U.S. DEPARTMENT OF ENERGY | Office of NUCLEAR ENERGY

Clean. Reliable. Nuclear.

Nuclear Science User Facilities (NSUF)

Tansel Selekler, Federal Program Manager
Simon Pimblott, Chief Scientist

Nuclear Science User Facilities (NSUF)

- Established in 2007 as DOE Office of Nuclear Energy's user facility
  - Focus: Irradiation effects in nuclear fuels and materials
  - Provides access to capabilities and to expertise at no cost to the user
  - Supports experiment design, fabrication, transport, irradiation, PIE, disposition

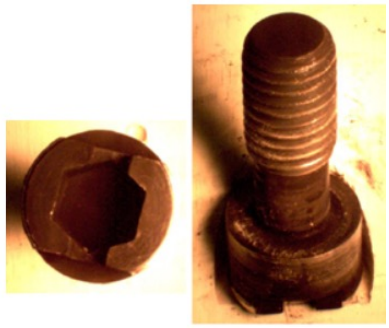
- Projects are selected through open, competitive proposal processes
  - Consolidated Innovative Nuclear Research (CINR) FOA
    - Neutron Irradiation and Post Irradiation Examination (PIE) ($500K - $4.0M, up to 7 years)
    - Synchrotron or Neutron Beamline or PIE only ($50K to $750K, up to 3 years)
    - Neutron irradiation only ($500K - $3.5M, up to 3 years)
    - Ion or Gamma Irradiation only ($20K - $100K, up to 3 years)
    - Ion or Gamma Irradiation and PIE ($50K - $250K, up to 3 years)
  - Rapid Turnaround Experiments (RTE)
    - Not part of the CINR FOA
    - Limited scope ($50K) and completed within 9 months
    - Open to university, national laboratory, and industry applicants

A Consortium Offering Research Opportunities

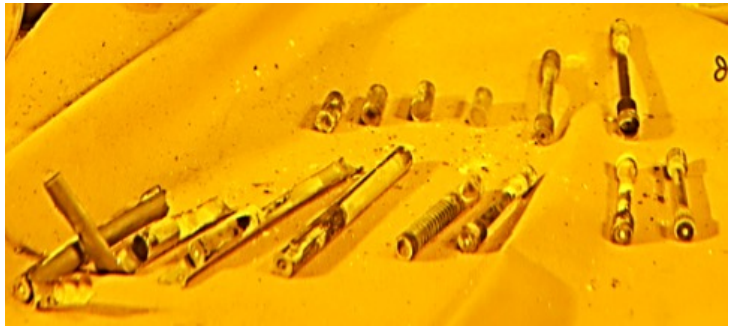
Neutron Irradiations	Ion Irradiations	Gamma Irradiations	Post Irradiation Examination	Characterization Beamlines	High Performance Computing
INL Idaho National Laboratory	University of Wisconsin-Madison	INL Idaho National Laboratory	INL Idaho National Laboratory	CAES Center for Advanced Energy Studies	Brookhaven National Laboratory	INL Idaho National Laboratory
Oak Ridge National Laboratory	University of Michigan	Oak Ridge National Laboratory	Oak Ridge National Laboratory	Cal	NC State University	
MIT Massachusetts Institute of Technology	Argonne National Laboratory	Sandia National Laboratories	PNNL	NC State University	Los Alamos National Laboratory	
NC State University	Sandia National Laboratories		University of Michigan	Purdue University		
Ohio State	Texas A&M University		Westinghouse	University of Florida		
SCK•CEN Studiecentrum voor Kernenergie Centre d'Etude de l'Energie Nucleaire	Lawrence Livermore National Laboratory		Los Alamos National Laboratory	University of Wisconsin-Madison		
			SCK•CEN Studiecentrum voor Kernenergie Centre d'Etude de l'Energie Nucleaire			

Nuclear Fuels and Materials Library (NFML)

- The library includes over 6000 specimens from NSUF projects, legacy research projects, commercial reactors, and research reactors
- Most specimens are neutron irradiated with small number of ion irradiated materials
- Web-based searchable database through nsuf.inl.gov
  - Material or fuel composition
  - Specimen configuration
  - Irradiation conditions
  - Publications



- Specimens include:
  - Steels – conventional and advanced
  - Nickel and uranium alloys
  - Ceramics
  - High purity elemental materials
  - Actinides
  - Various fuel forms and constituents (Please contact NSUF)



NSUF Workscopes

- **NSUF-1**: **NUCLEAR ENERGY RELATED R&D SUPPORTED BY NUCLEAR SCIENCE USER FACILITIES CAPABILITIES**

  (Federal POC – Tansel Selekler, Technical POC – Rory Kennedy)

  Eligible to lead: University Applicants

  – NSUF-1.1: CORE AND STRUCTURAL MATERIALS AND NUCLEAR FUEL BEHAVIOR AND ADVANCED NUCLEAR FUEL DEVELOPMENT

    (UP TO 7 YEARS, $800,000 R&D funding) (NSUF READINESS REQUIREMENTS APPLY)

- **NSUF-2**: **NUCLEAR SCIENCE USER FACILITIES ACCESS ONLY**

  (Federal POC – Tansel Selekler, Technical POC – Rory Kennedy)

  Eligible to lead: University, National Laboratory & Industry Applicants

  – NSUF-2.1: CORE AND STRUCTURAL MATERIALS AND NUCLEAR FUEL BEHAVIOR AND ADVANCED NUCLEAR FUEL DEVELOPMENT

    (UP TO 7 YEARS) (NSUF READINESS REQUIREMENTS APPLY)

  – NSUF-2.2: HIGH PERFORMANCE COMPUTING AT IDAHO NATIONAL LABORATORY

    (LIMITED TO 3 YEARS)

NSUF Changes and Reminders

- NSUF-1 workscope is open to **University** applicants only
  (Change from FY 2021 FOA)

- NSUF-2 workscope is open to **University, National Laboratory & Industry** applicants
  (Change from FY 2021 FOA)

- NSUF process is described in Appendix D
- Non-negotiable NSUF User Agreement in Appendix E
- LOI, Pre-Applications, Preliminary SOW, Final SOW, Full Applications submitted by Lead Applicant
- Cost Estimates (for NSUF Access) prepared and submitted by NSUF Technical Leads
- Preliminary development must be complete and applicant ready for NSUF access prior to submission
  - Applicant must demonstrate readiness in Pre-Application and Full Application
  - NSUF Readiness Criteria described in FOA Part I B.2.2

- All research MUST be non-proprietary and results MUST be published.

NSUF-1 Nuclear Energy Related R&D Supported by NSUF Capabilities

Objective

- Provide access to the capabilities of the NSUF for research projects supporting the DOE Office of Nuclear Energy mission

Types of Projects

- Neutron Irradiation and Post Irradiation Examination (PIE)
- Synchrotron or Neutron Beamline or PIE only
- Ion or Gamma Irradiation only
- Ion or Gamma Irradiation and PIE

Restrictions

- Scope and duration of R&D funding must be identified
- All applications submitted under this workscope will couple funding with NSUF access.

Up to $800K R&D funding for applicant to support research directly associated with the proposed project in addition to the access to NSUF capabilities

NSUF-1 Nuclear Energy Related R&D Supported by NSUF Capabilities

NSUF-1.1: CORE AND STRUCTURAL MATERIALS AND NUCLEAR FUEL BEHAVIOR AND ADVANCED NUCLEAR FUEL DEVELOPMENT

- Focused on:
  - fundamental understanding of irradiation effects in core and structural materials and the behavior of nuclear fuels (including cladding) in reactor, and
  - research into advanced nuclear fuels and improving the performance of current fuels
- Areas of interest include:
  - material aging and degradation mechanisms, testing alternate and/or radiation resistant materials for application in current and future fission reactors, and materials from alternate or advanced manufacturing techniques (including welding and joining)
  - physics and chemistry of nuclear fuels, irradiation and thermal effects on microstructure development and the effects on, for example, thermophysical and thermomechanical properties as well as chemical interactions.
- Work on common place conventionally and additively manufactured materials such as 304 SS and 316 SS, 718 Inconel, uncoated Zirconium alloys, and SiC and SiC-SiC composites that have been the target of previous NSUF awards are not requested.

- A complete list of NSUF awards made under the FY2017 to FY2021 CINR funding opportunities can be found under the R&D flag on the website NEUP.inl.gov

NSUF-2 NSUF Access Only Workscopes

Objective

- Provide access to the capabilities of the NSUF for research projects supporting the DOE Office of Nuclear Energy mission

Types of Projects

- Neutron Irradiation and Post Irradiation Examination (PIE)
- Synchrotron or Neutron Beamline or PIE only
- Ion or Gamma Irradiation only
- Ion or Gamma Irradiation and PIE
- Computational projects requiring INL High Performance Computing

Restrictions

- R&D support funding for applicant not provided.
- Source, scope and duration of R&D funding must be identified.
- NSUF does not fund travel, salaries, or other user costs.

NSUF-2 NSUF Access Only Workscopes

NSUF-2.1: CORE AND STRUCTURAL MATERIALS AND NUCLEAR FUEL BEHAVIOR AND ADVANCED NUCLEAR FUEL DEVELOPMENT

- Focused on:
  - fundamental understanding of irradiation effects in core and structural materials and the behavior of nuclear fuels (including cladding) in reactor, and
  - research into advanced nuclear fuels and improving the performance of current fuels
- Areas of interest include:
  - material aging and degradation mechanisms, testing alternate and/or radiation resistant materials for application in current and future fission reactors, and materials from alternate or advanced manufacturing techniques (including welding and joining)
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NSUF-2 NSUF Access Only Workscopes

NSUF-2.2: HIGH PERFORMANCE COMPUTING AT IDAHO NATIONAL LABORATORY

- Provide scientific computing capabilities to support efforts in advanced modeling and simulation (Sawtooth, Falcon and Lemhi)
- Proposals in this area may address a wide range of research activities including:
  - performance of materials in harsh environments (including the effects of irradiation and high temperatures),
  - performance of existing light water and advanced nuclear reactors
  - multiscale, multi-physics analysis of nuclear fuel performance
- Support includes access to INL HPC systems, assistance with system login and running code, basic HPC training, and software support and expertise as requested.
- Available software includes an assortment of tools in the areas of: Computer Aided Engineering, Chemistry, Code Development, Data Manipulation, Math, MPI, Neutronics and Transport, Numerical Libraries, Programming, and Visualization
- Access to HPC resources through this FOA does not provide licenses to software
- Use of DOE-developed software from the NEAMS programs is encouraged

INL HPC Capabilities

- **Sawtooth**: INL's newest supercomputer operates with a LINPACK rating of 5.6 petaflops and is ranked #37 on the November 2019 TOP500 list. The HPE SGI 8600 system comprises 99,792 cores with 403 TB of memory. The system also includes dedicated GPU capability.

- **Lemhi**: A Dell 6420-based system operating on an OmniPath fat tree network. It contains 20,160 cores and 94 total terabytes of memory. Lemhi is rated at 1 petaflop and ranked #427 on the November 2018 TOP500 list.

- **Falcon**: An SGI ICE-X distributed memory system comprised of 34,992 cores, with each node containing dual Xeon E5-2695 v4 processors. It is rated at 1.1 petaflops and includes 121 TB of memory.

NSUF User Agreement

- Upon award of an NSUF supported project, the NSUF User Agreement must be signed before activities will begin on the project.

- Failure to sign the non-negotiable User Agreement within 30 days of receipt of the User Agreement may result in cancellation of an awarded project.

Contact Information

- Federal Program Manager: Tansel Selekler
  Tansel.Selekler@nuclear.energy.gov
- Technical Point of Contact: J. Rory Kennedy
  Rory.Kennedy@inl.gov
- NSUF Website
  nsuf.inl.gov


NSUF
Nuclear Science
User Facilities