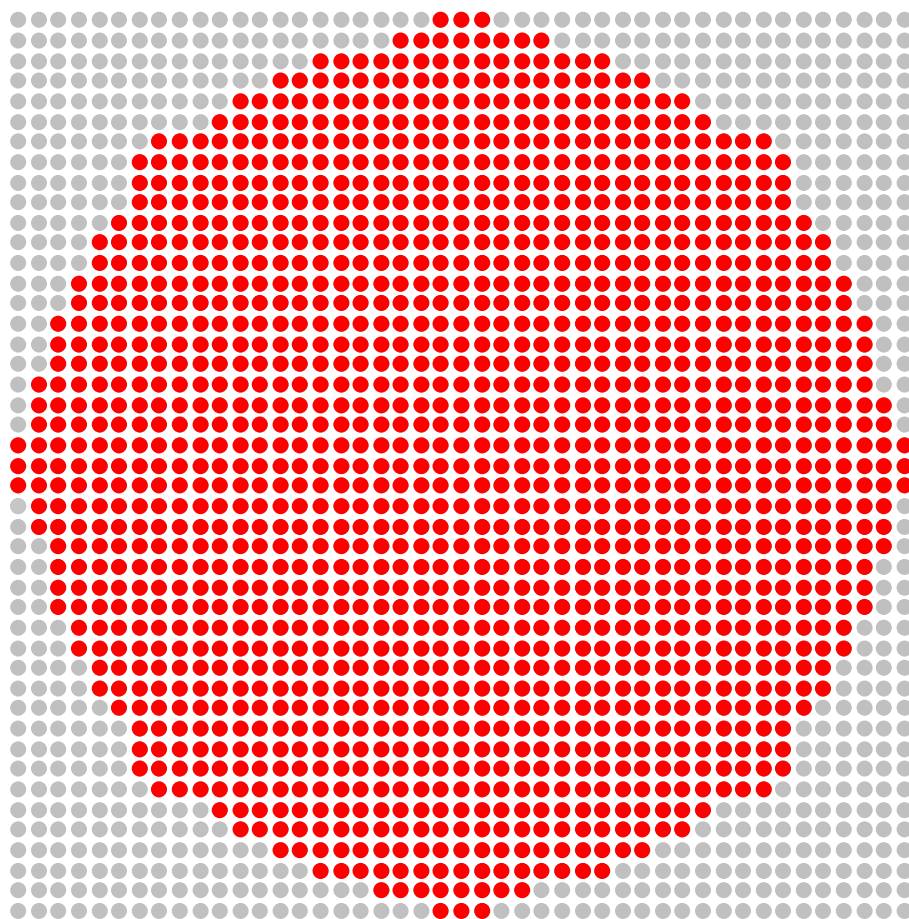
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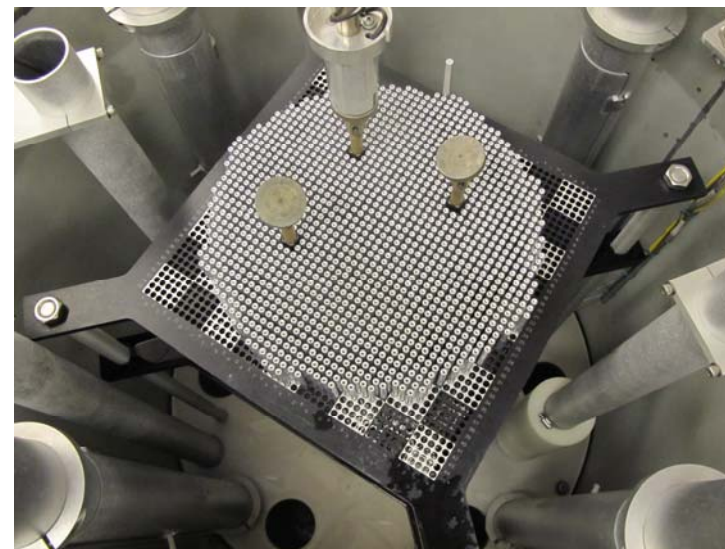
IER-285

- **This experiment was done to answer a request from SRNL for integral critical experiments with titanium in a thermal system**
- **This experiment series was done as a set of progressive fuel-rod-replacement experiments in the 7uPCX critical assembly**
- **We used titanium and aluminum replacement rods**
- **A benchmark evaluation (LEU-COMP-THERM-097) has been published in the *International Handbook of Evaluated Criticality Safety Benchmark Experiments***
- **We are working on a set of experiments (IER-451) with titanium sleeves on another set of fuel rods (BUCCX)**

Case 1

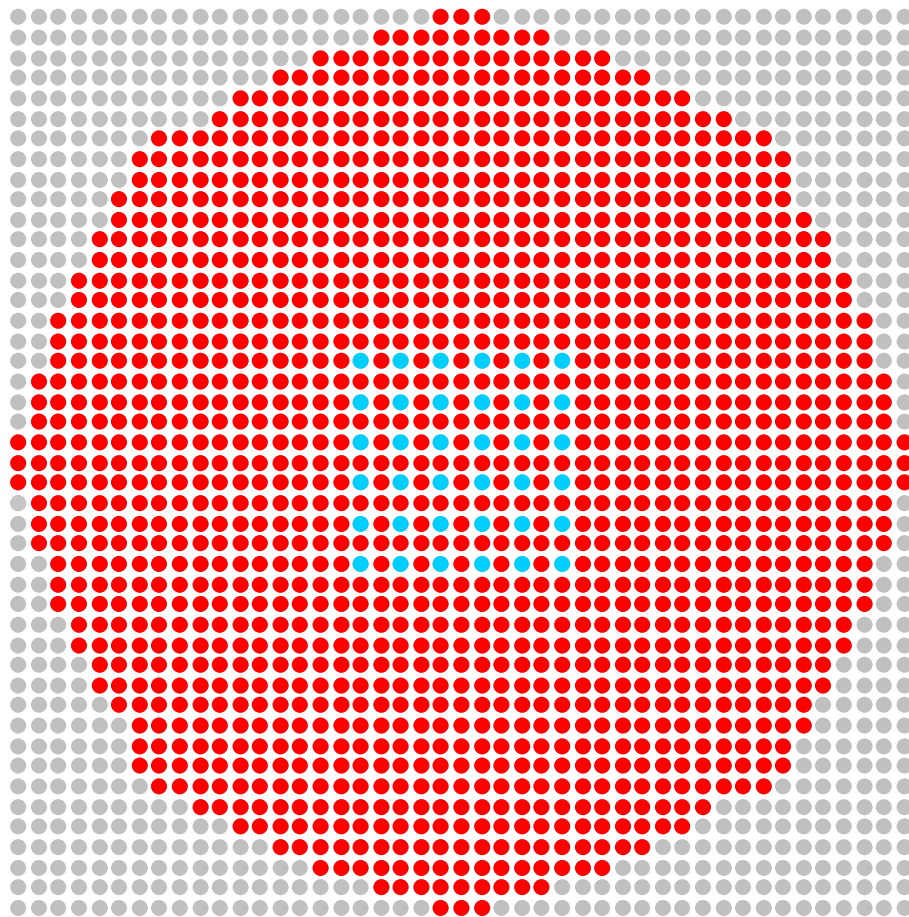


- Fuel Rod
- Empty Grid Location

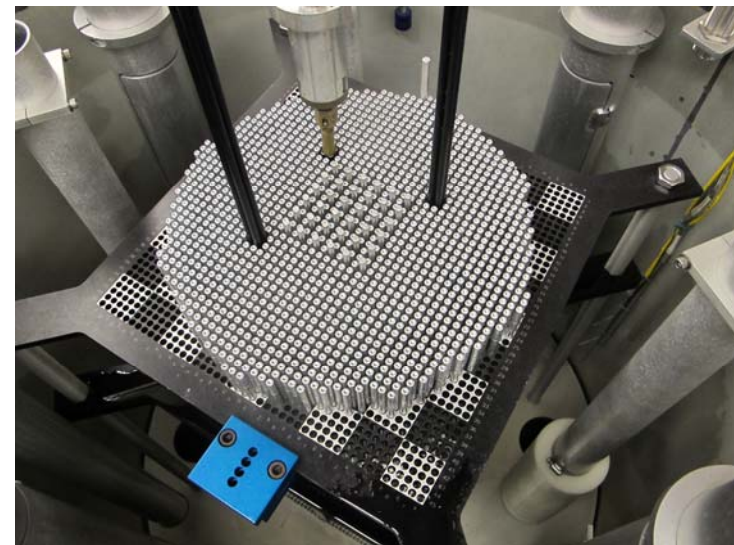


Fuel	1457
Expt.	0
Empty	0
Total	1457

Case 16

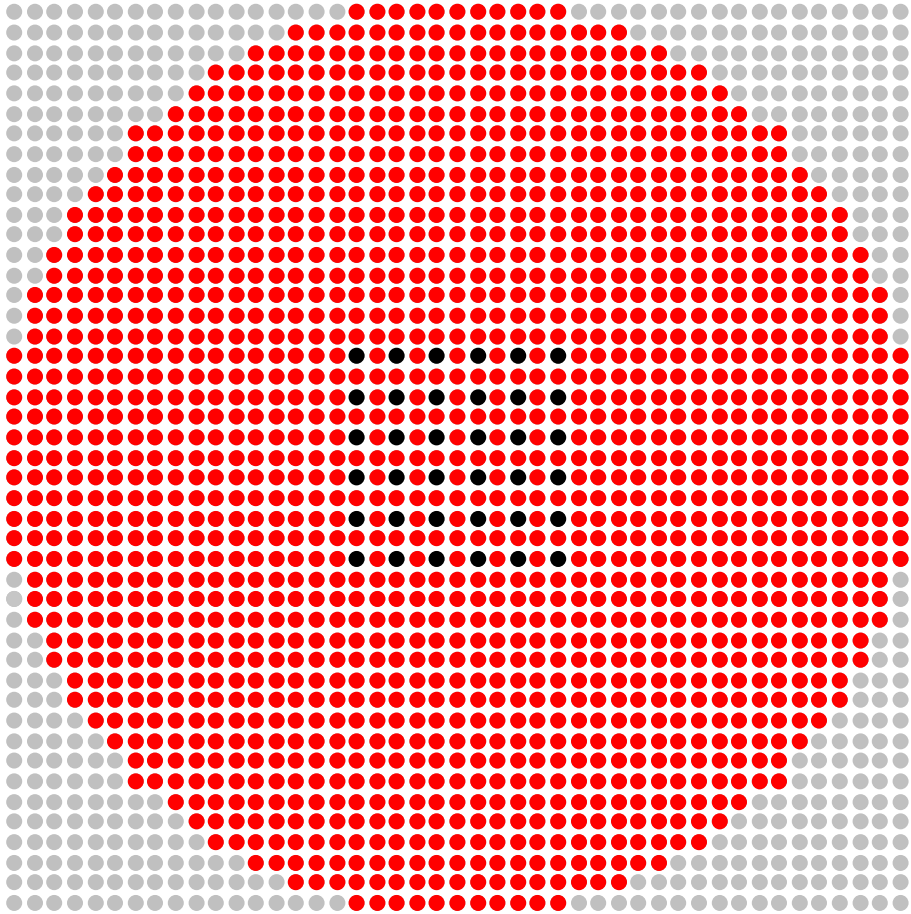


- Fuel Rod
- Empty Grid Location
- Aluminum Experiment Rod

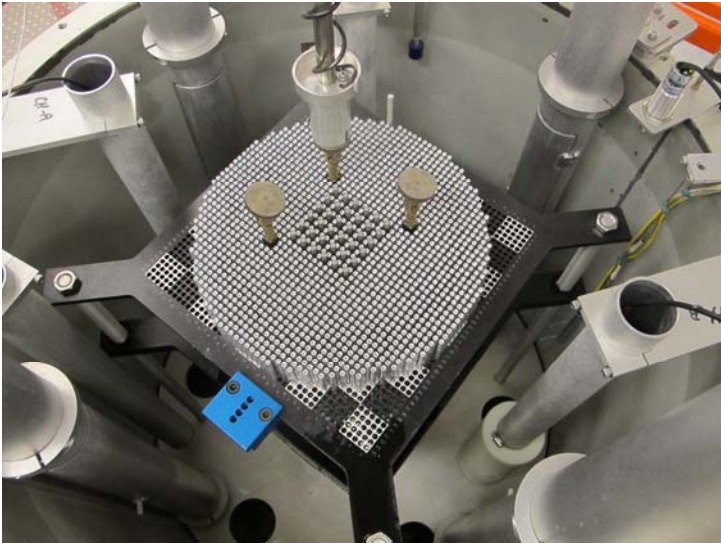


Fuel	1429
Expt.	36 Al
Empty	0
Total	1465

Case 8

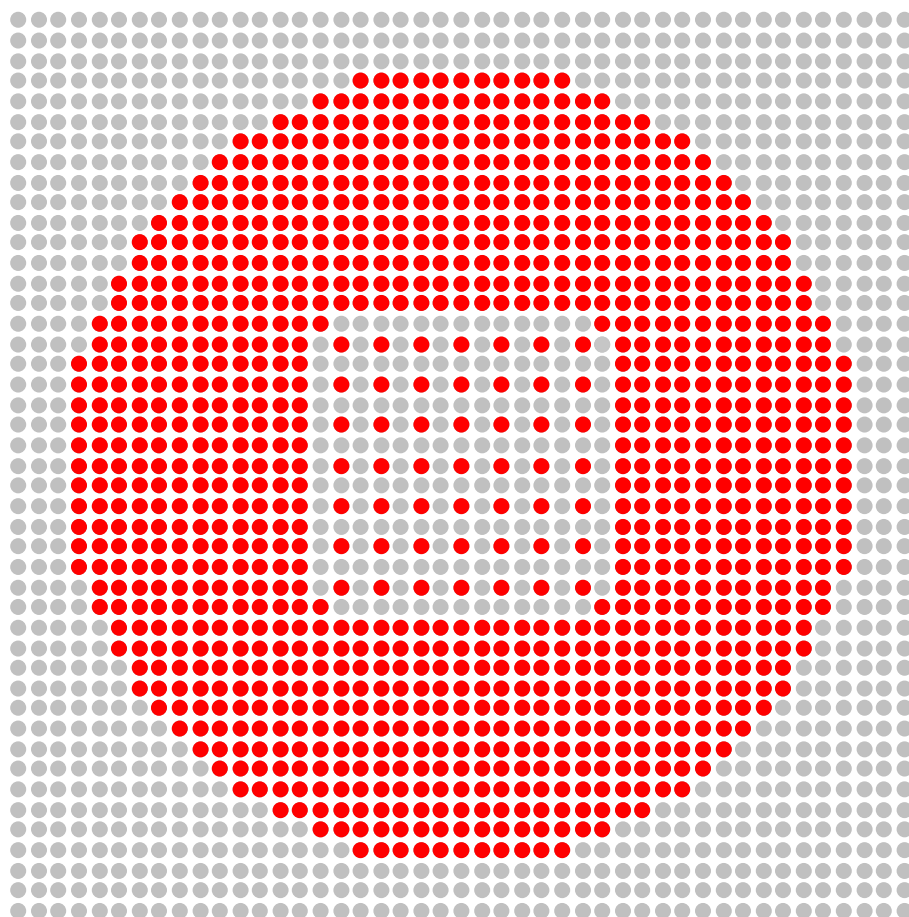


- Fuel Rod
- Empty Grid Location
- Titanium Experiment Rod

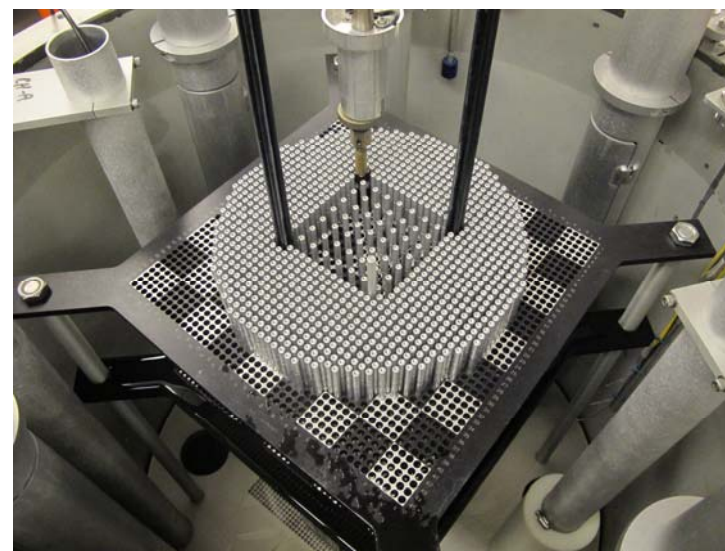


Fuel	1573
Expt.	36 Ti
Empty	0
Total	1609

Case 18

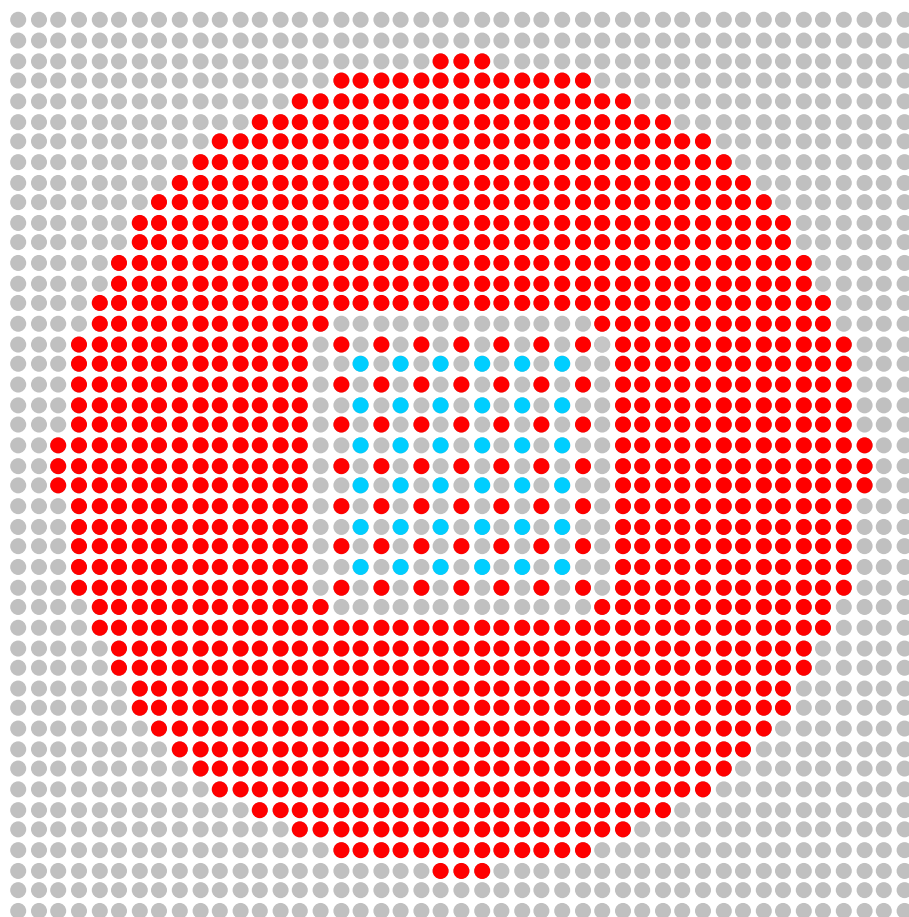


- Fuel Rod
- Empty Grid Location

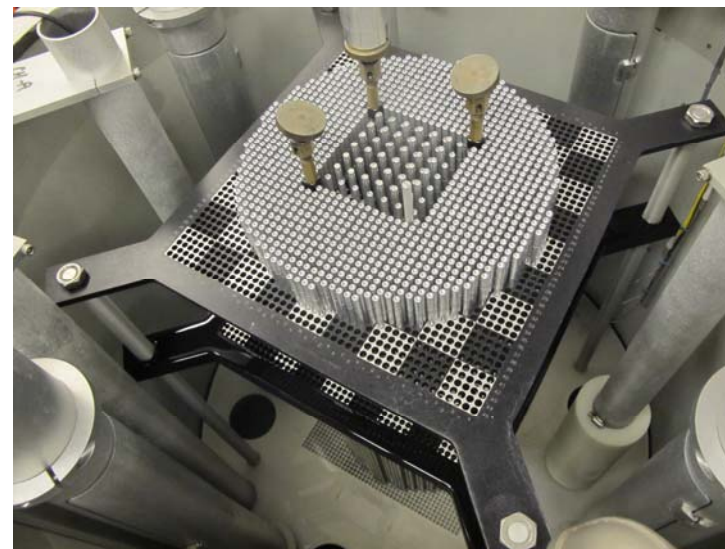


Fuel	1037
Expt.	0
Empty	172
Total	1209

Case 19

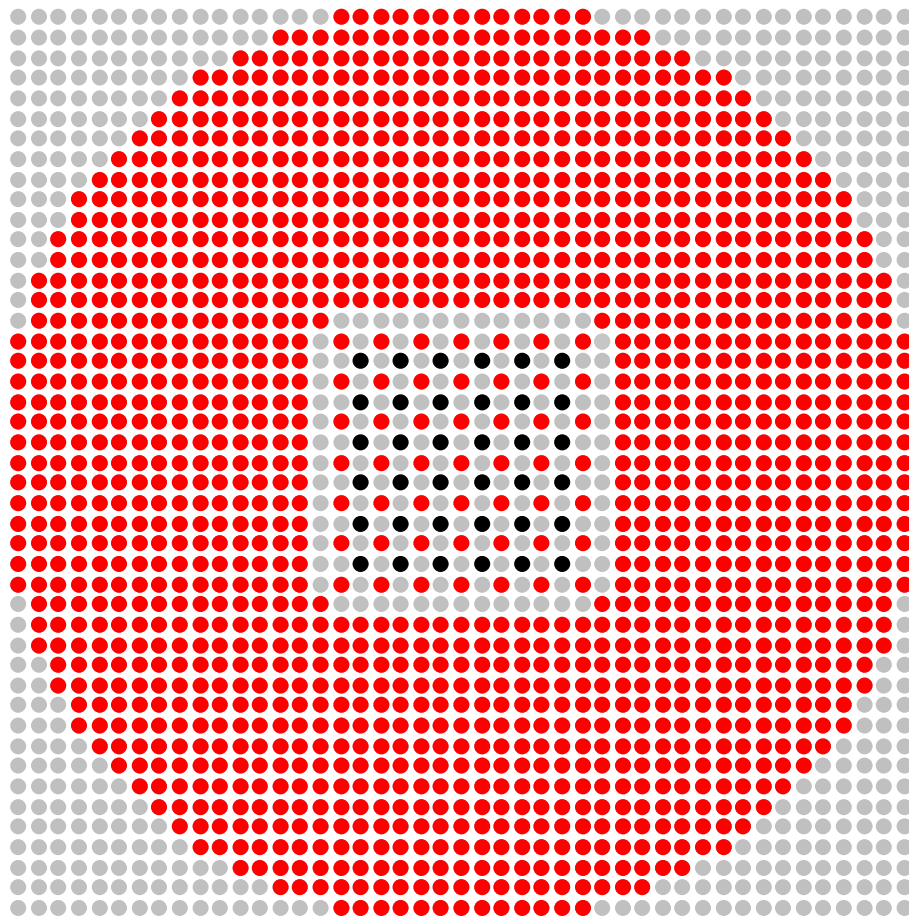


- Fuel Rod
- Empty Grid Location
- Aluminum Experiment Rod

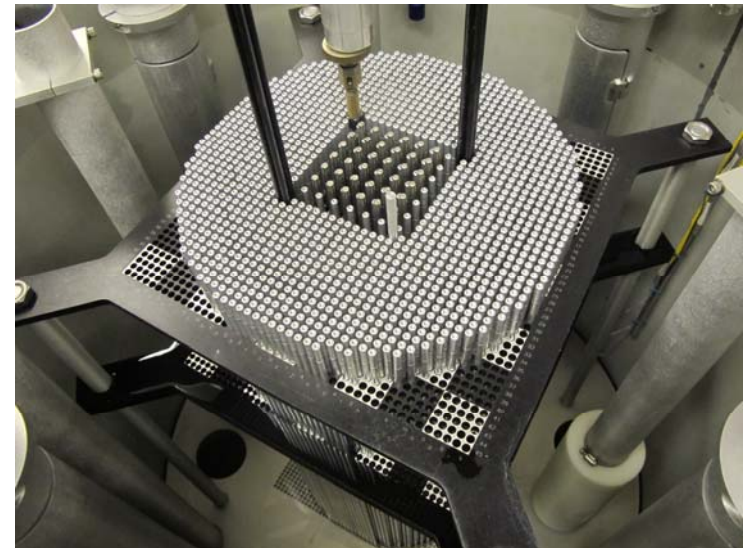


Fuel	1097
Expt.	36 Al
Empty	136
Total	1269

Case 24

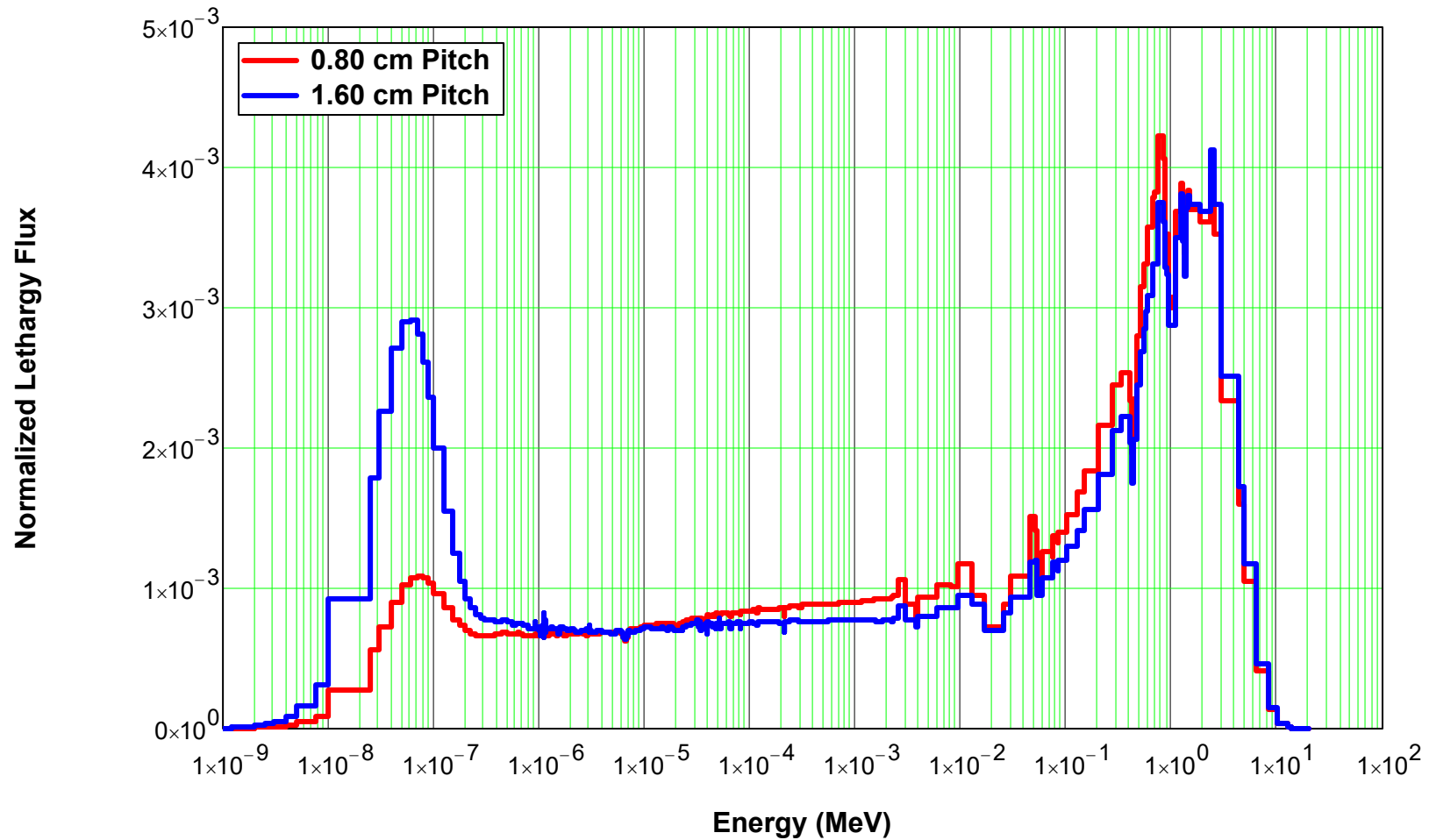


- Fuel Rod
- Empty Grid Location
- Titanium Experiment Rod

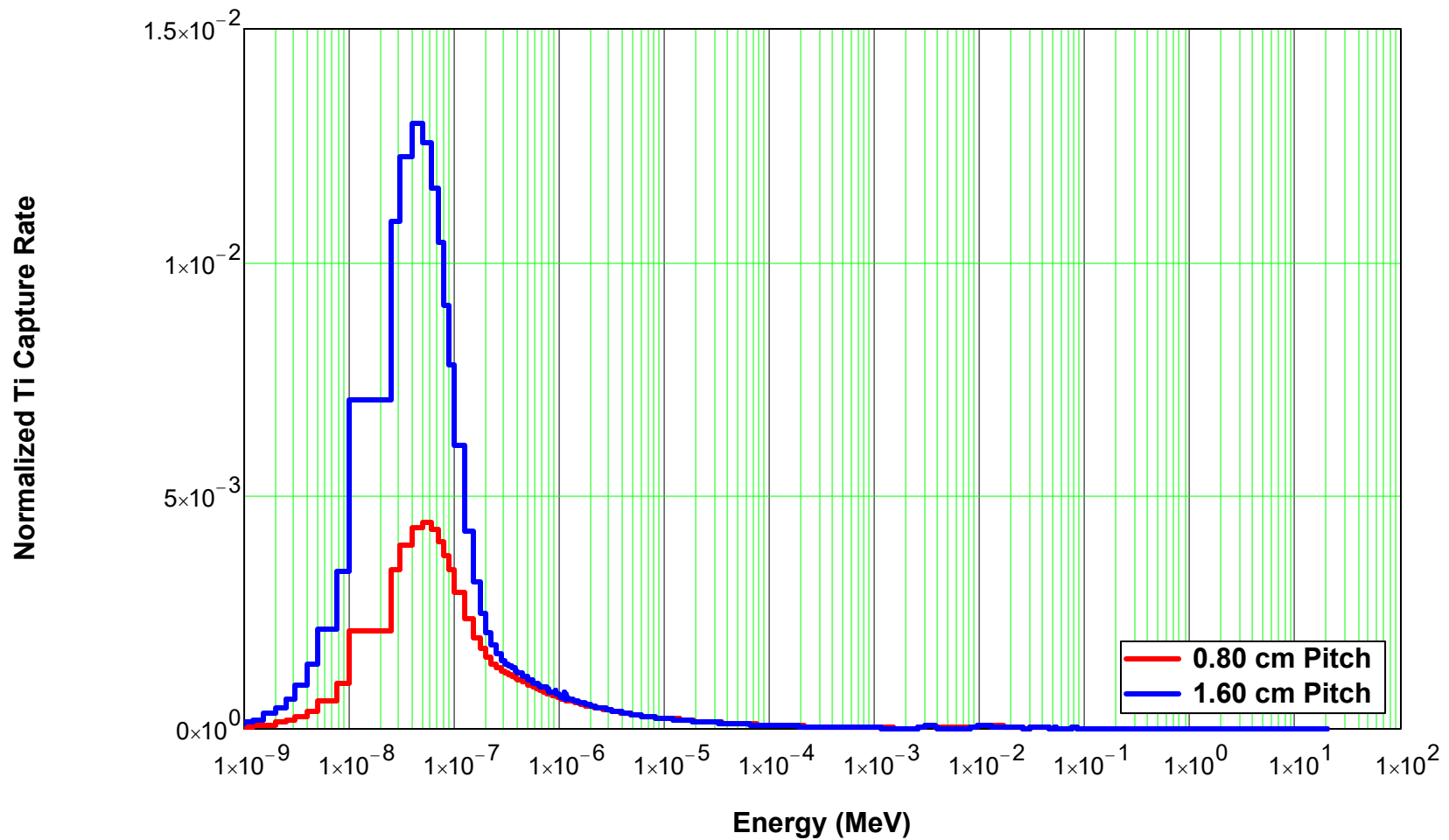


Fuel	1485
Expt.	36 Ti
Empty	136
Total	1657

A comparison of the neutron spectra in the titanium rods



A comparison of the capture rate in the titanium rods





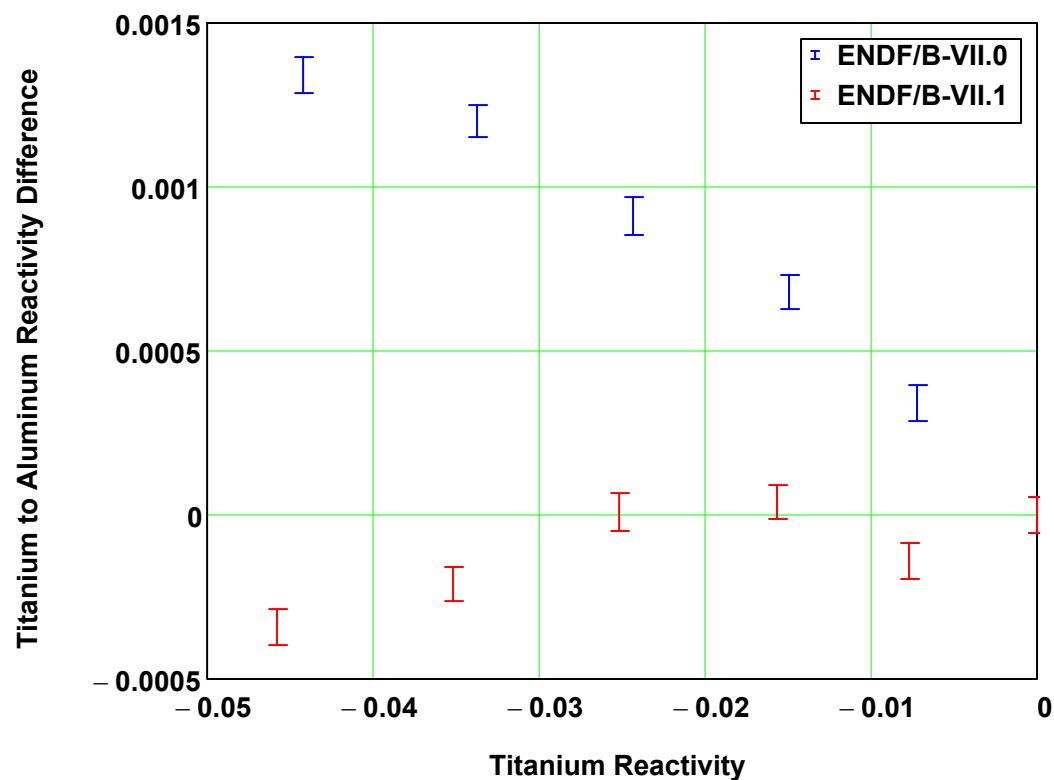
The bottom line in the LCT097 evaluation

- **24 benchmark configurations**
 - **17 at 0.8 cm pitch**
 - 1 with no experiment rods
 - 8 with aluminum experiment rods
 - 8 with titanium experiment rods
 - **7 at 1.6 cm pitch**
 - 1 with no experiment rods
 - The remainder with 36 Ti + Al experiment rods
 - 0, 4, 9, 16, 25, 36 titanium experiment rods
- **Benchmark model k_{eff} s from 0.9991 to 0.9998**
- **Overall uncertainties in k_{eff} of 0.0007 to 0.0011**




The experiments test changes to the Ti cross sections

The ^{48}Ti capture cross section was increased about 6% between ENDF/B-VII.0 and ENDF/B-VII.1



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