



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Nuclear Science User Facilities

Nuclear Energy Infrastructure Database

Brenden Heidrich

NSUF Chief Irradiation Scientist

Adv. Man. and Supply Chain Innovation

Nuclear Energy Leadership Summit

Idaho Falls, ID

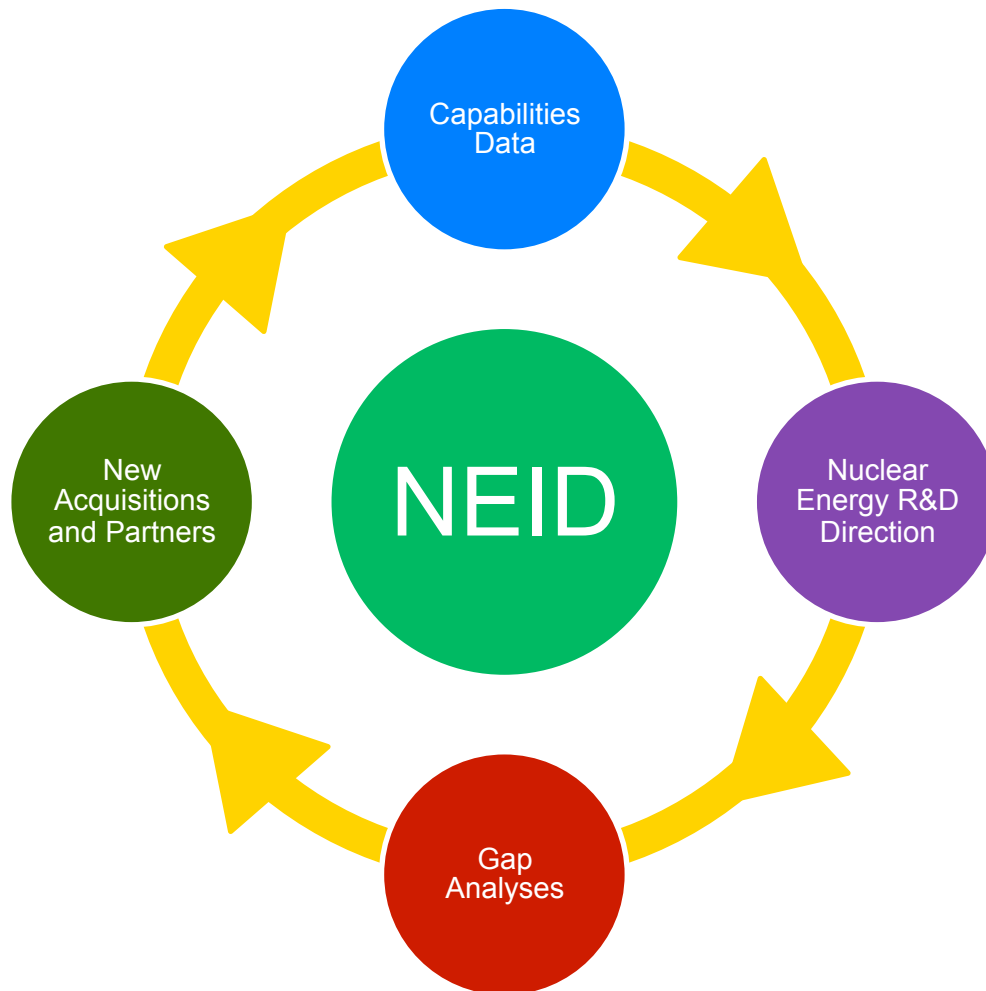
October 3, 2017



INL/CON-17-43290

Infrastructure Management Program

1. Gather Data on Nuclear Energy R&D Capabilities
2. Estimate Near, Mid and Long-term R&D Directions
3. Use these to perform gap analyses for Nuclear Energy R&D.
4. Assist funding decisions and incorporate the results into the NEID.

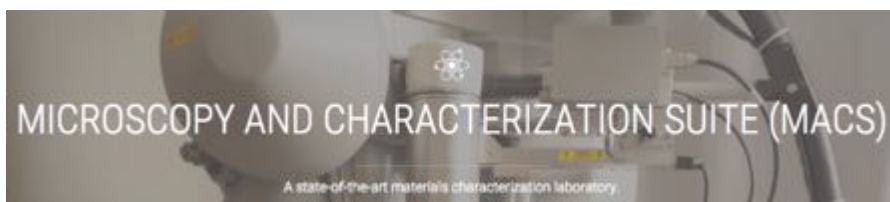


■ Resource for a variety of the nuclear energy groups:

- Nuclear Energy Research Community
 - Aiding their search for capabilities on current or future projects
- Office of Nuclear Energy
 - Aiding in infrastructure investment decisions
- NSUF Technical Leads
 - Aiding in the search for the best and most cost effective capability available



NEID Organization



FEI Quanta 3D FEG
Focused Ion Beam
SEM Microscope



Institutions (150)

Facilities (500)

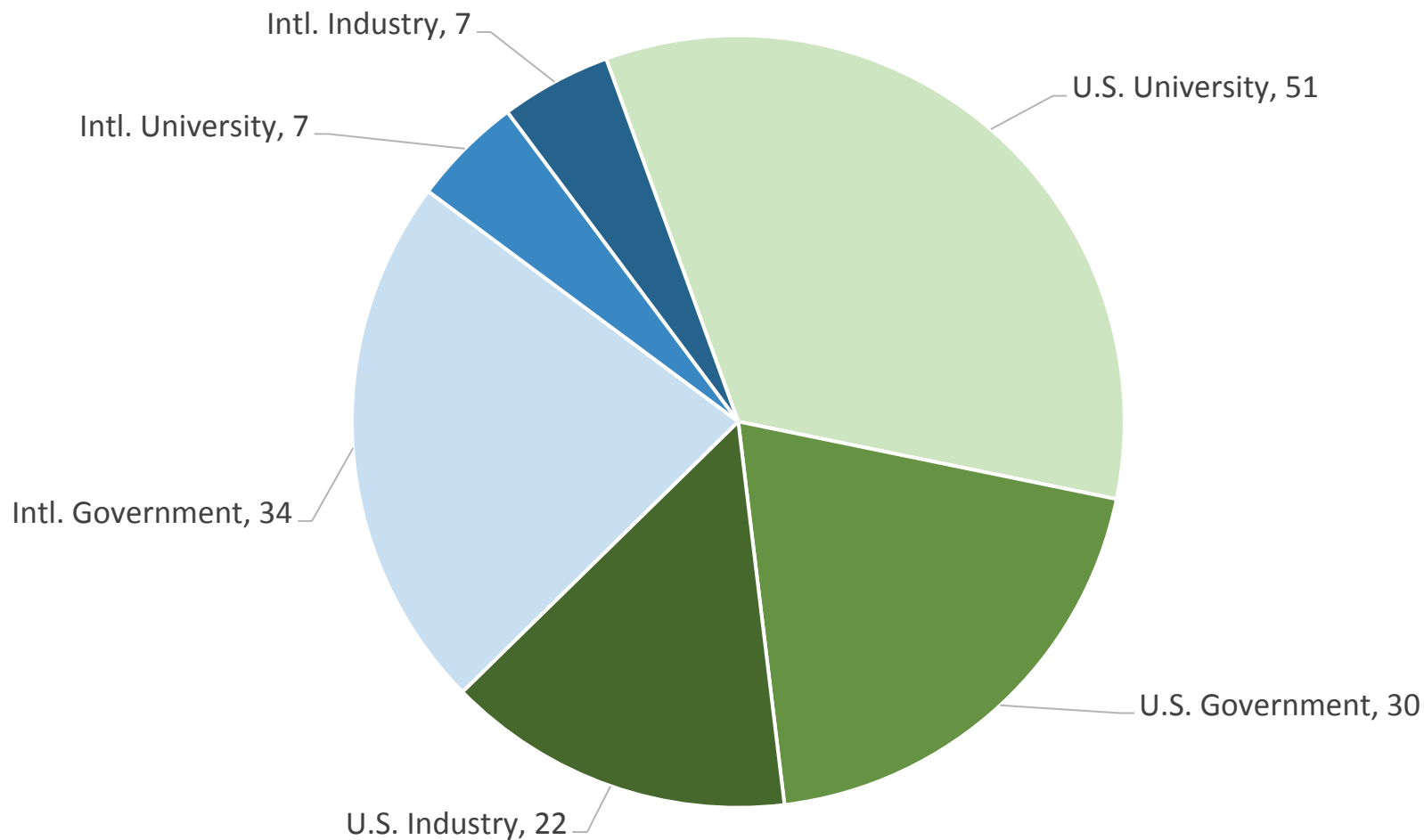
Instruments (1000)



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Nuclear Energy Institutions in NEID

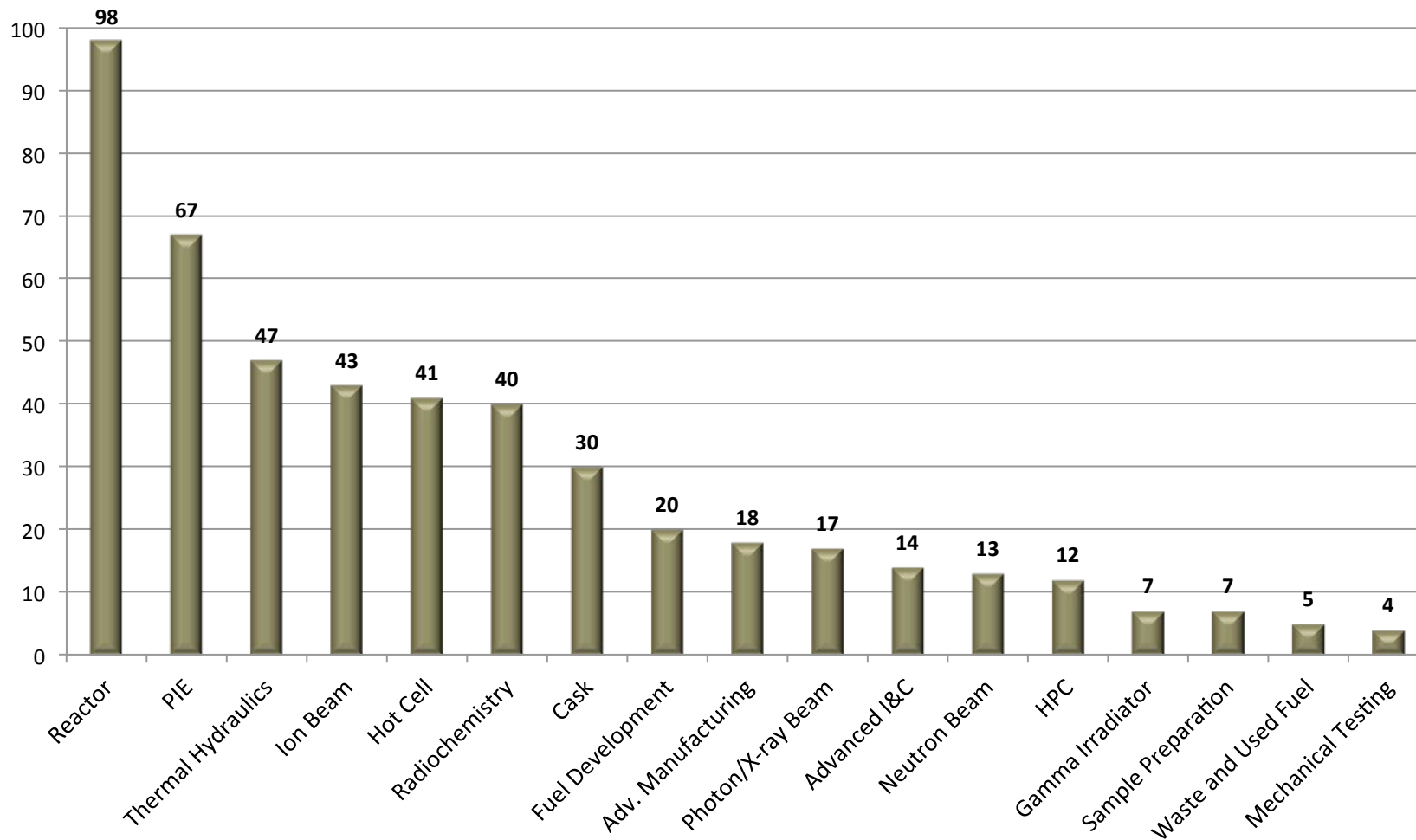




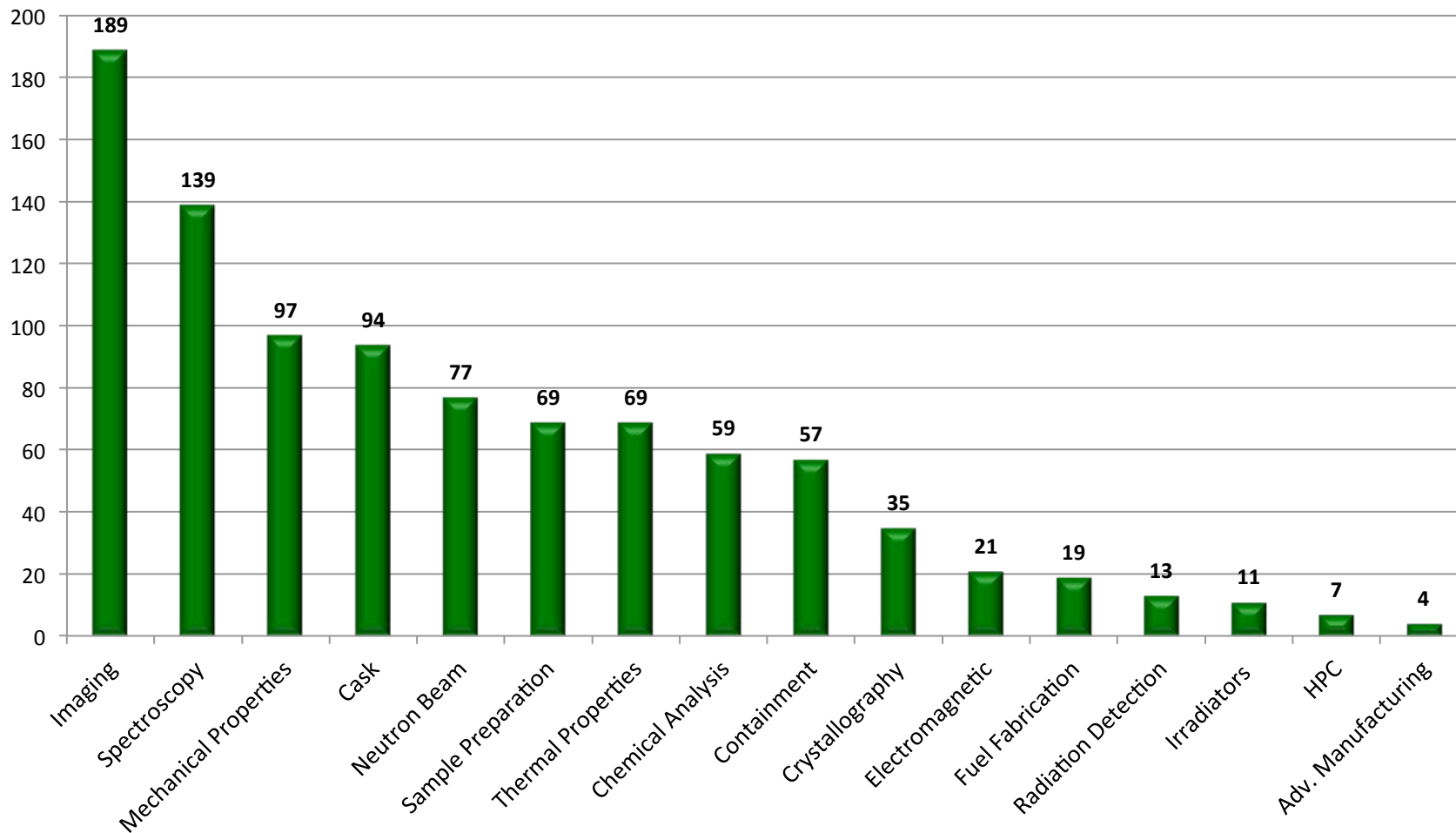
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R&D Facilities in NEID



Scientific Instruments in NEID



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https://nseuf.int.gov

 Nuclear Science
User Facilities


- ABOUT US
- USERS ORGANIZATION
- PUBLICATIONS
- PROJECTS
- CALL/SOLICITATION
INFORMATION
- MY NSUF
- INFRASTRUCTURE**
- LOG ON

Users Meeting
What to expect at this one-of-its-kind workshop

READ MORE →

Master - slave manipulator: Argonne National Laboratory

NEID Access





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Interface Layout



Infrastructure

Brenden Heidrich

NSUF / NEID

Home
Browse
Guides
Search
Calculator
Lists
RFI Submission
Help

Welcome

What would you like to research?

Capabilities

Quick Search

Q

Other Searches

Nuclear Energy Infrastructure Database

Nuclear Fuels and Materials Library

What would you like to research?

Materials

Quick Search

Q

Other Searches

Nuclear Energy Infrastructure Database

Nuclear Fuels and Materials Library



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World-wide nuclear energy R&D institutions



Institution Search

Idaho National Laboratory



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 - Projects/Materials
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Name Idaho National Laboratory
Owner Type Dept of Energy
State Idaho
Country United States of America
Agreement State No
Website <https://www.inl.gov/>



[View All Instruments](#) [Edit](#)



Facilities

10

Facility	Abbreviation	Facility Type(s)
Advanced Test Reactor	ATR	Reactor
Analytical Laboratory	AL	Hot Cell, Post-irradiation Examination
ATR Critical Facility	ATR-C	Reactor
ATR Gamma Facility	ATR-GF	Gamma/Neutron Irradiator
Battery Test Center	BTC	Technology Testing
Bonneville County Technology Center	BCTC	Radio-chemistry

Specific Facility Advanced Test Reactor

		Edit
Institution	Idaho National Laboratory	
Name	Advanced Test Reactor (ATR)	
Building	TRA-670	
Primary Type	Reactor	
Core Functions	Advanced Fuels and materials irradiation. Water-cooled, high-flux test reactor.	
Unique Functions	Five in-pile pressurized water loops currently provide prototypic PWR conditions (pressure, temperature, flow, water chemistry) for fuel and material samples with the ability to tailor the neutron flux to meet desired conditions. Each loop has a full range of instrumentation capabilities. Two of the five loops have transient testing capabilities. There are proposed plans to reactivate a sixth water loop. The ATR has a capacity for up to nine water loops.	
Hotwork Facilities	HFEF	
Support Equipment	MFC, Test Train Assembly Facility	
Materials Allowed	beta/gamma only	
Sample Encapsulation	none	
Atmosphere	gas/PWR	
Commissioning Date	1967	
Recent Upgrade	2013	
RAM License	Department of Energy	
License End Date	2099	
Docket Number	0	
User Facility	Yes	
Cost To Maintain	1,250,000	
GAIN Partner	No	
NSUF Partner	Yes	
NE Use Percentage	50	
Funding Sources	<ul style="list-style-type: none"> DOD DOE-NE 	
Number Of Staff	305	
Point Of Contact	Shawn Hill	
Email	shawn.hill@inl.gov	
State	Idaho	
Website URL	inl.gov/research/advanced-test-reactor-research/	
Data Sources	<ul style="list-style-type: none"> Required Assets for a NE Applied R&D Program Facilities for the Future of NE Research INL TYSPs DOE Facilities Inventory Draft (6.16.2014) IAEA Databases (RTF DB, RTR DB & Beamline DB) Facility NSUF User's Guide 	

Instruments

Abbr	Name	Type
	Video Probe (boroscope)	Dimensional
	Instron Tensile Tester	Mechanical Properties
NRAD	MFC Neutron Radiography Facility	Macroscopic Imaging
ATR FFSC	ATR Fresh Fuel Shipping Cask	Cask
ATR-GF	Gamma Facility (ATR Canal)	Gamma/Neutron Irradiator
Loop 2A	Loop 2A	Reactor Irradiation Position
A (1-8)	A Positions (Inboard)	Reactor Irradiation Position
A (9-16)	A Positions (Outboard)	Reactor Irradiation Position
B (1-8)	B Position (Small)	Reactor Irradiation Position
B (9-12)	B Position (Large)	Reactor Irradiation Position
H (1-14)	H Positions	Reactor Irradiation Position
I (1,6,11,16)	I Positions (Large)	Reactor Irradiation Position
I (2-20, except 6,11,16)	I Positions (Medium)	Reactor Irradiation Position
I (21-24)	I Positions (Small)	Reactor Irradiation Position
ON (1-12) OS (1-22)	Outer Tank Irradiation Positions (North and South of Core)	Reactor Irradiation Position



Specific “Instrument”

Advanced Test Reactor Gamma Irradiation Facility



Date Of Data April 4, 2016

The ATR Gamma Facility, formerly designated the ATR Small Gamma Facility, is located toward the east end and on the south side of the ATR storage canal. This is not the original EG&G "Large" Gamma Irradiation Facility, that has been decommissioned. The gamma field is produced by placing irradiated fuel elements in grid locations around the position where the test is inserted. The dose rate of the field produced is approximately $1E+6$ R/hr., but can be varied ($5E+6$ R/hr. maximum) by varying the distance of fuel elements from the test or by selecting fuel of different gamma strengths. That intensity will fall off at the rate of approximately 5% per day as the fission products in the fuel elements decay away. The peak field at the center of the tube was recently measured to be approximately $2.5E+6$ rad/hr. The dose rates are normally measured by using high range ionization chambers and instrumentation. These can be lowered into the dry tube for actual counting before installing the test sample hardware. Fuel elements can be moved from one location to another with the dry tube in place.

Gamma Irradiation using ATR fuel elements

Located in Building TRA-670 in the ATR canal.

- Support the current fleet of current reactors

Joe Shaw

Joe.Shaw@inl.gov

Idaho Falls

Idaho

(208)-533-4379

- Facility NSUF User's Guide

April 4, 2016

 Edit



FACT SHEET

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INFRASTRUCTURE

DAIN WHITE



Partner Capabilities

The behavior of fuels and materials in a nuclear reactor irradiation environment is extremely complex and provides a rich field for scientific investigation. NSUF Partner Facilities offers access to world-class capabilities to help researchers understand the complex behaviors of these fuels and materials. These include the Advanced Test Reactor and post-irradiation examination capabilities of Idaho National Laboratory and capabilities at 87 partner facilities.

PARTNERS: Facilities

10 ▾	Search... ✕			
Facility	Institution	Guide	Materials	Website
Advanced Materials Laboratory			alpha/beta/gamma	Website
Advanced Test Reactor		User Guide	beta/gamma only	Website
Advanced Transportation Laboratory			beta/gamma only	Website
Analytical Chemistry Laboratory			beta/gamma only	Website
Analytical Chemistry Laboratory @ Materials Center of Excellence			beta/gamma only	Website
Analytical Instrumentation Facility			beta/gamma only	Website
Analytical Instruments Laboratory			alpha/beta/gamma	Website
Analytical Laboratory			beta/gamma only	Website
Analytical Support Operations at the Radiochemical Processing Lab			beta/gamma only	Website
ATR Critical Facility			beta/gamma only	

Showing 1 to 10 of 87 entries

Previous 1 2 3 4 5 ... 9 Next



NSUF Partner Detail



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Advanced Test Reactor (ATR)

Idaho National Laboratory, Idaho

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Institution	Idaho National Laboratory
Name	Advanced Test Reactor (ATR)
Building	TRA-670 Reactor
Core Functions	Advanced Fuels and materials irradiation. Water-cooled, high-flux test reactor.
Unique Functions	Five in-pile pressurized water loops currently provide prototypic PWR conditions (pressure, temperature, flow, water chemistry) for fuel and material samples with the ability to tailor the neutron flux to meet desired conditions. Each loop has a full range of instrumentation capabilities. Two of the five loops have transient testing capabilities. There are proposed plans to reactivate a sixth water loop. The ATR has a capacity for up to nine water loops.
Hotwork Facilities	HFEF
Support Equipment	MFC, Test Train Assembly Facility
Radiological Limit	<100mR/hr @ 30cm
Materials Allowed	beta/gamma only
Sample Encapsulation	none
Atmosphere	gas/PWR
Commissioning Date	1967
Recent Upgrade	2013
RAM License	Department of Energy
License End Date	2099
Docket Number	0
User Facility	Yes
User Org Web Page	nsuf.inl.gov
Proposal Web Page	nsuf.inl.gov
GAIN Partner	No
NSUF Partner	Yes
NE Use Percentage	50
Number Of Staff	305
Point Of Contact	Shawn Hill
Website URL	https://factsheets.inl.gov/FactSheets/AdvancedTestReactorSafety.pdf
User Guide	ATRUUsersGuide.pdf

NSUF Fuels and Materials Library

Provides irradiated samples for users to access and conduct research through a competitively reviewed proposal process.

The library includes over 3500 specimens as part of the NSUF awarded research.

Materials Include:

- **Steels**
- **Other alloys**
- **Ceramics**
- **Pure materials**
- **Actinides**
- **Fission products**



**INL
Legacy
materials**

**Volunteered
materials
from outside
the INL**

**Supporting
documentation
related to
samples**

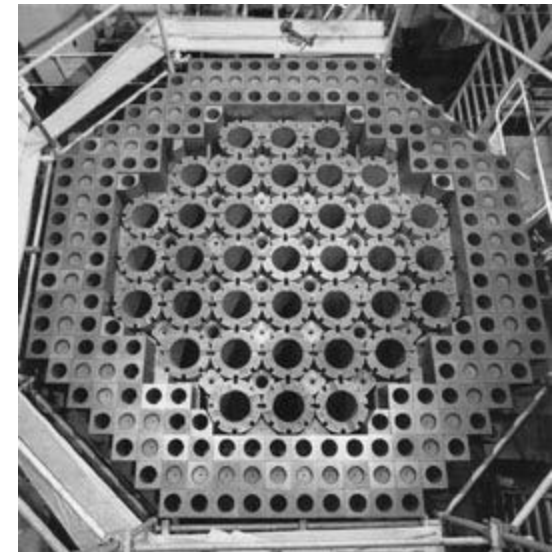
■ **Most samples in the library have been neutron irradiated:**

- **EBR-II** (Idaho National Laboratory)
- **ATR** (Idaho National Laboratory)
- **HFIR** (Oak Ridge National Laboratory)
- **FFTF** (Hanford Site / Pacific Northwest National Laboratory)
- José Cabrera Nuclear Power Station (in negotiation)



■ **A smaller number were proton irradiated:**

- LANSCE (Los Alamos National Laboratory)





NSUF Fuels and Materials Library

Steels	
17-4 PH SS	Fe-Cr Alloys
304 SS	HCM12-A
304 SS welds	HT-9
Super 304H	MA-956
316 SS	MA-957
347 SS	MAR-2008
416 SS	Mo-ODS
420 SS	nCr-YWT
9Cr ODS	NF616
Borated Steel	NF709
Carbon Steel	PM2000
Cast ASS	T-91
D9 ASS	Tool Steel T-1
Eurofer 97	XM-19
F82H-IEA	various model alloys

Other Alloys	Ceramics	Pure Materials
Al_3Hf	Al_2O_3	Copper
Al1100	MgO	Iron
Al6061	MgO-ZrO_2	Ni/Cu/Nb (DC)
Aluminum Bronze	$\text{Mg}_2\text{-SnO}_4$	Nickel
Berylco #25	$\text{MgO}_{1.5}\text{Al}_2\text{O}_3$	Niobium
C276 Hasteloy	MgTiO_3	Silver
Incoloy 800H	$\text{Nd}_2\text{Zr}_2\text{O}_7$	Tantalum
Inconel X/X-750	SiC	Tungsten
Stellite	Ti_2AlC	Zirconium
	Ti_3AlC_2	
	Ti_2AlN	
	TiO_2	
	Ti_3SiC_2	

Small amounts of purified actinides and fission products in liquid form.

What (else) can we build from NSUF data?

1. We can connect facilities and instruments as parts of a process to accomplish a research method or process, such as:

- Microstructural characterization of irradiated fuel.
- Irradiation experiment (through design, fabrication, irradiation, etc.)

2. We can include fuels and materials:

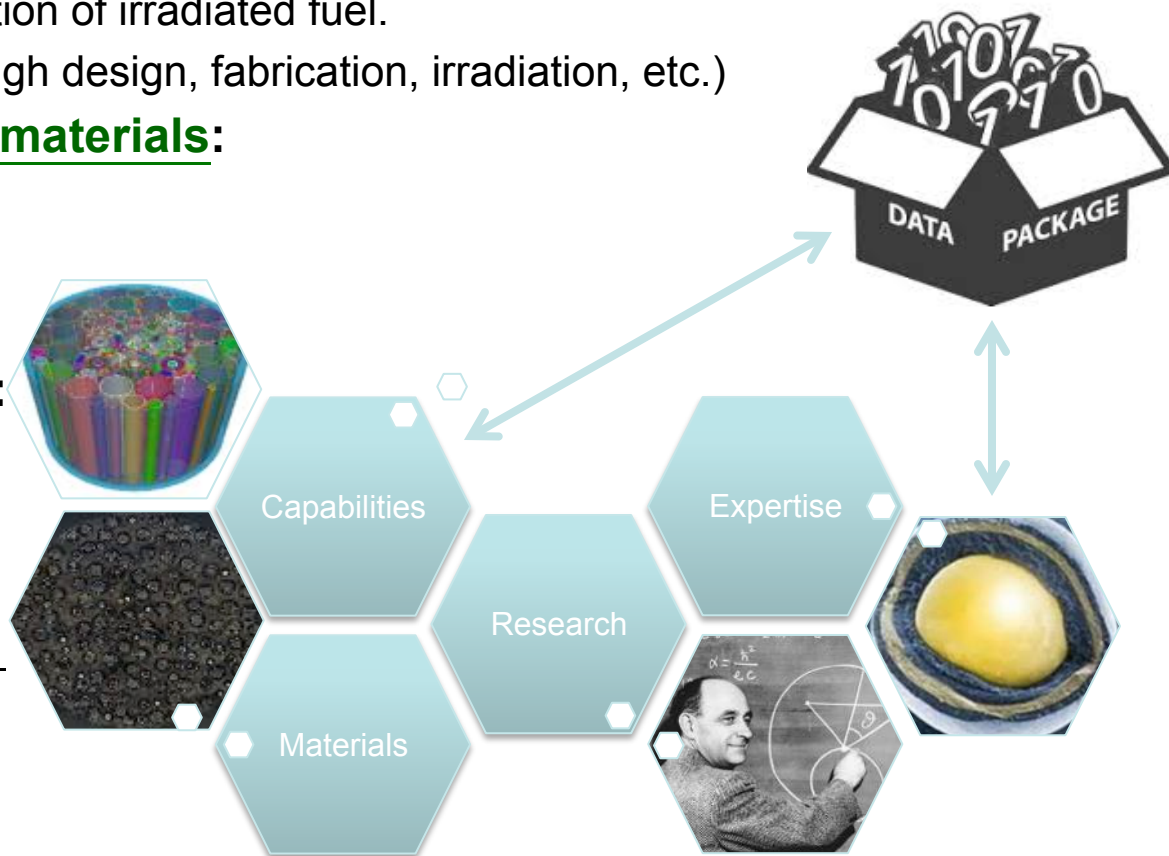
- Fuels and Materials Library
- Link to facilities utilized
- Link to researchers

3. We can connect research:

- Subject matter
- Facilities utilized
- PIs & collaborators

4. We can include expertise:

- Support for **GAIN**



What's missing?



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SME DATABASE

PI/SME Name

Research Area/Subject Matter

INSTITUTION ←

PROJECT DATABASE

PROJECT NAME

Project ID	Start Date	Project Type
Proposal	End Date	Material Type
CINR #	PI Name	Research Area
RTE #	Tech Lead	INSTITUTION ←
NSUF Call	Facility Tech Lead	FACILITY ←
Award Date	Collaborators	Documentation

NEID

INSTITUTION

FACILITY

REACTOR

REACTOR POSITION

→ **PROJECT NAME**

REACTOR ←

REACTOR POSITION ←

Sample ID Code	# of Samples
Capsule	Samples Remaining
Packet	Specimen Availability
Material Code	Availability Date
Material Name	Certification
Material Description	Certification Code
KGT #	Storage FACILITY ←
Specimen Type	Notes
Dimensions	

FUELS & MATERIALS LIBRARY

PLANNED

Temperature

Dose (DPA)

Fluence [$\times 10^{20}$]

Flux [$\times 10^{14}$]

Environment

AS RUN DATA

Temperature

Actual Dose (DPA)

Fluence [$\times 10^{20}$]

Flux [$\times 10^{14}$]

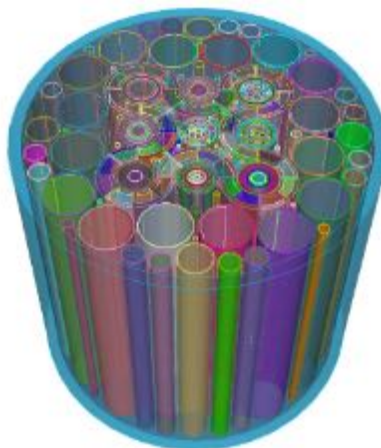
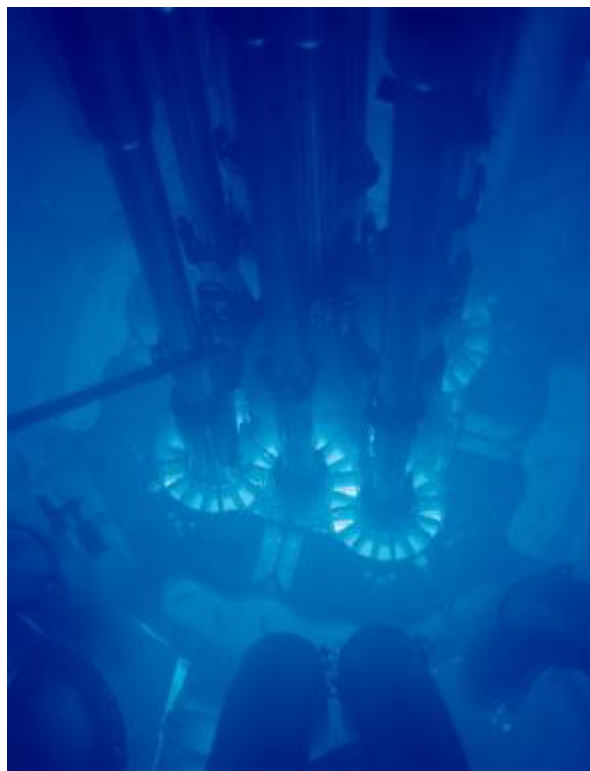
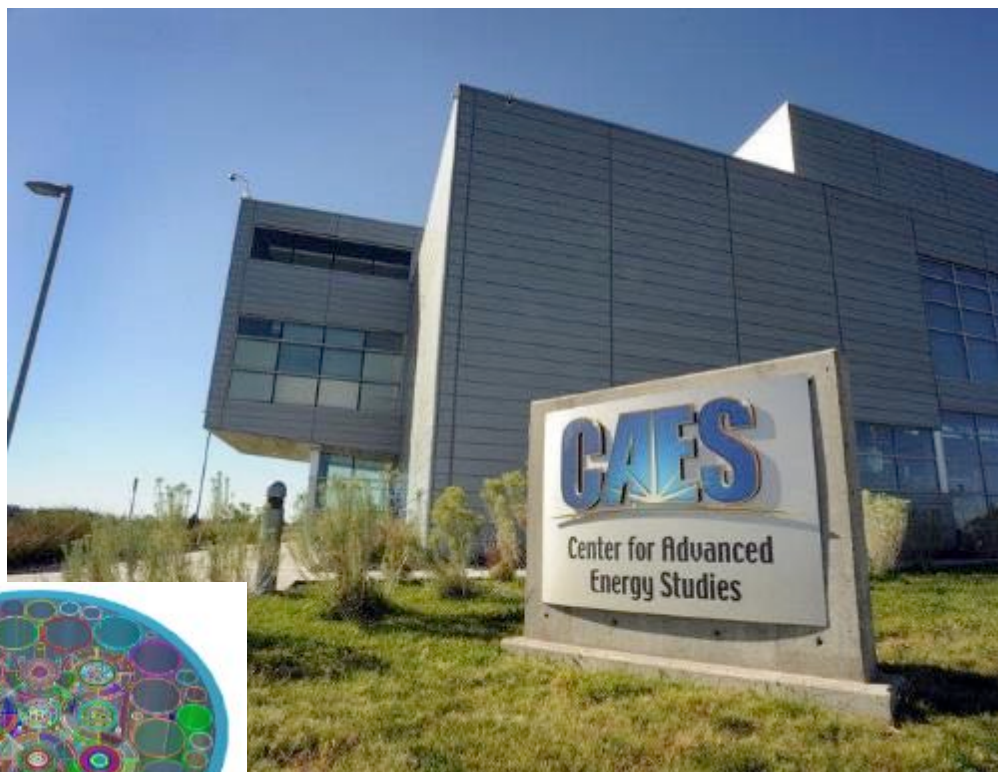
Environment

Contact Information for NSUF

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