



U.S. DEPARTMENT OF  
**ENERGY**

**Nuclear Energy**

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# **US Nuclear Science User Facilities (NSUF) Overview**

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U.S. Department of Energy**

**FY2018 Consolidated Solicitation Webinar**

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## ■ Established in 2007 as DOE Office of Nuclear Energy first and only user facility

- Irradiation effects in nuclear fuels and materials
- Provide access to capabilities and expertise at no cost to the user
- Support design, fabrication, transport, irradiation, PIE, disposition
- Link intellectual capital with nuclear research infrastructure to fulfill mission of DOE-NE

## ■ Projects are selected through an open competitive proposal process

- Consolidated Innovative Nuclear Research (1 call/year)
  - Irradiation + PIE (\$1.0M - \$4.0M, up to 7 years)
  - PIE only (~\$500K, up to 3 years)
  - Irradiation only (\$500K - \$3.5M)
  - Beamlines at other user facilities
- Rapid Turnaround Experiments (3 calls/year)
- Proposals welcome from University, National Laboratory, Industry, Small Business



- Partner Facilities program started in 2008
- Name changed to Nuclear Science User Facilities in 2014
- 11 Universities + 4 Universities in CAES, 7 National Laboratories, 1 industry



# NSUF Capabilities

**Neutron  
Irradiations**

**Ion  
Irradiations**

**Gamma  
Irradiations**

**Hot Cells &  
Shielded Cells**

**Beamlines**

**High  
Performance  
Computing**



ILLINOIS TECH  
SINCE 1890



**BROOKHAVEN**  
NATIONAL LABORATORY



TEXAS A&M  
UNIVERSITY.





## ■ High radiation level measurements/instrumentation

- Neutron Radiography
- Elemental & Isotopic Analyses
- Gas Sampling and Analyses
- Profilometry
- Gamma Scanning
- Mechanical Testing (tensile, charpy)
- Micro-focus X-ray Diffraction
- Thermal Analyses
- Eddy Current
- IASCC
- Electron Probe Micro Analysis (EPMA)
- Electron and Optical Microscopy
- Focused ion Beam (FIB)



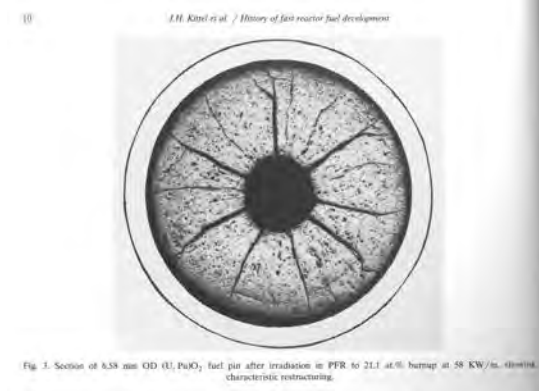


## ■ Low radiation level measurements/instrumentation

- Electron and Optical Microscopy
  - Scanning Electron Microscopy (SEM)
  - Transmission Electron Microscopy (TEM)
- Focused Ion Beam (FIB)
- Mechanical Testing
  - Tensile
  - Hardness
  - Micro- and Nano-Indentation
- X-ray Diffraction
- Photo Electron Spectroscopy
  - X-ray Photo Electron Spectroscopy (XPS)
  - UV Photo Electron Spectroscopy (UPS)
  - Auger Spectroscopy
- Irradiation Assisted Stress Corrosion Cracking (IASCC)
- Positron Annihilation Spectroscopy
- Atomic Force Microscopy
- Secondary Ion Mass Spectrometry
- Thermal Analysis
  - Thermal Conductivity
  - Heat Capacity
  - Thermal Expansion
- Nuclear Magnetic Resonance



- Understanding atomic level phenomena in fuels that affect thermal transport, elemental migration/diffusion, interface interaction, etc. as complex microstructures develop under irradiation
  - Ceramic, metallic, TRISO, ATF
- Understanding fundamental defect evolution in irradiated structural materials across multiple length scales as they affect mechanical properties.
  - RPV, austenitic, F/M, Zr alloys, ATF
- Development of innovative radiation resistant materials for advanced reactor systems
- Development of radiation resistant sensors for collecting high fidelity on-line irradiation test data
- Development of materials from advanced manufacturing techniques
- Providing fundamental actinide nuclear data that can help inform advanced reactor and fuel cycle modeling and simulation campaign



# Nuclear Fuels and Materials Library (NFML)

- The library includes over **3500 specimens** as part of the NSUF awarded research. 6K – 7K additional specimens by year end.
- Most materials are neutron irradiated with small number of ion irradiated materials.
- SAM irradiation series to stock library moving forward
- Effort to consolidate materials into easily accessible locations to reduce costs of retrieval.
- Web-based searchable database through **nsuf.inl.gov**
- Interest in collaboration on international efforts.
- 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



# Nuclear Energy Infrastructure Database (NEID)

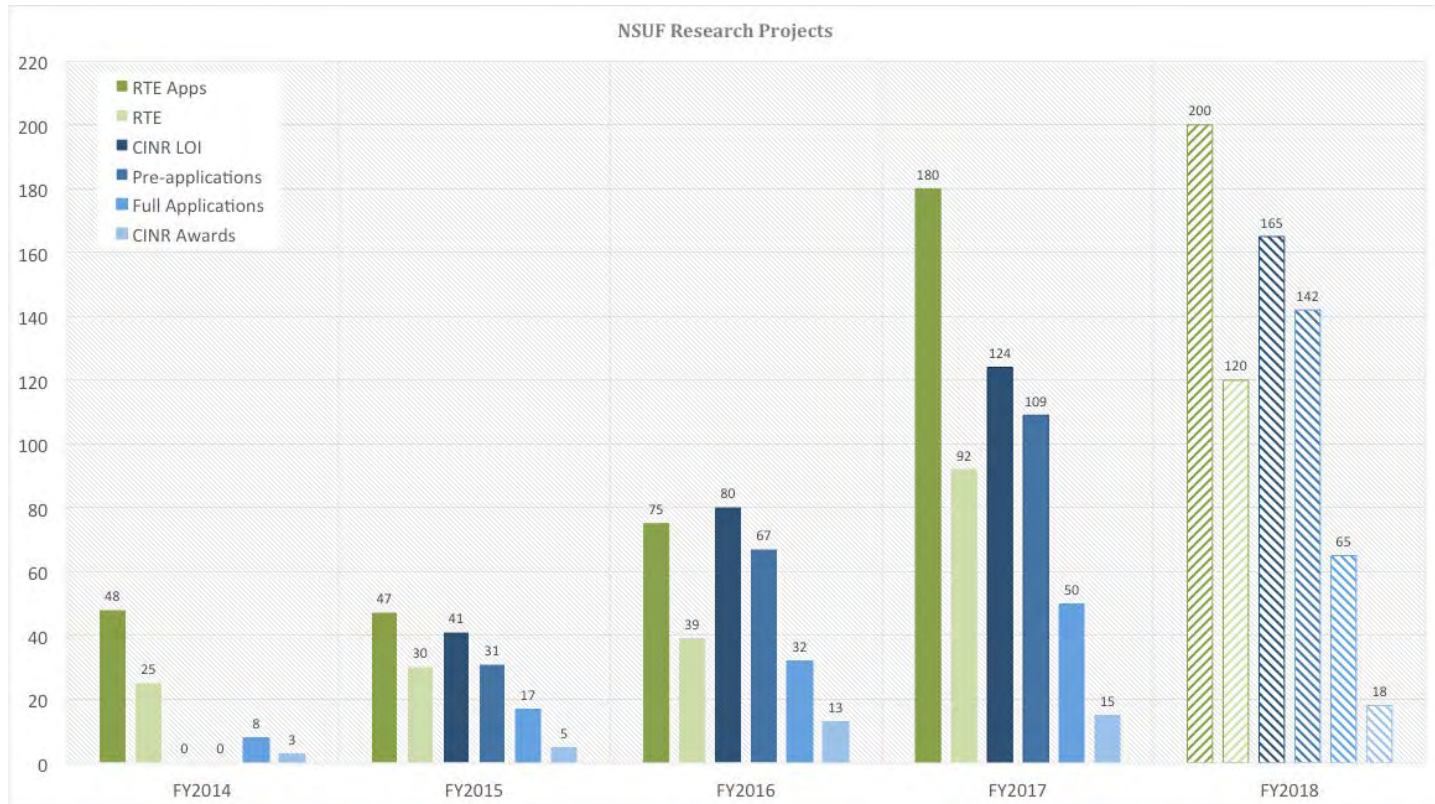
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- **[nsuf-infrastructure.inl.gov](https://nsuf-infrastructure.inl.gov)**
- A searchable and interactive database of all pertinent infrastructure supported by, or related to, the DOE Office of Nuclear Energy (DOE-NE)
- Used for analyses to identify needs, redundancies, efficiencies, distributions, etc., to best understand the utility of DOE-NE's available infrastructure, inform the content of infrastructure calls, and provide information to NSUF users
- Infrastructure information collected can be combined with information on R&D needs as part of infrastructure gap analysis



# Historical and Projected Growth

## Nuclear Energy



Graphics created by Brenden Heidrich

### ■ CINR type projects support

- FY 2014 – \$400K, 8 full proposals, 3 awards
- FY 2015 – \$4.1M, 41 LOIs, 31 pre-proposals, 17 full proposals, 5 awards
- FY 2016 – \$10M, 80 LOIs, 67 pre-proposals, 32 full proposals, 13 awards
- FY 2017 – ~\$11M, 124 LOIs, 108 pre-proposals, 50 full proposals, 15 awards

