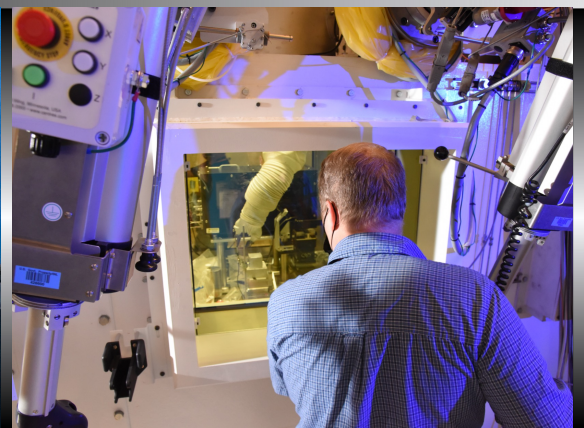
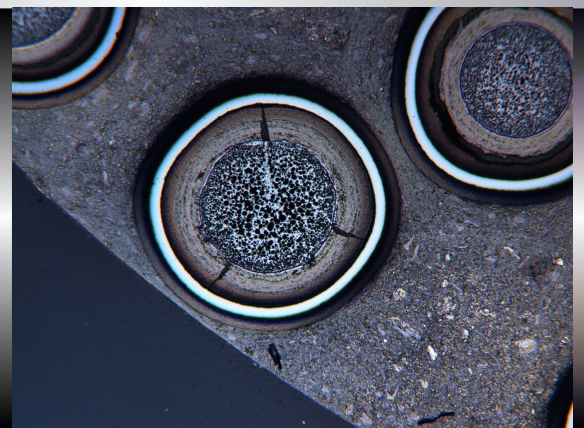
Nuclear Science User Facilities (NSUF) Overview and Status

J. Rory Kennedy, Ph.D.

2022 Nuclear Academics Discussion Meeting
September 7, 2022





NSUF Nuclear Science User Facilities

The Nuclear Science User Facilities

Vision
- U.S. leads the world in nuclear energy research with cutting edge resources.

Mission
- Coordinate a consortium of institutions to provide access, at no cost to the user, to unique and highly specialized nuclear research facilities and technical expertise.

Goal
- Produce the highest quality research results that will impact and increase understanding of advanced nuclear energy technologies important to DOE-NE and support national priorities by adapting to the needs of DOE-NE programs, industry, and new innovative concepts.

Strategic R&D Support
- Provide mechanisms for research organizations to collaborate, conduct irradiations and post irradiation analyses, and utilize high performance computing at facilities not normally accessible to these organizations.

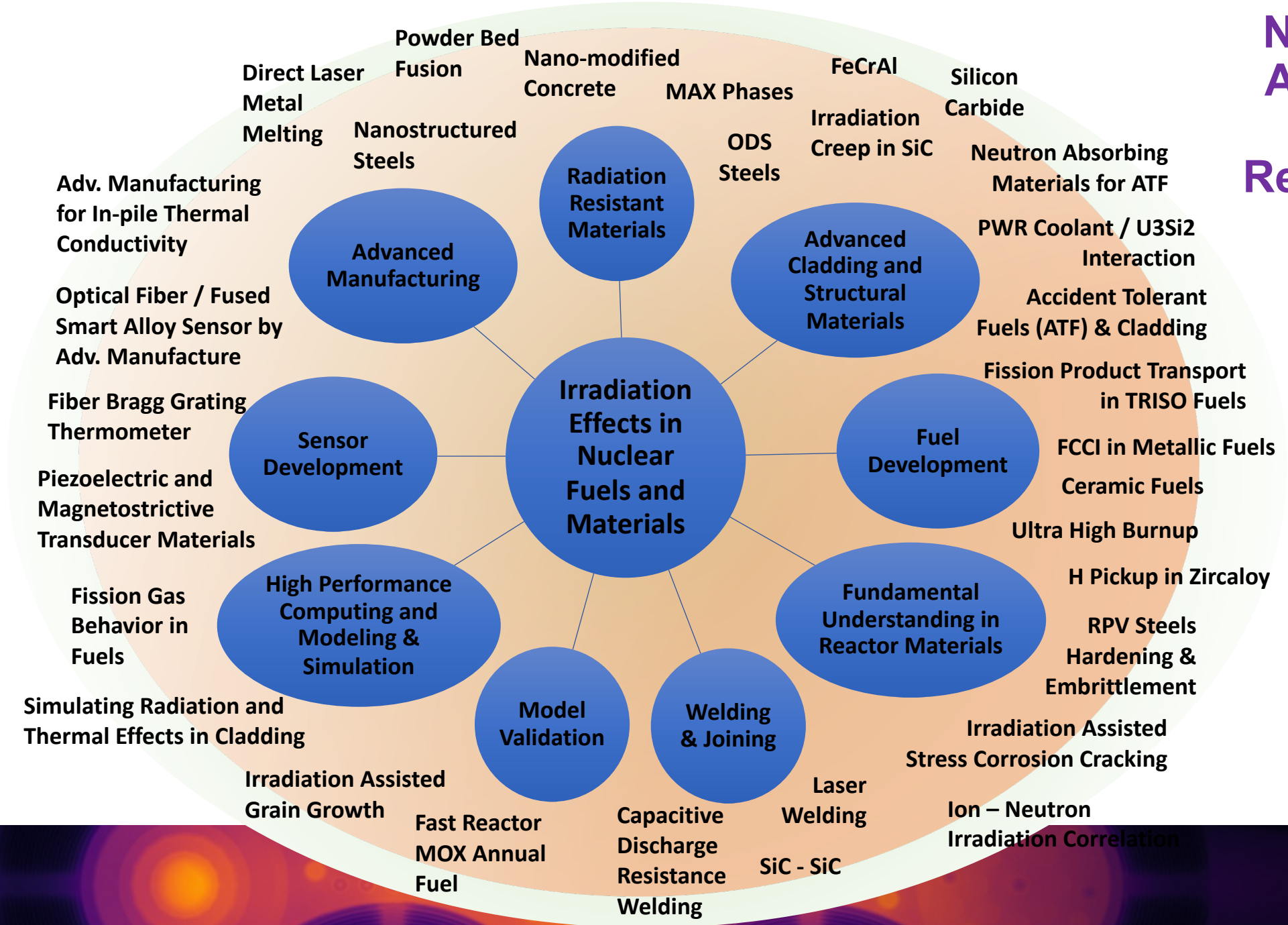
The Nuclear Science User Facilities

- **Established 2007 as US DOE Office of Nuclear Energy first & only user facility**
- **Founded at Idaho National Laboratory initially intended as a single institution user facility. INL remains lead and primary institution**
- **NSUF operates as typical US user facility (no cost to user, competitive proposal processes, no funding to users) but also some unique aspects**
- **<u>Unique aspects of NSUF</u>**
  - **Consortium of facilities/capabilities, not single institution (currently 9 Universities + 3 Universities in CAES, 8 National Laboratories, 1 industry)**
  - **NSUF offers multiple capabilities to a single scientific area:**
    - **Irradiation effects in nuclear fuels and materials.**
  - **Projects can last many years or be short duration.**
    - **Largest projects include design, fabrication, transport, irradiation, PIE, and final disposition.**
  - **No base funding to facilities.**
    - **Funding to facility is for project cost and is fully forward funded.**

The Nuclear Science User Facilities

- Generally select projects through open competitive proposal processes
  - Consolidated Innovative Nuclear Research (CINR FOA, 1 call/year)
    - Neutron Irradiation + PIE ($500K - $4.0M, up to 7 years) includes design, analyses, fabrication, transport, irradiation, disassembly, PIE, disposition
    - PIE only (up to ~$750K and 3 years)
    - Neutron Irradiation only (up to $3.5M)
    - Ion or Gamma Irradiation + PIE (up to $250K)
    - Ion or Gamma Irradiation only (up to $100K)
    - Beamlines at other user facilities
    - Possibility to also receive user R&D funding on limited number of work scopes
  - Rapid Turnaround Experiments (RTE, 3 calls/year, limited $$, executed within 9 months)
- Proposals welcome from university, government laboratory, industry, and small business researchers. Only non-proprietary projects accepted. All awarded projects are fully forward funded.

NSUF Research Areas Cover All Technical Readiness Levels (TRLs)



NSUF Nuclear Science User Facilities

NSUF Capabilities Offer Research Opportunities

Neutron Irradiations	Ion Irradiations	Gamma Irradiations	Hot Cells & Shielded Cells	Low Activity Laboratories	Beamlines	High Performance Computing
INL	Wisconsin	INL	INL	INL	Brookhaven National Laboratory	INL
ORNL	Michigan	ORNL	ORNL	CAES	Argonne	
MIT	Argonne	Sandia	PNNL	ORNL	NC State	
NC State	Sandia		Los Alamos	Cal	Los Alamos	
Ohio State	A&M		Westinghouse	PNNL		
Sandia	Texas A&M		Michigan	Los Alamos		
SCK•CEN	Lawrence Livermore		SCK•CEN	NC State, Michigan, Purdue, Wisconsin, Florida		
				SCK•CEN		

INL +

9 Universities

CAES (3 Univ)

7 National Labs

1 Industry

1 Int'l Affiliate

New capabilities:

Texas Austin: Prompt Gamma Neutron Activation Analysis 2022

Penn State: Radiation Science and Engineering Center 2023

ANL: APS AML HEXM beamline 2024

Visit nsuf.inl.gov for details at individual facilities

NSUF Staff and DOE Update

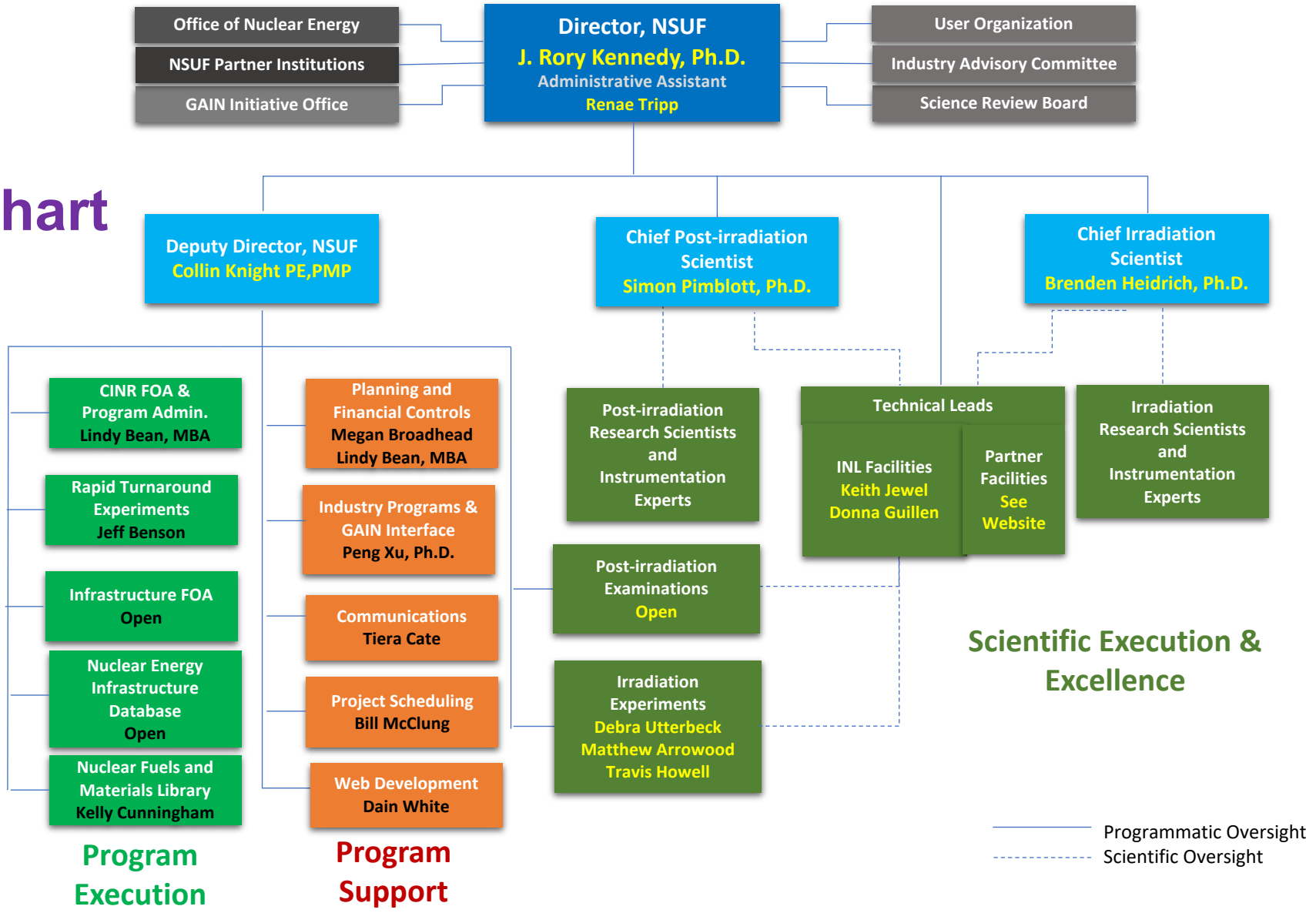
- **DOE Contacts**
  - **Alice Caponiti replaced Shane Johnson as Deputy Assistant Secretary (DAS) (2020)**
  - **Suibel Schuppner replaces Alice Caponiti as Office of Nuclear Energy Technologies Director (2020)**
  - **Melissa Bates brought on as Enabling Technologies Team lead (2020)**
  - **Tansel Selekler left as DOE-HQ NSUF Program Manager (2021) – position currently vacant**
  - **Willettia Amos replaced Jihad Aljayoushi as DOE-ID NSUF Program Manager (2019)**

NSUF Staff and DOE Update

Staff

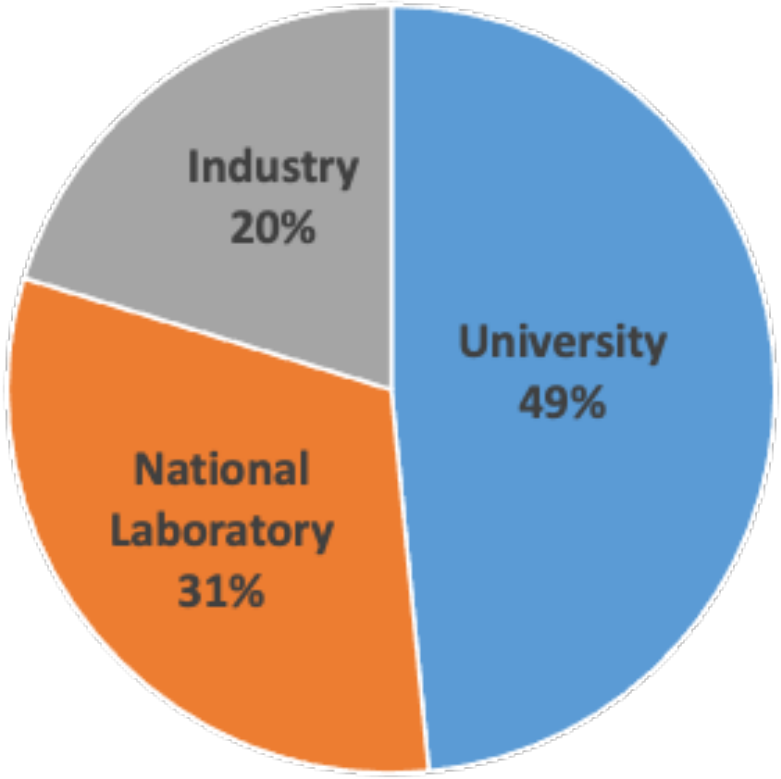
- Jeff Benson rejoined the NSUF as RTE administrator replacing Kelly Cunningham (2019)
- Kelly Cunningham becomes full time lead for the NFML (2019)
- Jon Kirkham (capabilities coordinator) leaves the NSUF (2019) – position remains vacant
- Travis Howell left as pfc to become EM (2019) for NSUF replaced by Rachel Jones who moved states (2021) replaced by Troy Taylor for a few months and current pfc is Megan Broadhead (2022)
- Laura Scheele replaced by Tiffany Adams as communications lead (2019) replaced by Tiera Cate (2022)
- John Jackson left as industry lead (2020) to lead micro-reactor program followed by Colin Judge who left to be MFC Division Director (2021) followed by Peng Xu (2021)
- John Coody left as scheduler (2019) replaced by Bill McClung (2020)
- Brenden Heidrich (Chief Scientist for Irradiations) stepped down as the National Technical Director for the NEET-CTD In-pile Instrumentation Initiative to be NS&T Department Manager
- Dan Ogden retires from INL (2022) replaced by Collin Knight as NSUF Deputy Director
- Collin Knight leaves NSUF PIE Coordinator position (2022) - position currently vacant
- Rory Kennedy will step down as director at end of CY 2022 (completing 9 years as director)

NSUF Organization Chart

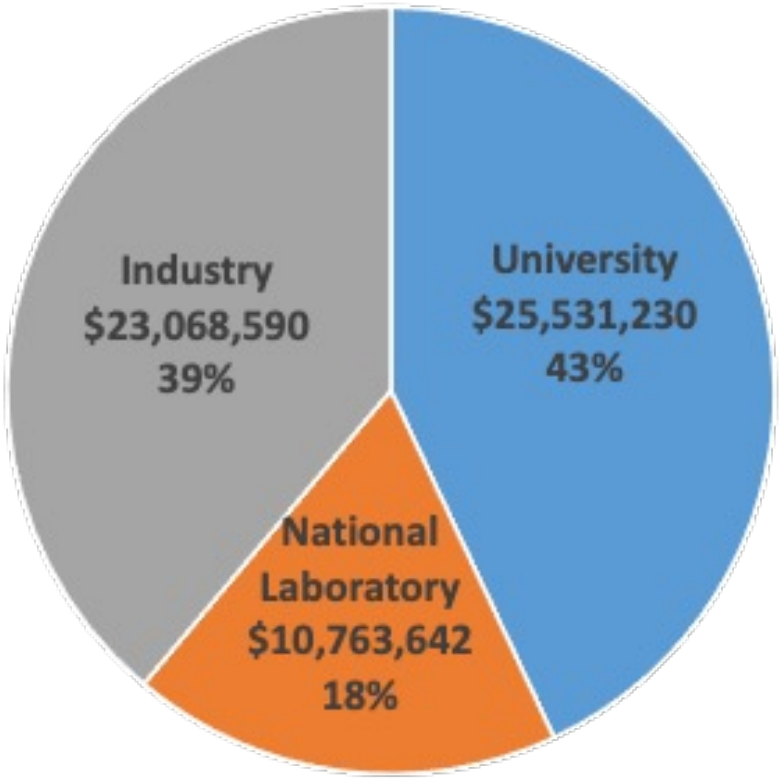


CINR Awarded Projects FY 2015 – FY 2021

Number of Awards by Institution Type 2015 - 2021



Value of Awards by Institution Type 2015 - 2021



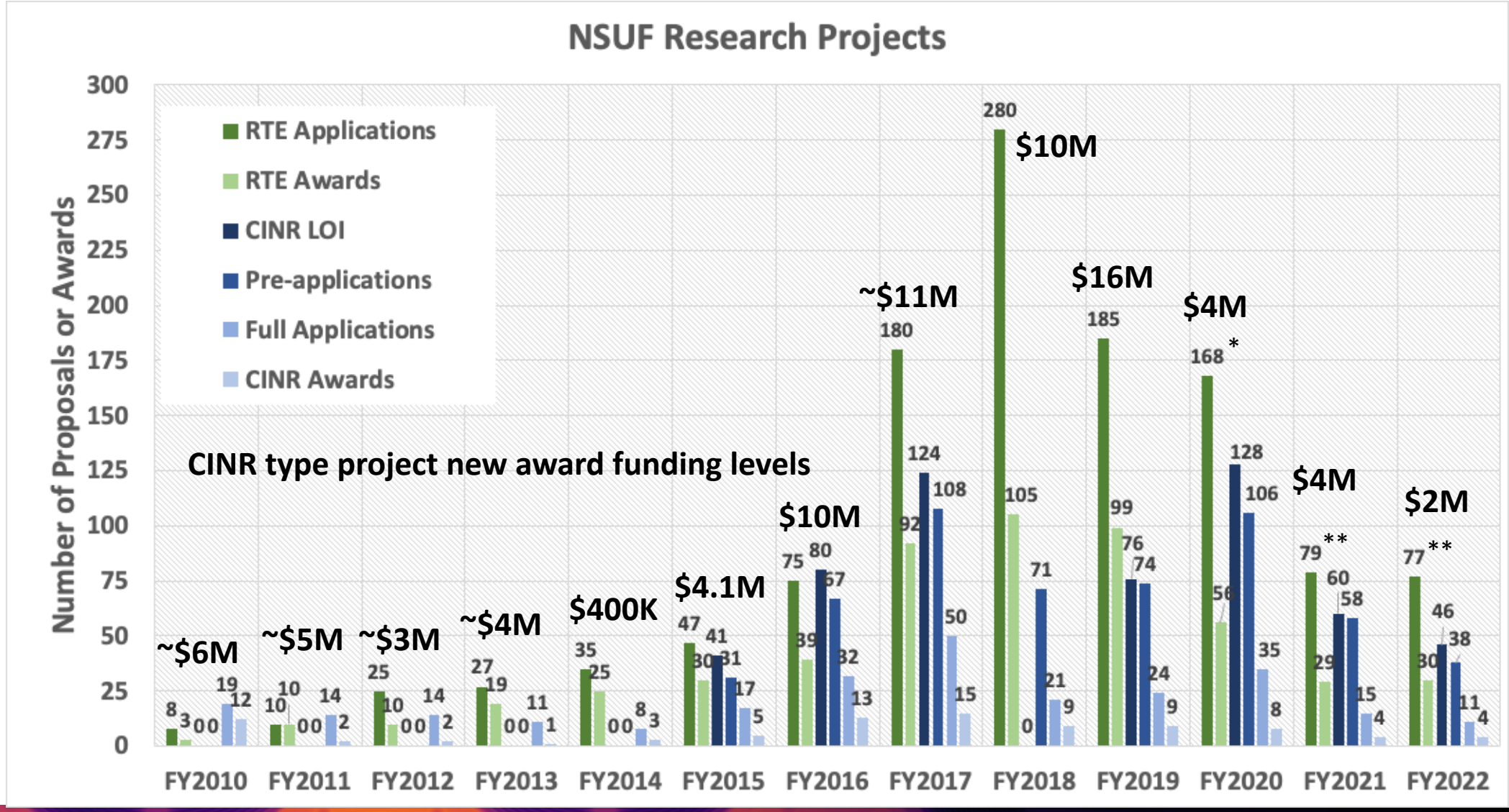
NSUF Projects Summary

FY 2007 – FY2022*

- Total of 58 CINR type projects executed
- Total of 42 CINR type projects currently ongoing
- Total of 498 RTEs executed
- Total of 49 RTEs ongoing
- 647 total projects awarded
  - 396 projects to 54 US universities
  - 189 projects to 8 national laboratories
  - 28 projects to 10 industry
  - 34 projects to 18 international (Oxford U., Manchester U., Liverpool U., Bristol U., Sheffield U., Huddersfield U., Sabanci U., Queens U., Leoben U., Nagoya U., NNL, ANSTO, CEA Saclay, Institutio Italiano di Technologia, SCK-CEN, EC-JRC-Karlsruhe, Studsvik Nuclear, Canadian Nuclear Laboratories)
- At any particular time, NSUF is typically managing ~100 – 130 projects

* As of 7/2022

Interest and Support

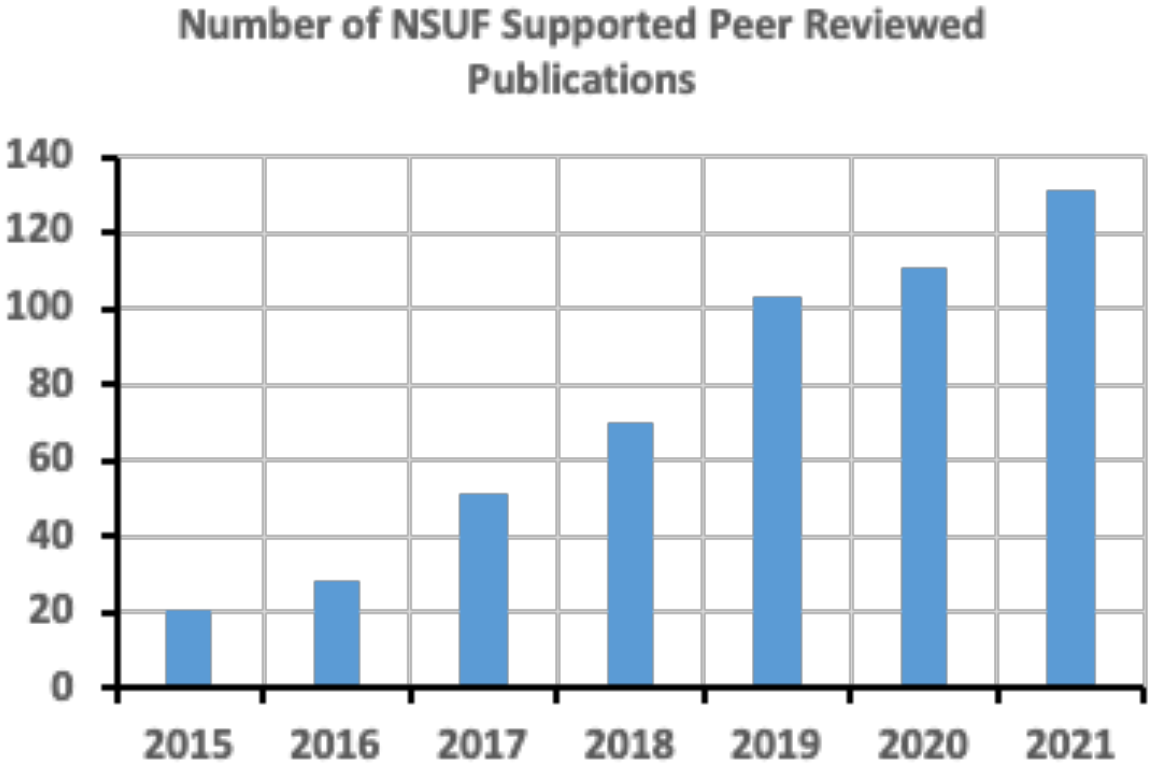


* Only 2 RTE solicitations in FY 2020

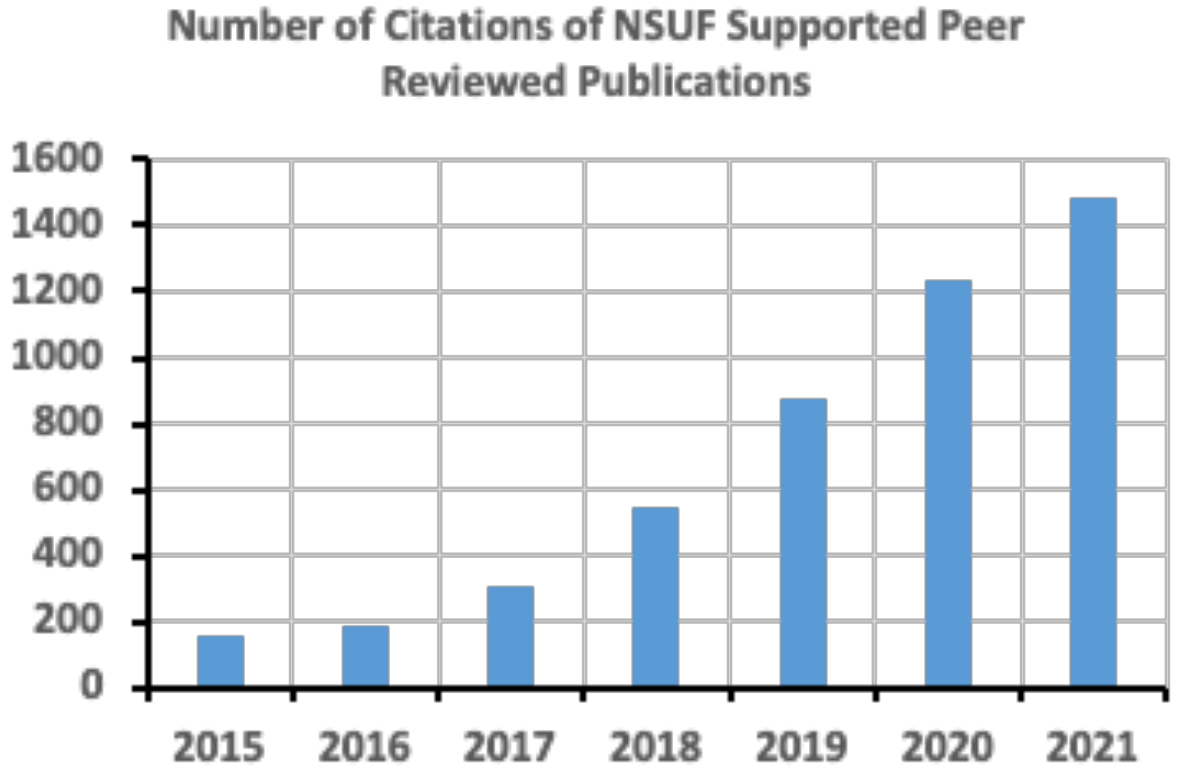
** Only 1 RTE solicitation in FY 2021 and 2022

Graphics created by Brenden Heidrich

NSUF Productivity and Impact



- Numbers are for calendar years
- Total NSUF publications through 2021: 585
- Increase in RTE awards through FY 2019.

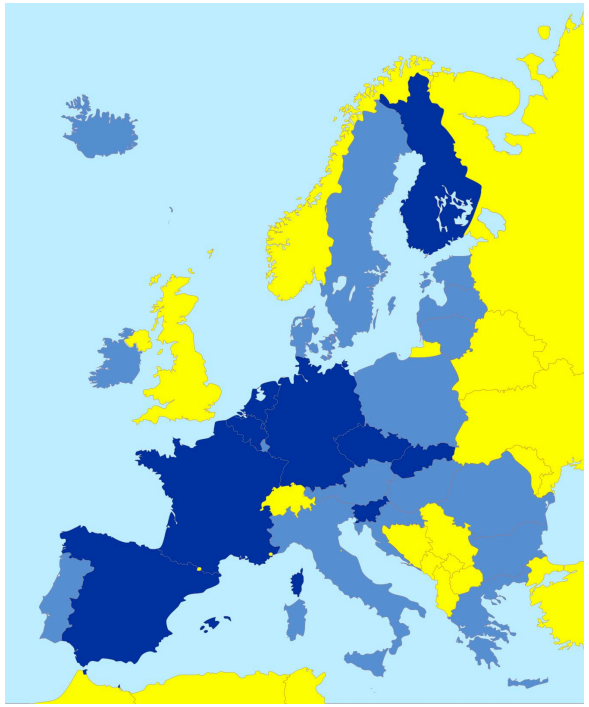


- Total NSUF citations: 5370 in 3874 citing articles
- H-index score of 33 (score of 27 to 9/2020)
- Journal of Nuclear Materials is by far the journal of choice.

Data generated and graphics created by Simon M. Pimblott

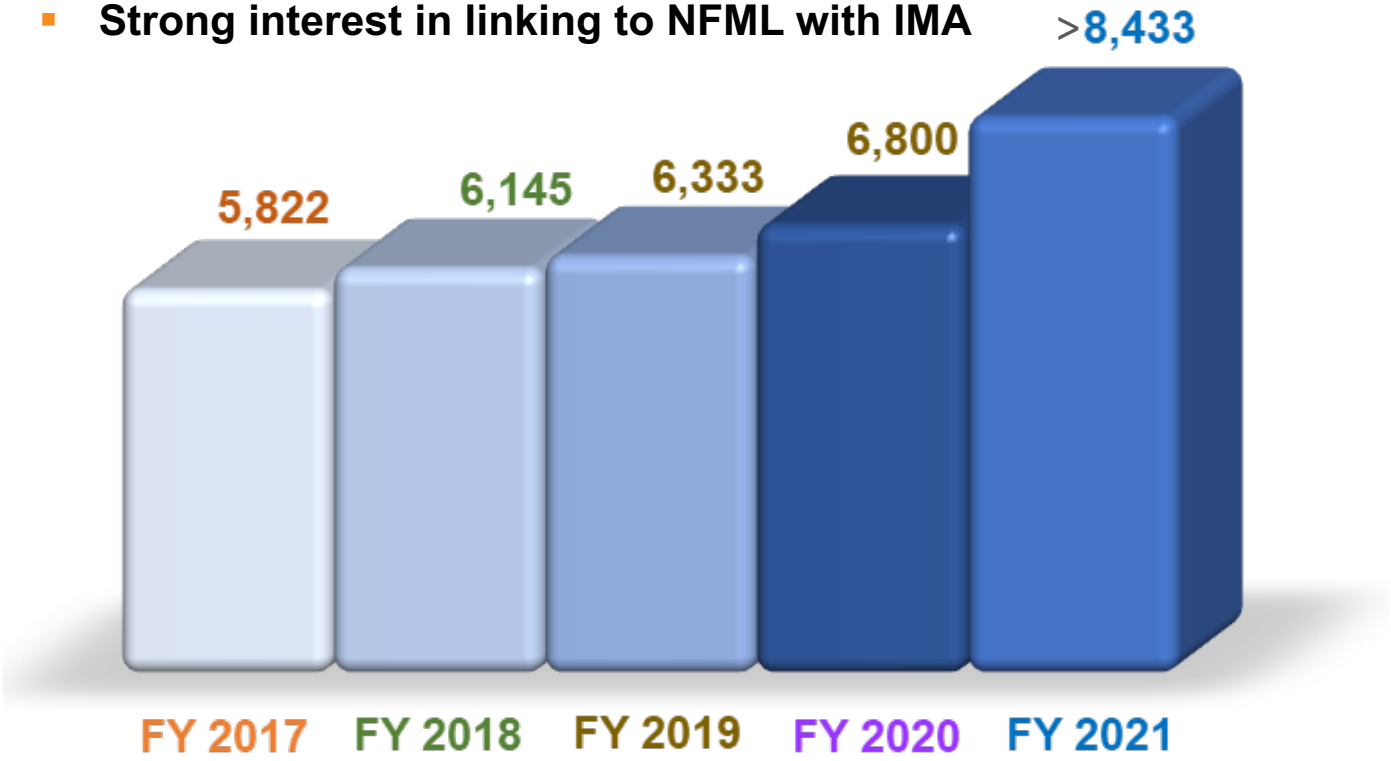
NSUF International Relations

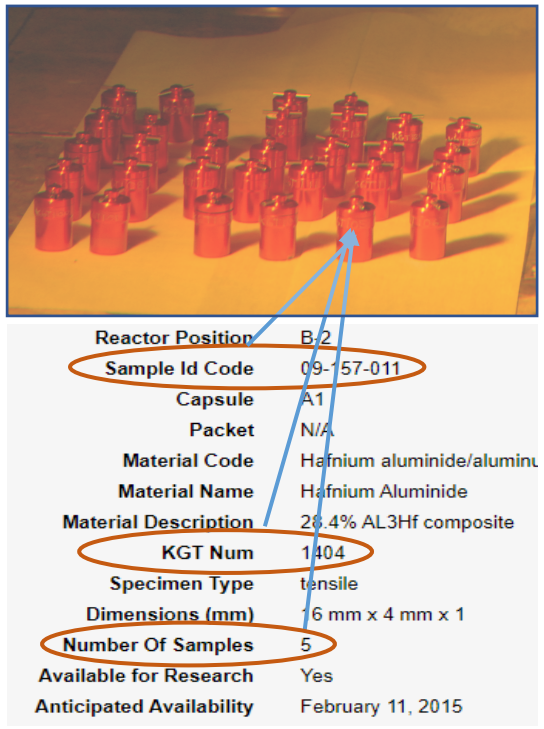
- **SCK-CEN BR-2 Reactor (Belgium)**
  - DOE – SCK/CEN MOU and Belgium Nuclear Research Centre – INL CRADA signed in early FY 2017
  - 4 projects with in-kind contributions
  - 1 project complete, 1 project “cancelled”, 2 projects (DISECT and instrumentation development) still underway.
  - BR2 changed core
- **OFFERR (eurOpean platForm For accEssing nucleaR R&d facilities) project**
  - European Commission Euratom framework
  - Objective to build a European user facility network
  - NSUF has given input and many aspects similar to NSUF
  - NSUF invited to participate in kickoff meeting (September 7, 2022)
  - Both NNUF and NSUF mentioned as international collaborators



NSUF International Relations

- **United Kingdom**
  - US invited to Nuclear Academics Discussion Meeting (NADM) and Executive Committee Meeting of National Nuclear User Facility (NNUF)
  - Initial area of mutual user facility interest and cooperation
    - Nuclear Fuels and Materials Library (NFML) and Irradiated Materials Archive (IMA)
    - Strong interest in linking to NFML with IMA





Reactor Position	B-2
Sample Id Code	09-157-011
Capsule	A1
Packet	N/A
Material Code	Hafnium aluminide/aluminu
Material Name	Hafnium Aluminide
Material Description	26.4% AL3Hf composite
KGT Num	1404
Specimen Type	tensile
Dimensions (mm)	16 mm x 4 mm x 1
Number Of Samples	5
Available for Research	Yes
Anticipated Availability	February 11, 2015

  - NNUF has opened access to non-UK based researchers

NSUF International Relations

- **United Kingdom**
  - **US-UK Nuclear Energy Research Collaboration Action Plan signed in 2019**
    - **Enabling Technologies Working Group**
      - **US Leads: Suibel Schuppner (DOE) & Rory Kennedy (INL)**
      - **UK Leads: Lindsey Butterworth (BEIS) & Paul Nevitt (NNL)**

1. Universities engagement

Continue robust nuclear energy research collaboration programme that has been ongoing between U.S. and U.K. Universities through competitive solicitations

US: Aaron Gravelle (DOE)

UK: Andrew Eustace (UKRI-EPSRC)

2. Nuclear Science User Facilities (NSUF) and National Nuclear User Facility (NNUF) Collaboration

Coordinate the establishment and implementation of processes to facilitate the sharing of user facility resources. Pilot irradiation project under development !

Coordinate nuclear fuels and materials sample library and archive assets

US: Rory Kennedy (INL)

UK: Chris Grovenor (University of Oxford)

3. Resource libraries

Identify programs and data of mutual interest; determining the ownership, format, and location of the key data and materials

Identify a means by which to capture and share the data and materials

US: Rory Kennedy (INL)

UK: Susan Morgan (NNL)

4. Public understanding and engagement

Work with leadership on how to implement best practices and how to communicate effectively with the public

US: Suzy Baker (DOE)

UK: Adrian Bull (NNL/University of Manchester)

Database Integration
Combined Materials Experiment Toolkit (CoMET)

- Multi-year effort.
- Supported by full-featured Web API (Advanced Programming Interface). API allows the Experiment Wizard to pull content from databases (NEID, NFML, NERD).
- Experiment Wizard integrates and links multiple systems, including the NEID, NFML, NERD, and RAD Calculator.
- Proposals benefit from direct integration with the NFML for sample requests and the NEID for facility and capability selections.
- Search functionality improved with Keyword Integration

Communications

- Check out https://nsuf.inl.gov/Home/Article/81
- Meetings, Presentations, and Conferences
- Newsletters
  - Feature Stories, General Announcements

The National Nuclear User Facility (NNUF): opportunities for access

TUESDAY, APRIL 12, 2022 - FACILITY HIGHLIGHT

The National Nuclear User Facility (NNUF) is a £100 million investment by the UK government in state-of-the-art experimental facilities for research and development in nuclear science and technology.

The aim is to install new equipment and laboratories, provide training opportunities for nuclear scientists and engineers, and foster international collaborations.

NNUF National Nuclear User Facility

Outstanding facilities

There are 30 NNUF facilities, many of which can handle active materials.

Additional capability has been added at well-established facilities, including the UK's National Nuclear Laboratory, the University of Manchester's Dalton Cumbrian Facility, and UKAEA's Materials Research Facility.

Newer projects include a neutron source at Birmingham, an investment in nuclear robotics at Bristol, UKAEA, Manchester, and NNL, and a new active Atom Probe Tomography facility in Oxford.

The latest facilities were funded in 2021 and are currently being installed.

Free access for international researchers

NNUF's £6.5 million user access scheme allows UK university researchers (or employees of any other organization eligible to bid for UKRI funding) to apply to use NNUF facilities free of charge. This scheme is now open to researchers from outside the UK.

Researchers are eligible if a faculty member in a UK university is included on the project team or if it can be shown that the proposed experiment is part of establishing/expanding a substantial collaboration between the research group and the institution hosting the facility.

Further eligibility details are on the NNUF website.

How to apply

Calls run quarterly. Users typically apply for experiments lasting up to 6 months. Those with persuasive cases can apply for a longer/larger project.

The 8th round opens in April, with a closing date of 31st May 2022. This covers access commencing primarily in July to September of 2022.

- Contact the facility(ies) to check the feasibility of the experiment (can include up to 3 NNUF facilities). Check the NNUF website for a current list.
- Complete a simple application form.


NSUF
Nuclear Science
User Facilities