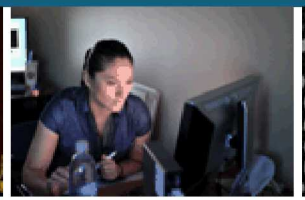
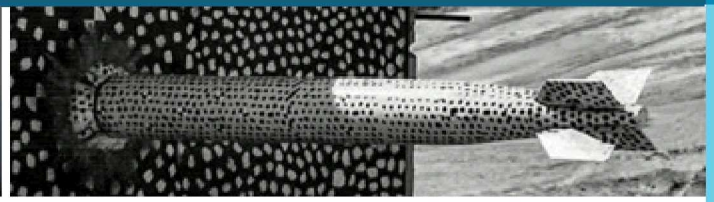
This work was supported by the DOE Nuclear Criticality Safety Program, funded and managed by the National Nuclear Security Administration for the Department of Energy.

SAND2020-1379PE

The NCSP at Sandia





Gary A. Harms and David E. Ames

Nuclear Criticality Safety Program Technical Program Review
Santa Fe
February 11-12, 2020

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NCSP Funding at Sandia

Element	Task	FY19 Element Total (k)	Task Funding (k)	Description	Spent
Total		$1,317		NCSP Funding at Sandia	$1,030,925
IE		$1,013		Integral Experiments	$806,437
	IE1S1		$371	Fixed Cost Items	
	IE1S2		$446	Programmatic Work	
	IE2		$69	Support for NCERC Safety	
	IE3		$92	CX Control System Upgrade	
	IE4		$35	Support for AFRRI Characterization	
T&E		$229		Training & Education	$150,398
	TE1		$204	Deliver Hands-On Training	
	TE2		$25	Support CSO Class Development	
TS		$75		Technical Support	$74,090
	TS-3		$75	Succession Planning for Key Staff	

This work was supported by the DOE Nuclear Criticality Safety Program, funded and managed by the National Nuclear Security Administration for the Department of Energy.

Sandia Integral Experiment Requests Current (2/20) Status

IER	Title	Sponsor	CED
209	7uPCX 0.855 cm Pitch, Variable Depth Pure Water Moderator	SNL	4b
230	Characterize the Thermal Capabilities of the 7uPCX	SNL	3b
304	Temperature Dependent Critical Benchmarks	ORNL	2
305	Critical Experiments with UO2 Rods and Molybdenum Foils	IRSN	2
306	Critical Experiments with UO2 Rods and Rhodium Foils	IRSN	1
441	Epithermal HEX Lattices with SNL 7uPCX Fuel for Testing Nuclear Data	ORNL	3a
451	Titanium Cross Sections in a Thermal Application (BUCCX Hardware)	SRNL	4b!
452	Inversion Point of the Isothermal Reactivity Coefficient	SNL	1

Completed in FY19

CED status in February 2020

Integral Experiment Request 451

IER	Title	Sponsor	CED
209	7uPCX 0.855 cm Pitch, Variable Depth Pure Water Moderator	SNL	4a
230	Characterize the Thermal Capabilities of the 7uPCX	SNL	3b
304	Temperature Dependent Critical Benchmarks	ORNL	2
305	Critical Experiments with UO2 Rods and Molybdenum Foils	IRSN	2
306	Critical Experiments with UO2 Rods and Rhodium Foils	IRSN	1
441	Epithermal HEX Lattices with SNL 7uPCX Fuel for Testing Nuclear Data	ORNL	2
451	Titanium Cross Sections in a Thermal Application (BUCCX Hardware)	SRNL	4b
452	Inversion Point of the Isothermal Reactivity Coefficient	SNL	1

IER-451		Started FY19 in CED-4a	CED Cost	FY19 Cost
	451-4a	Completed CED-4a in Q1	42,217	
	451-4b	Completed CED-4b in Q4	99,542	141,759

Savannah River National Laboratory requested integral experiments with titanium

- **Needed to benchmark criticality analysis of waste solution processing**

Sandia completed titanium rod-replacement experiments in 7uPCX and published benchmark in FY16

IER-451 is an independent experiment with titanium sleeves in BUCCX

- **Experiments were completed in FY18**
- **Published in FY19!**

Integral Experiment Request 209

IER	Title	Sponsor	CED
209	7uPCX 0.855 cm Pitch, Variable Depth Pure Water Moderator	SNL	4a
230	Characterize the Thermal Capabilities of the 7uPCX	SNL	3b
304	Temperature Dependent Critical Benchmarks	ORNL	2
305	Critical Experiments with UO2 Rods and Molybdenum Foils	IRSN	2
306	Critical Experiments with UO2 Rods and Rhodium Foils	IRSN	1
441	Epithermal HEX Lattices with SNL 7uPCX Fuel for Testing Nuclear Data	ORNL	2
451	Titanium Cross Sections in a Thermal Application (BUCCX Hardware)	SRNL	4b
452	Inversion Point of the Isothermal Reactivity Coefficient	SNL	1

IER-209		Started FY19 in CED-3b	CED Cost	Total Cost
	209-3b	Completed CED-3b in Q3	166771	
	209-4a	Finished the year in CED-4a	41091	207862

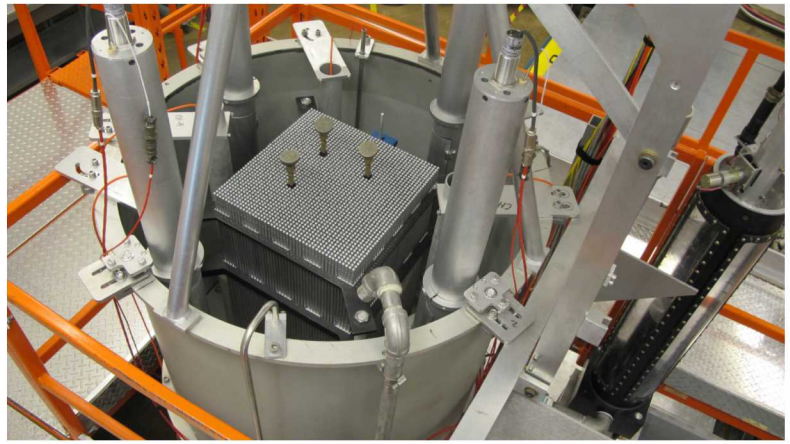
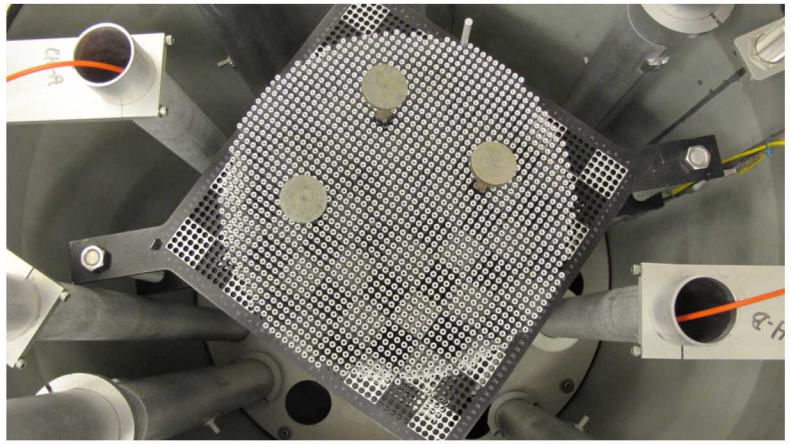
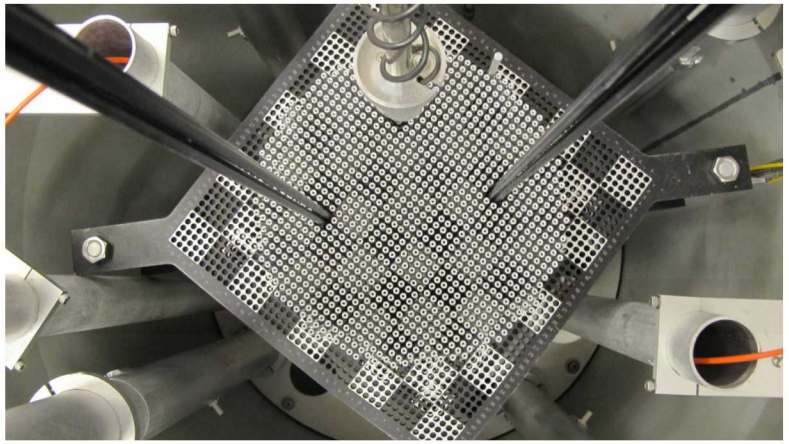
IER-209 is a Sandia experiment intended to explore our ability to perform partially-reflected experiments

- **Approach is on water height**

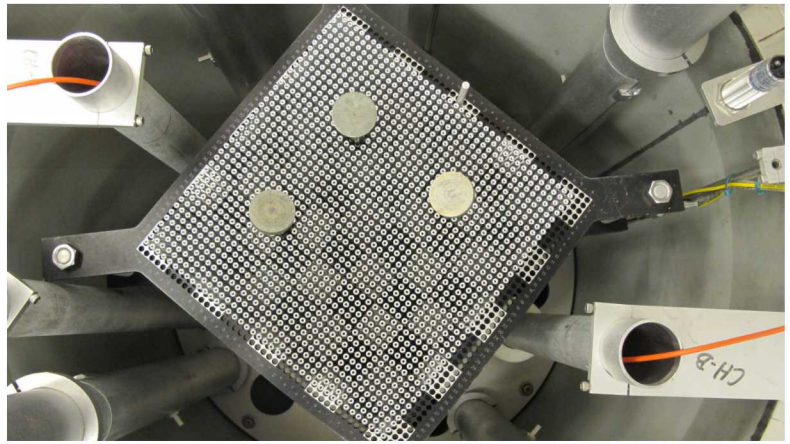
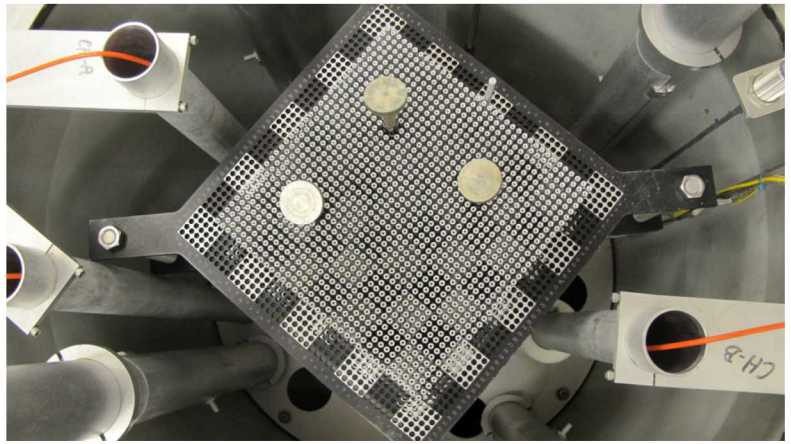
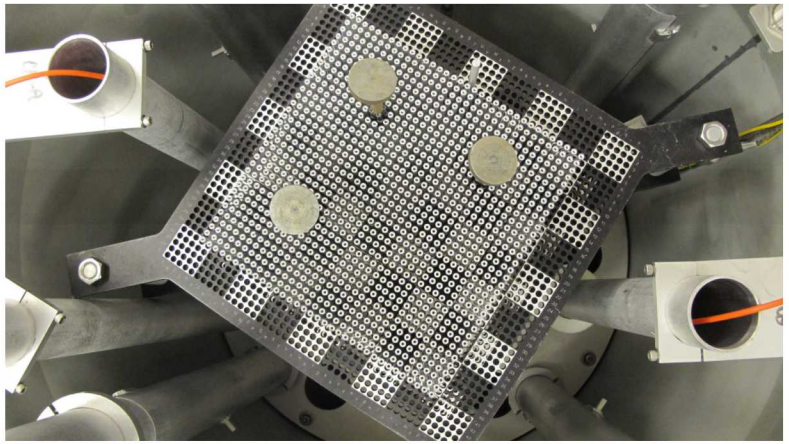
Similar to benchmark LEU-COMP-THERM-096 (IER-208) that we published in 2015

This experiment is now in CED-4b will appear as LEU-COMP-THERM-101 at the end of FY20

Integral Experiment Request 209

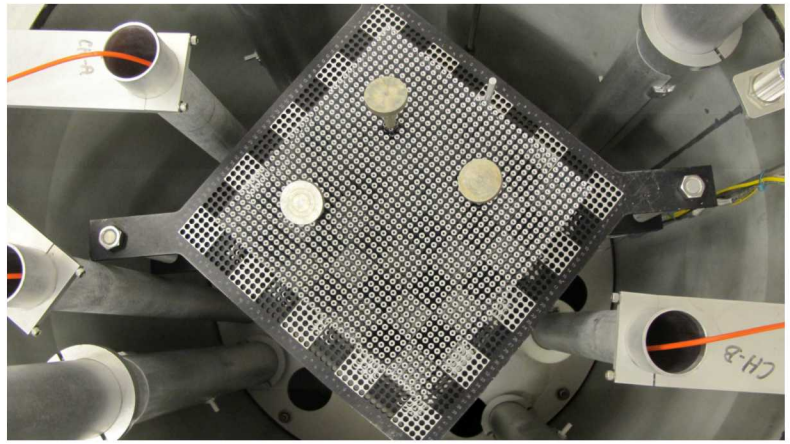
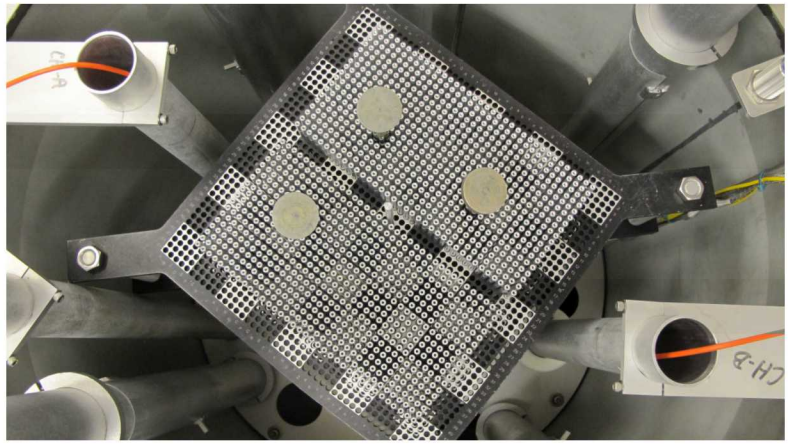
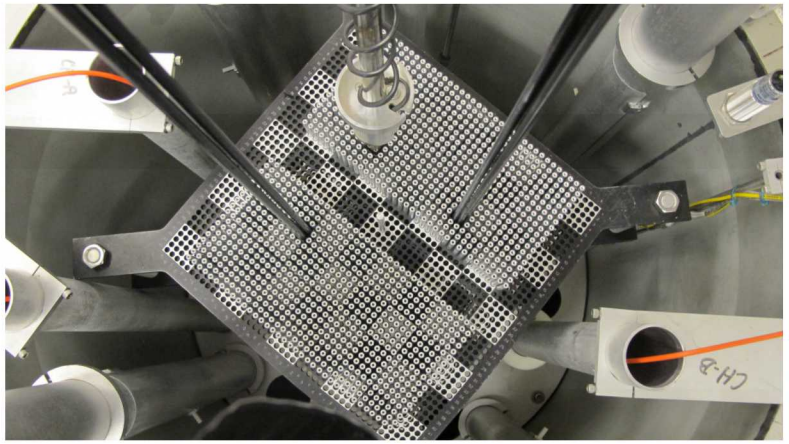




“Compact” Cores

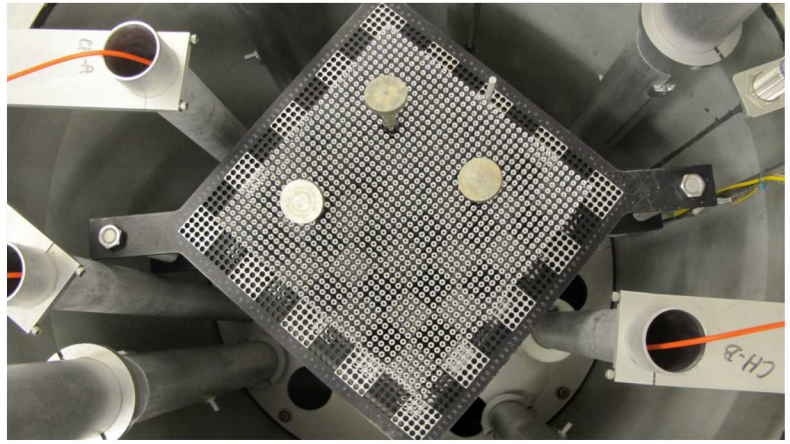
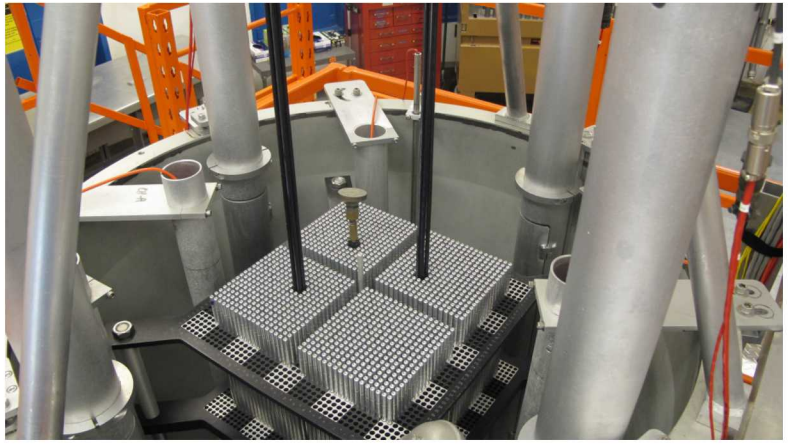
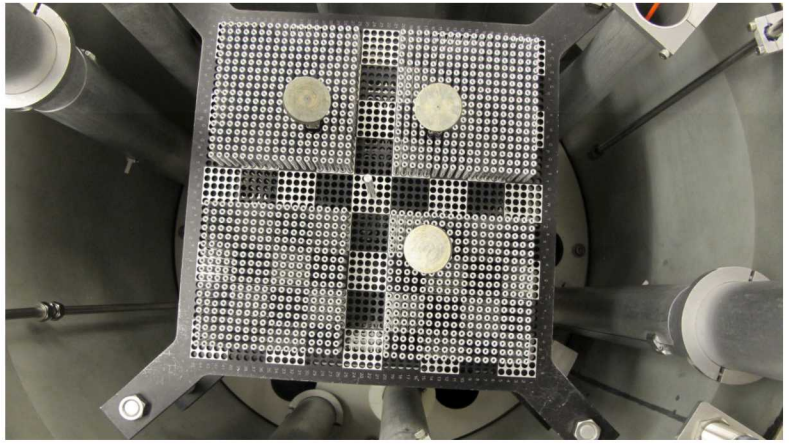




Square Cores

Integral Experiment Request 209

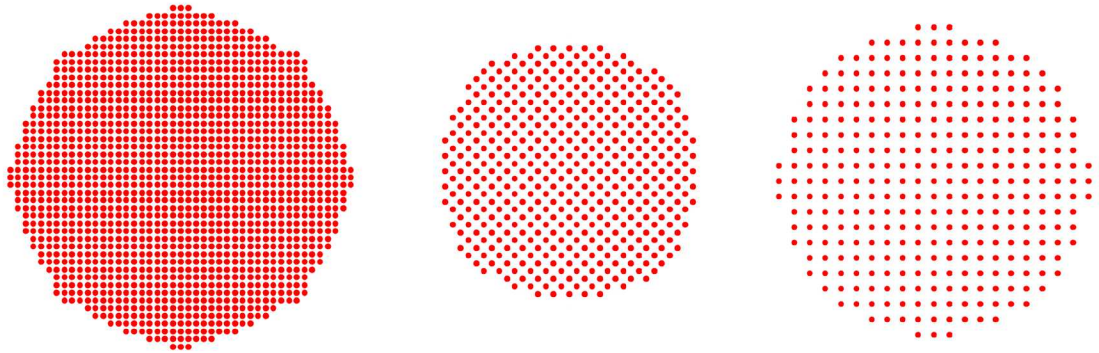
Linear Water Channels

Cruciform Water Channels

Integral Experiment Request 230

IER	Title	Sponsor	CED
209	7uPCX 0.855 cm Pitch, Variable Depth Pure Water Moderator	SNL	4a
230	Characterize the Thermal Capabilities of the 7uPCX	SNL	3b
304	Temperature Dependent Critical Benchmarks	ORNL	2
305	Critical Experiments with UO2 Rods and Molybdenum Foils	IRSN	2
306	Critical Experiments with UO2 Rods and Rhodium Foils	IRSN	1
441	Epithermal HEX Lattices with SNL 7uPCX Fuel for Testing Nuclear Data	ORNL	2
451	Titanium Cross Sections in a Thermal Application (BUCCX Hardware)	SRNL	4b
452	Inversion Point of the Isothermal Reactivity Coefficient	SNL	1



0.800 cm Pitch
1461 Rods at DC

1.132 cm Pitch
454 Rods at DC

1.600 cm Pitch
328 Rods at DC

IER-230		Started FY19 in CED-2	CED Cost	Total Cost
	230-2	Completed CED-2 in Q2	21958	
	230-3a	Completed CED-3a in Q3	25784	
	230-3b	Finished the year in CED-3b	58711	106453

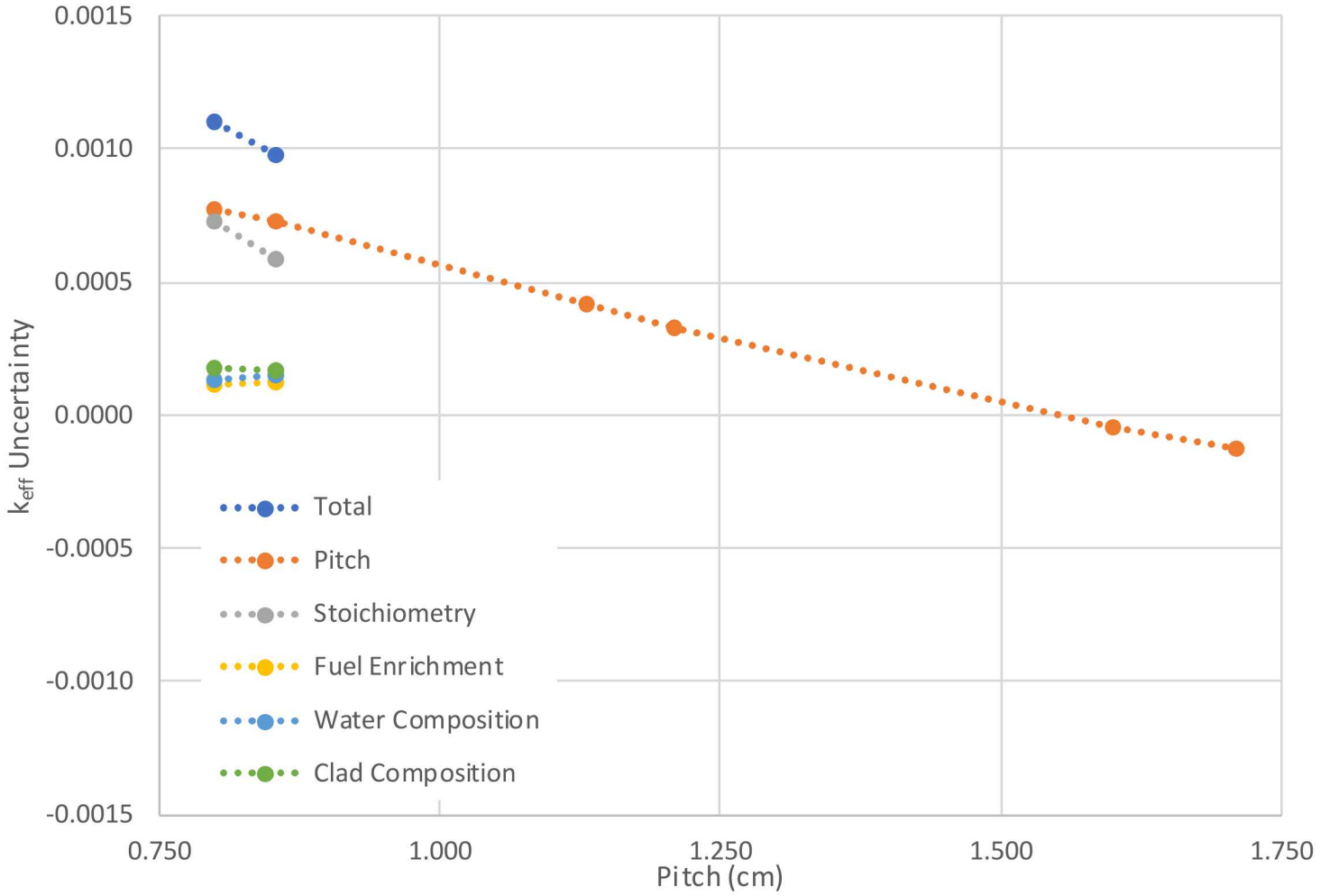
IER-230 is a Sandia experiment intended to explore the behavior of our 7uPCX experiment as a function of fuel-to-water ratio

- **Approach is on number of fuel rods**

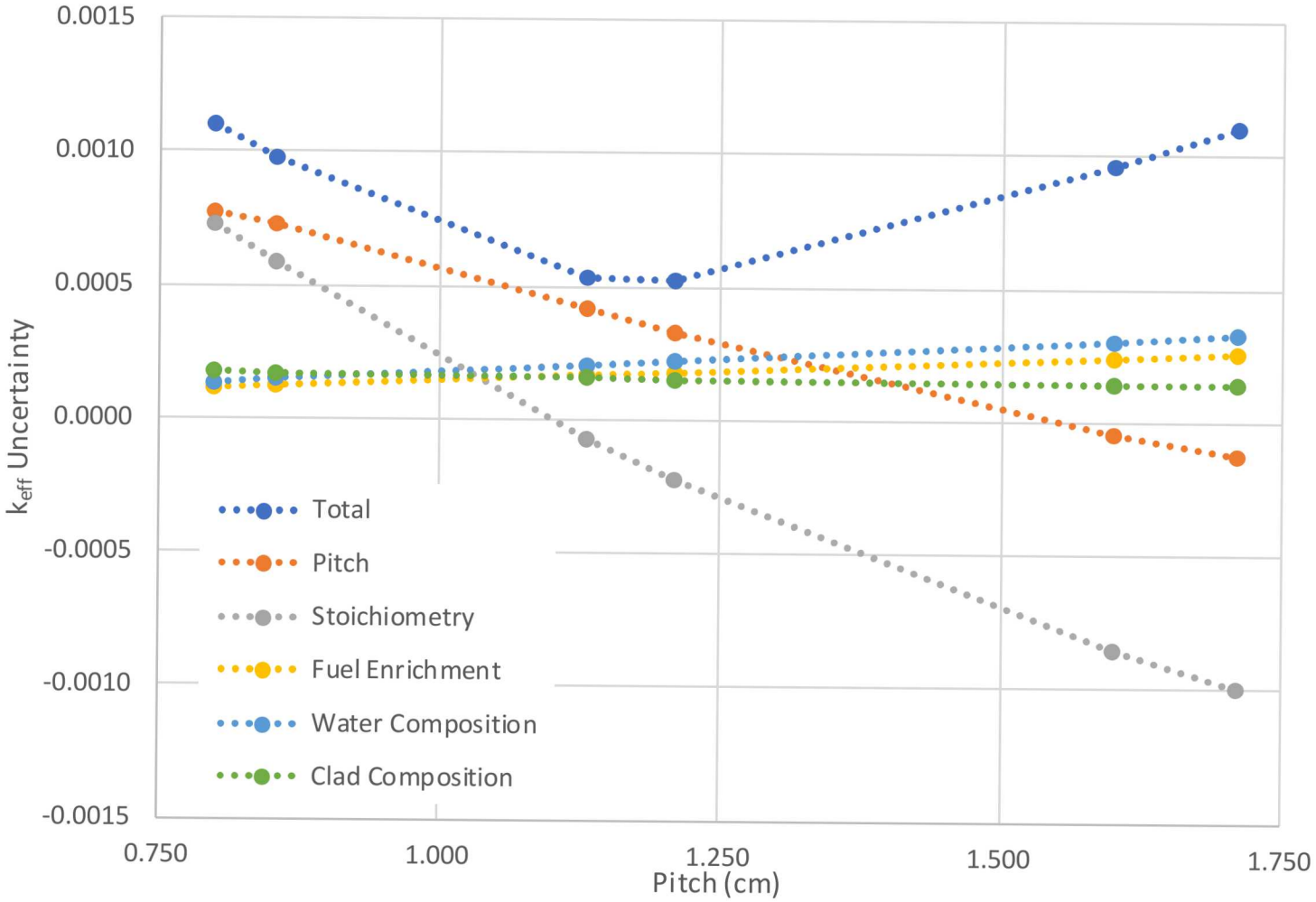
David Ames is the experimenter

This experiment is now in CED-3b and is expected to be published in 2021

LCT080 (0.800 cm) and LCT078 (0.855 cm) Uncertainties



IER-230 Uncertainties



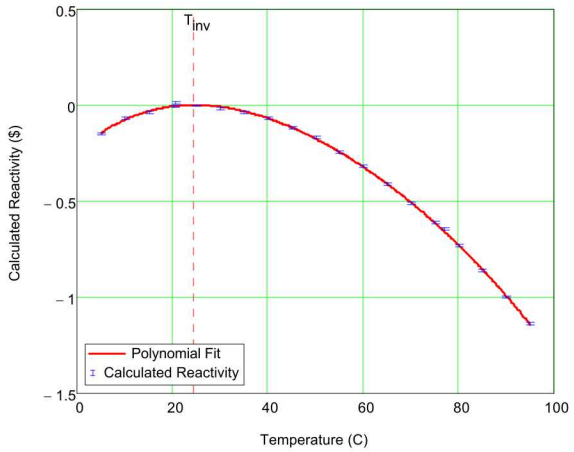
Integral Experiment Request 452

IER	Title	Sponsor	CED
209	7uPCX 0.855 cm Pitch, Variable Depth Pure Water Moderator	SNL	4a
230	Characterize the Thermal Capabilities of the 7uPCX	SNL	3b
304	Temperature Dependent Critical Benchmarks	ORNL	2
305	Critical Experiments with UO2 Rods and Molybdenum Foils	IRSN	2
306	Critical Experiments with UO2 Rods and Rhodium Foils	IRSN	1
441	Epithermal HEX Lattices with SNL 7uPCX Fuel for Testing Nuclear Data	ORNL	2
451	Titanium Cross Sections in a Thermal Application (BUCCX Hardware)	SRNL	4b
452	Inversion Point of the Isothermal Reactivity Coefficient	SNL	1

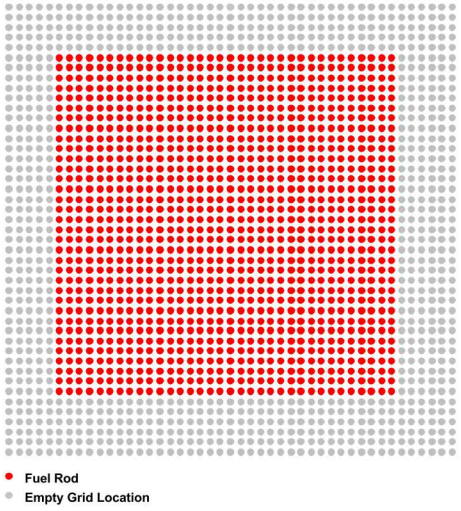
IER-452		Started FY19 in CED-1	CED Cost	Total Cost
	452-1	Finished the year in CED-1	0	0

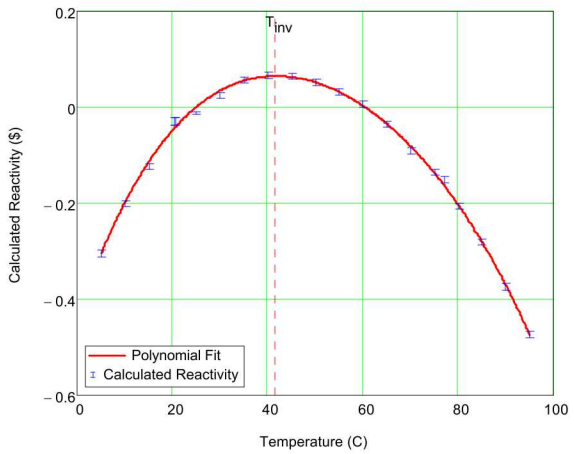
IER-452 is a Sandia experiment intended to explore the behavior of the temperature coefficient in the 7uPCX

Integral Experiment Request 452 – Why?

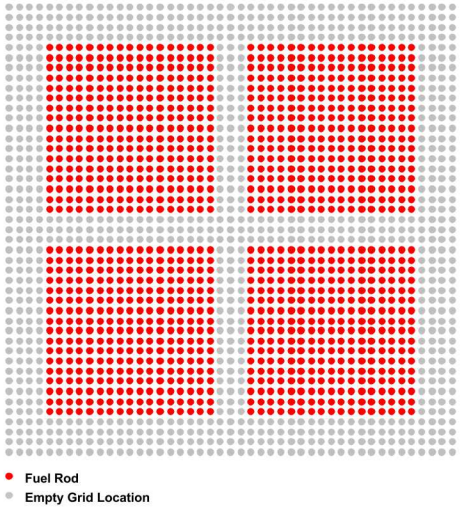


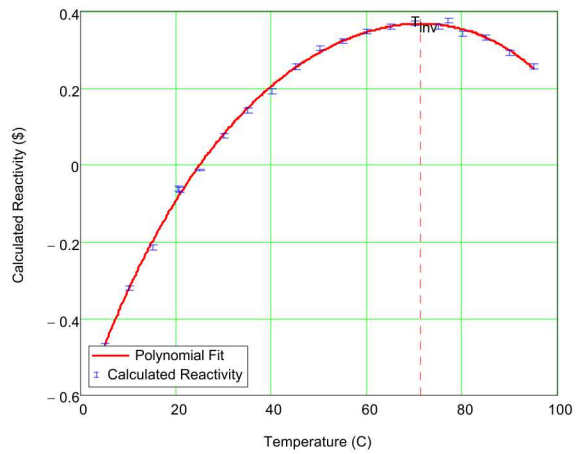
T_{inv} ~ 25°C



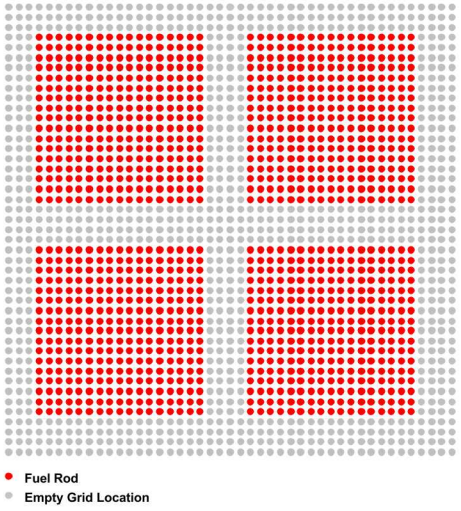


T_{inv} ~ 42°C





T_{inv} ~ 71°C



Integral Experiment Request 304 and 441

IER	Title	Sponsor	CED
209	7uPCX 0.855 cm Pitch, Variable Depth Pure Water Moderator	SNL	4a
230	Characterize the Thermal Capabilities of the 7uPCX	SNL	3b
304	Temperature Dependent Critical Benchmarks	ORNL	2
305	Critical Experiments with UO2 Rods and Molybdenum Foils	IRSN	2
306	Critical Experiments with UO2 Rods and Rhodium Foils	IRSN	1
441	Epithermal HEX Lattices with SNL 7uPCX Fuel for Testing Nuclear Data	ORNL	2
451	Titanium Cross Sections in a Thermal Application (BUCCX Hardware)	SRNL	4b
452	Inversion Point of the Isothermal Reactivity Coefficient	SNL	1

Justin Clarity at ORNL is leading the design of these experiments

IER-304		Started FY19 in CED-2	CED Cost	Total Cost
	304-2	Finished the year in CED-2	1,970	1,970

IER-441		Started FY19 in CED2	CED Cost	Total Cost
	304-2	CED2 completed Q2	0	
	304-3?	Finished the year between CED-2 and -3	0	0

IER-304 is an ORNL experiment intended to explore the behavior of the Sandia criticals as a function of temperature

IER-441 is an ORNL experiment intended to harden the neutron spectrum in the assembly

Integral Experiment Requests 305 and 306

IER	Title	Sponsor	CED
209	7uPCX 0.855 cm Pitch, Variable Depth Pure Water Moderator	SNL	4a
230	Characterize the Thermal Capabilities of the 7uPCX	SNL	3b
304	Temperature Dependent Critical Benchmarks	ORNL	2
305	Critical Experiments with UO2 Rods and Molybdenum Foils	IRSN	2
306	Critical Experiments with UO2 Rods and Rhodium Foils	IRSN	1
441	Epithermal HEX Lattices with SNL 7uPCX Fuel for Testing Nuclear Data	ORNL	2
451	Titanium Cross Sections in a Thermal Application (BUCCX Hardware)	SRNL	4b
452	Inversion Point of the Isothermal Reactivity Coefficient	SNL	1

Nicolas Leclaire at IRSN is leading the design of these experiments

IER-305		Started FY19 in CED-1	CED Cost	Total Cost
	305-1	Completed CED-1 in Q1	0	
	305-2	Finished the year in CED-2	0	0

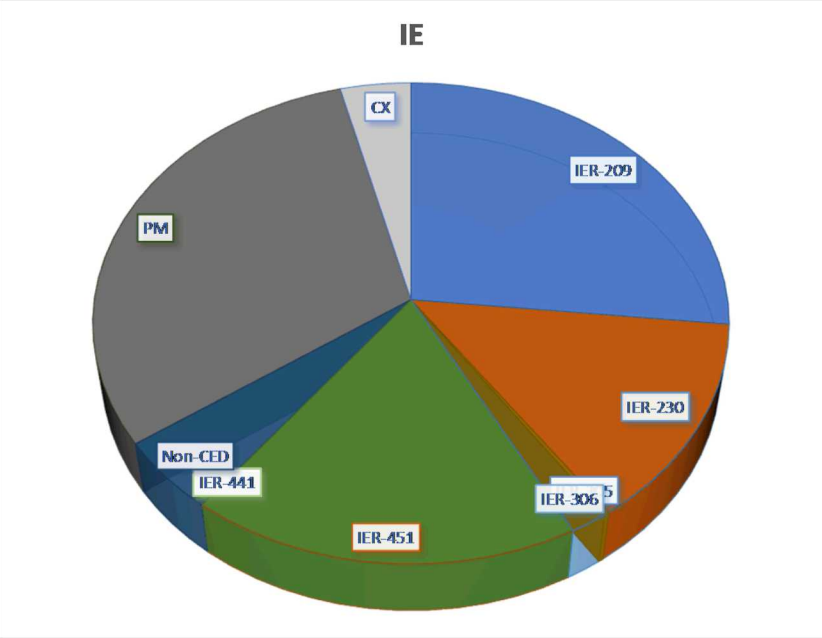
IER-306		Started FY19 in CED-1	CED Cost	Total Cost
	306-1	Finished the year in CED-1	13,626	13,626

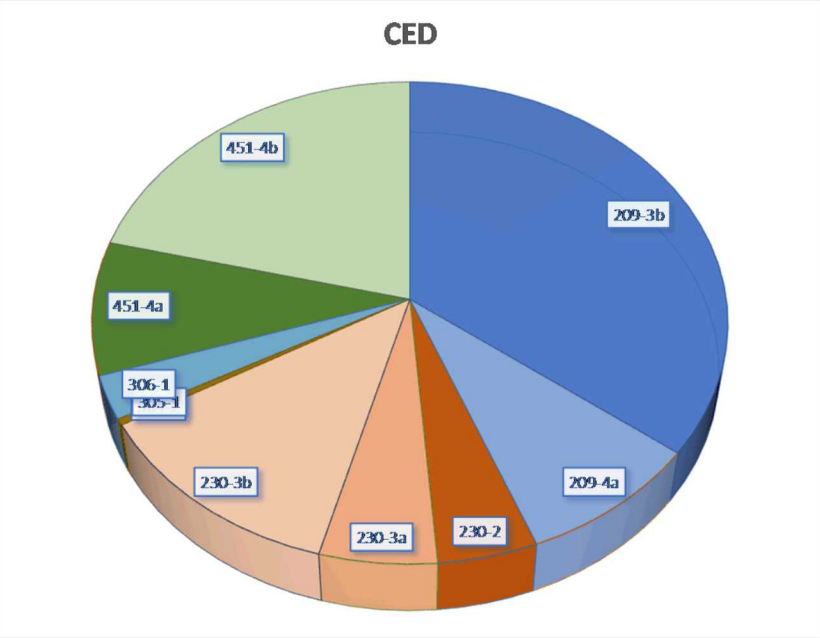
IER-305 is an IRSN experiment intended to benchmark the effect of molybdenum on critical systems

IER-306 is an IRSN experiment intended to benchmark the effect of rhodium on critical systems

Sandia Progress on Experiments in FY19

IER	Started FY19	Completed	Ended FY19	Spending
451	CED-4a	CED-4a (Q1), CED-4b (Q4)	Complete	$142k
209	CED-3b	CED-3b (Q3)	CED-4a	$208k
230	CED-2	CED-2 (Q2), CED-3a (Q3)	CED-3b	$106k
304	CED-2	–	CED-2	$2k
305	CED-1	CED-1 (Q1)	CED-2	$0
306	CED-1	–	CED-1	$14k
441	CED-2	CED-2 (Q2)	CED-2/3	$0
452	CED-1	–	CED-1	$0
			Total	$472k





Critical Experiments at Sandia