

# **Advanced Test Reactor National Scientific User Facility Rapid Turnaround Experiments**

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# What are User Facilities?

***Regional, national or international facilities with unique experimental capabilities. Access is typically cost free through a competitive proposal process.***



Advanced Photon Source (ANL)



Spallation Neutron Source (ORNL)

There are currently 49 DOE user facilities in the U.S.

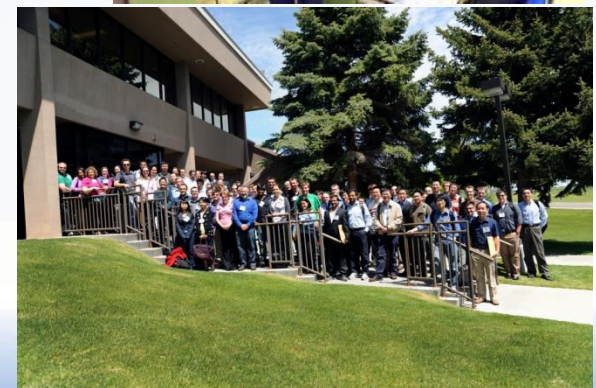
- Advanced scientific computing research
- High flux synchrotron and neutron sources
- Electron beam characterization
- Nano-scale science
- Biological and environmental research
- High energy and nuclear physics
- Fusion energy science

.....But before 2007 there were no user facilities to address the unique challenges of nuclear energy!

# Meeting Nuclear Research Needs

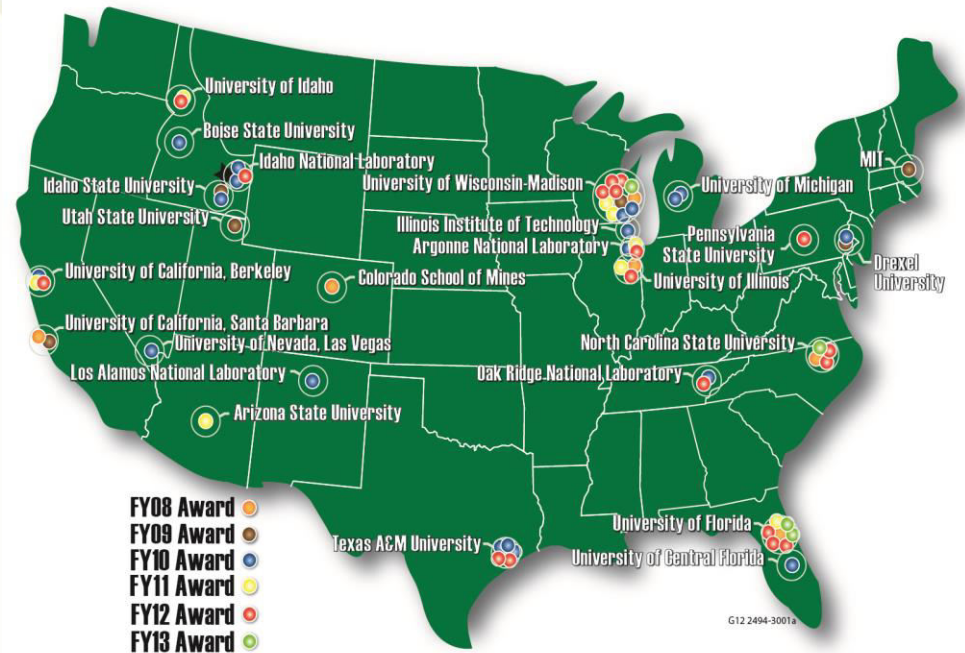
- To perform the research required to support nuclear energy development requires specialized (expensive) and increasingly rare capabilities
  - High flux reactors
  - Hot cells
  - Support infrastructure (shipping casks, test fabrication, etc.)
- But also intellectual capital
  - Universities
  - Nuclear industry
  - Innovative small businesses
  - National laboratories

***ATR designated as a NSUF as a means to provide the research community access to national capability to conduct cutting edge nuclear technology research and development***



# Sponsorship of Non-Proprietary Experiments

- Awarded via Proposal Submittal
- Can be Irradiation or PIE-only
- ATR Critical Facility
- Selection Review Process
  - Peer review for technical merit
  - Relevancy review for NE programs
  - Technical feasibility
- 72 Projects Awarded
  - 63 to 20 universities
  - 9 to 4 laboratories



***Opening new opportunities  
to researchers***

# Sample Library— Expanding Research Opportunities

- Irradiation Experiments Performed by ATR NSUF Researchers Investigate Novel Fuels and Materials
- More Samples are Irradiated than are Investigated due to Budget and Time Constraints.
- “Extra” Specimens are Made Available in the Sample Library to the Research Community
- Additional Samples are From Other Irradiation Projects (i.e., not ATR NSUF)
  - Decommissioned reactors
  - Previous INL programs
  - Other laboratories



***Optimize the value of the irradiation investment***



# Current Partner Facilities



*Partnerships bring additional capabilities to the ATR NSUF, offer collaborative opportunities beyond the INL and form a foundation for nuclear research that reaches across the U.S.*

*Fiscal Year 2013 has seen continued growth with the addition of our first industry partner.*

*Rapid Turnaround Experiments are an ideal venue for these kinds of collaborative endeavors.*



# ATR NSUF Partnerships

- Partnership Objectives
  - ATR NSUF aims to meet customer needs
    - Experiments completed sooner
    - Less cost to DOE (enables more experiment awards)
    - May not need full INL capabilities
  - Higher utilization of partner facilities
  - Support educational initiatives as the university (faculty research, student participation)
- ATR NSUF will include additional capability that benefits users
  - University research reactors
  - Hot cells or hot laboratories
  - Accelerator facilities
- Partnership Process
  - Potential partners self-nominate
  - Evaluation and selection
  - Capabilities added to next proposal solicitation

# Center for Advanced Energy Studies (CAES)

- Collaboration between INL and Idaho Universities
- Facility owned by State of Idaho
- NRC Licensed, via Idaho State University
- Imaging Laboratory will house high-end equipment for use with lower activity samples
- Small sample mechanical testing
- Material quantity limits sufficient for atom probe and TEM on fuel
- Outside the INL firewall, easier remote access for researchers





# Microscopy and Characterization Suite (MaCS)



## Local Electrode Atom Probe

Creates 3-D images of atoms in solids



## Nano-indenter, with Atomic Force Microscope

Measures mechanical properties on very small scale samples



**Focused Ion Beam**  
Sections materials at micro- and nano-scales for TEM and LEAP microscopy.



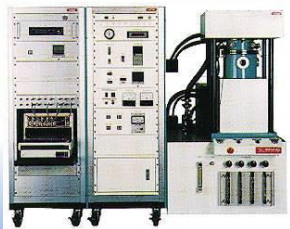
## Automated Hardness Tester

Measures and evaluates the micro-hardness of materials



**Transmission Electron Microscope**  
Images nano-scale material structures

- In CAES
- Non-security Access for Users
- NRC License for Small Radioactive Samples
- Test Material Properties by Destructive and Nondestructive Means
- Characterize Materials with State-of-the art Microscopy



## Spark Plasma Sintering

Creates fully dense metals, ceramics and metal-ceramic composites



## Scanning Electron Microscope

Images material surfaces at the nano-scale

# ATR NSUF Rapid Turnaround Experiments

- In 2011, Responding to Decreased DOE Budgets, ATR NSUF Instituted the Rapid Turnaround Experiment, or RTE
- Focus is on Research that can be Performed in Partner Facilities, MaCS Laboratory, Material Previously Irradiated, Available via the ATR NSUF Sample Library, or PI-Provided Material
- *NOT* for Full Irradiations in ATR or Extensive PIE Experiments
- Expectation is that Experiment can be Completed in  $\leq 2$  months for  $\leq \$50K$
- RTE Proposal Call is Open All Year, with Proposal Reviews Quarterly
- Submitted via ATR NSUF Web Site
- RTE Proposal Reviews
  - Technical Peer Review
  - Facility Feasibility Review
  - NE Programmatic Relevance Review

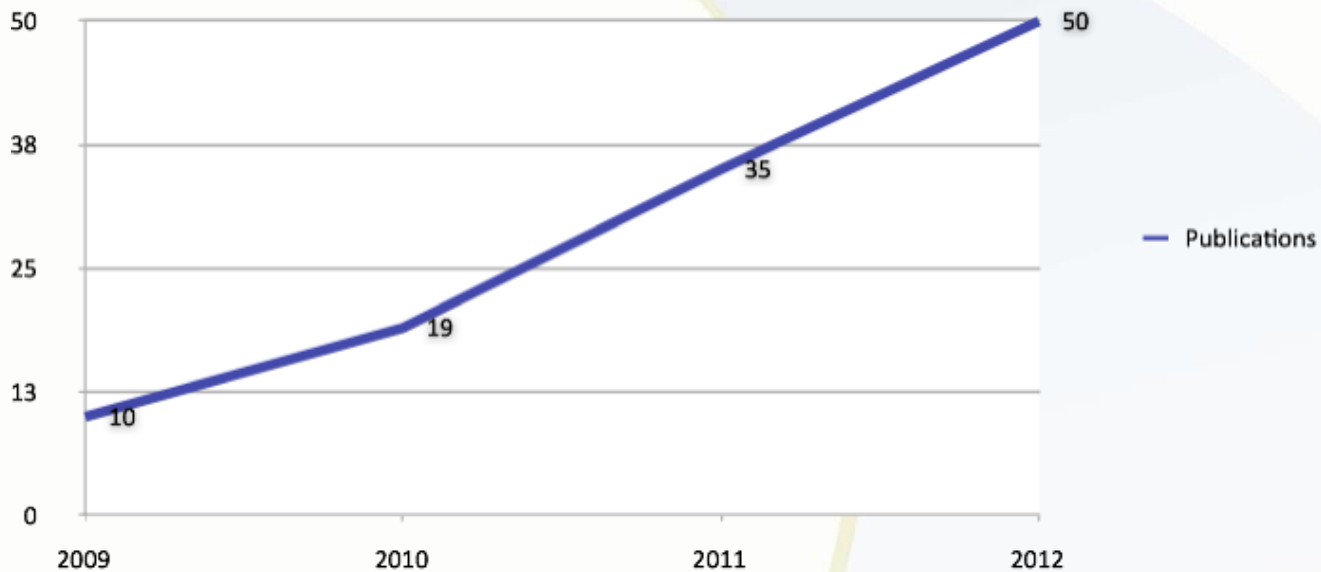
***Increase Research Opportunities for Experimenters***

# ATR NSUF RTE Examples

- “*Irradiation Damage of Ceramic Material*” – Irradiation performed in NCSU PULSTAR reactor and characterization at NCSU
- “*Atom Probe Tomography to Study Fission Product Damage in Model Nuclear Fuel*” – Irradiated surrogate fuel,  $\text{CeO}_2$ , was characterized in the MaCS lab
- “*Effect of Heavy Ion Bombardment on Uranium Dioxide Thin Films Under Various Conditions of Irradiation Dose, Temperature, and Actinide Surrogates*” – Use of X-ray absorption spectroscopy to observe changes in  $\text{UO}_2$  local atomic structure at the Advanced Photon Source, Materials Research Collaborative Access Team
- “*Atom Probe Tomography on Highly Irradiated Ferritic/Martensitic Steels*” – Previously irradiated material from the Fast Flux Test Facility, atom probe samples extracted using LANL and UCB expertise, then sent to MaCS for Local Electron Atom Probe investigations

# ATR NSUF Publications, 2009 - 2012

Publication History 2009-2012



2009-2012 Total= 114

*Portal to national capability, pairing ideas to assets*



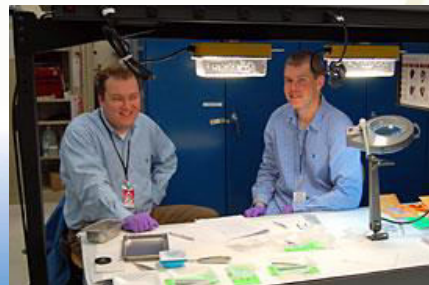
Test reactors and critical facilities (ATR, ATRC, HFIR, MITR, PULSTAR)



Examination facilities (INL, MaCS, NCSU, ORNL, PNNL, UC Berkeley, Michigan, Purdue, UNLV, IIT, Wisconsin Westinghouse)



Other National User Facilities (APS, SHaRE, NIST, LANSCE)



An active and engaged user community

# The ATR NSUF Program Team

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