Nuclear Science User Facilities

Nuclear Fuels and Materials Library

Kelly Cunningham
NFML Coordinator

NSUF Industry Advisory Meeting
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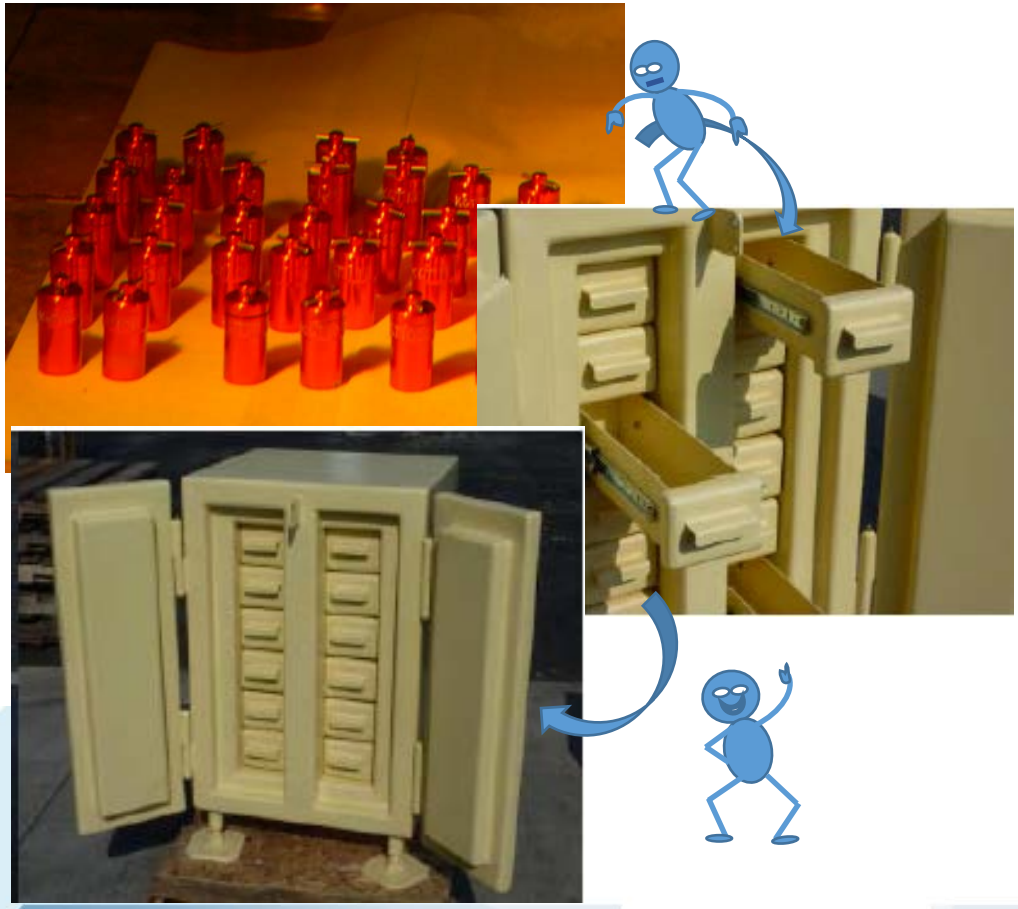
INL/MIS-18-46097

Nuclear Fuels and Materials Library

- **Nuclear Science User Facilities**

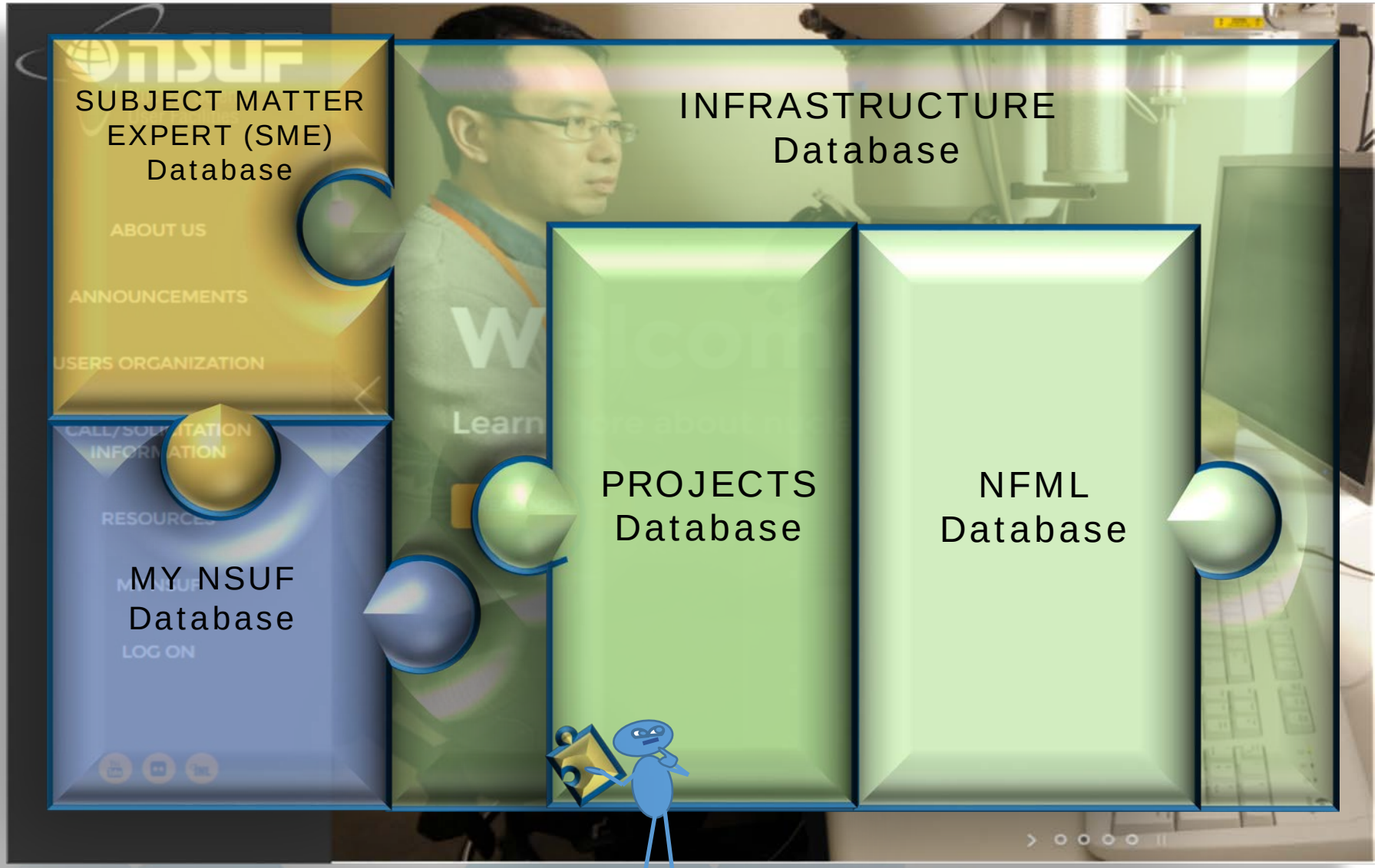
  Established in 2007 by DOE-NE to support nuclear energy R&D by providing researchers with no-cost-to-the-user access to unique facilities and **materials** through competitive processes, Work-for-Others projects, etc. as agreed upon with NSUF Director.

- **The NSUF Nuclear Fuels and Materials Library**
  - Includes nuclear fuel and material samples from past and ongoing irradiation test campaigns, decommissioned power reactors, and donations from other sources.
  - Contains >6000 searchable samples and corresponding information
    - Irradiation Conditions
    - Experiment information
    - Project reports



NUCLEAR SCIENCE USER FACILITIES Website

NSUF.INL.GOV



NUCLEAR SCIENCE USER FACILITIES (*integrated*) Website

SUBJECT MATTER EXPERT (SME) Database

PI NAME
INSTITUTION
PROPOSALS
Expertise
Publications
Presentations
Personal Information

INFRASTRUCTURE Database

INSTITUTIONS
FACILITIES
EQUIPMENT
Google Maps

SEARCH
NEID
NFML
PEOPLE

PROJECTS Database

PROPOSAL/Project
PI NAME
Research Area
Material Type
INSTITUTION
FACILITY
PUBLICATIONS
PRESENTATIONS

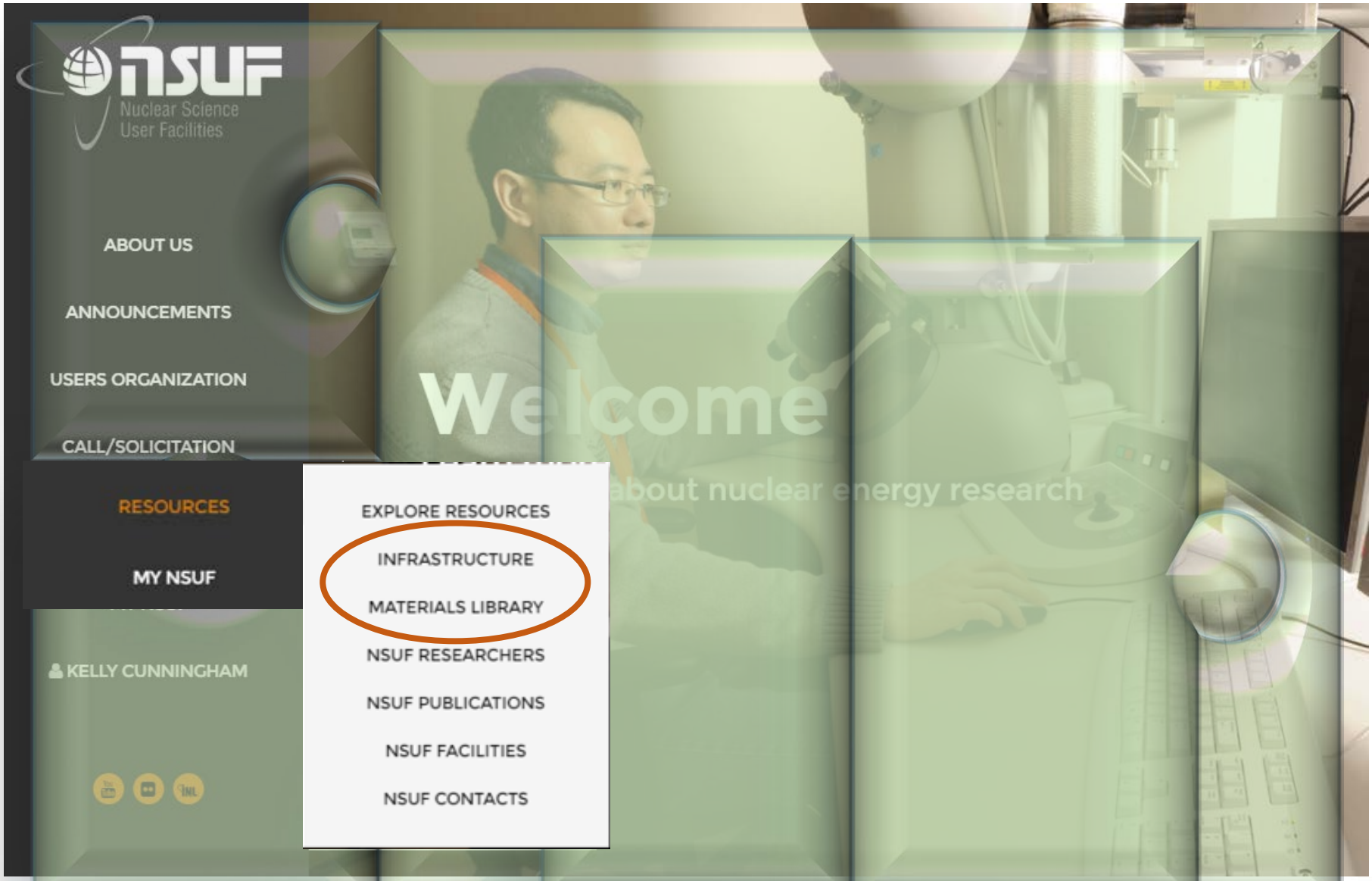
NFML Database

Material Name
Reactor/Position
SAMPLE TYPE
DIMENSIONS
Storage Facility
Availability
Samples Remaining
Planned/As-Run Temp
Planned/As-Run Dose
Flux
Fluence
Environment
Documents

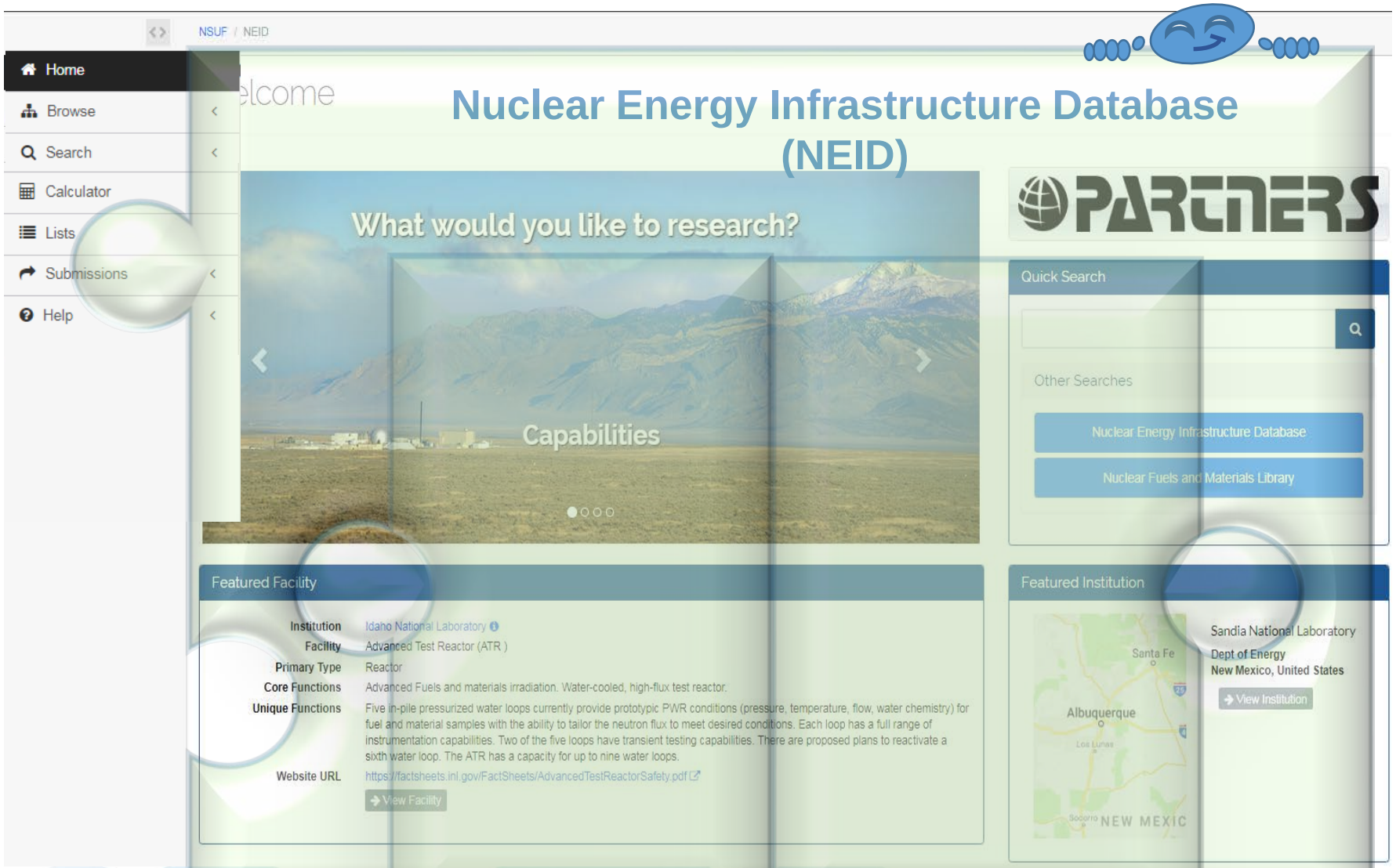
MY NSUF Database

PI NAME
PROPOSALS
RTE#
INSTITUTION
FACILITY
Collaborators
Sample Info
Research Area
PUBLICATIONS
PRESENTATIONS

Finding the Nuclear Fuels and Materials Library

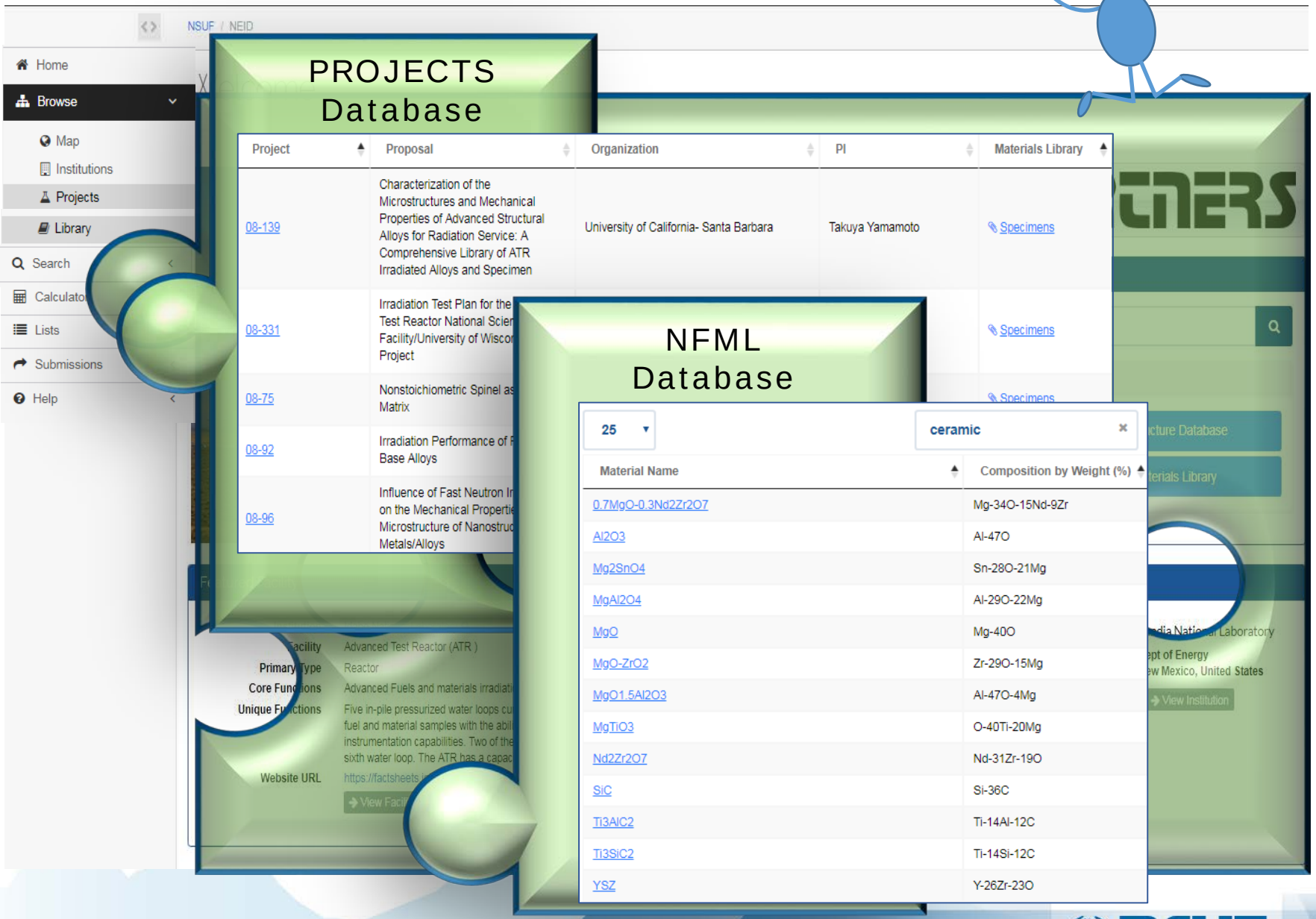


Finding the Nuclear Fuels and Materials Library
nsuf-infrastructure.inl.gov



Nuclear Fuels and Materials Library

Browse



Nuclear Fuels and Materials Library
Projects/Samples

NSUF / NEID

- Home
- Browse
  - Map
  - Institutions
  - Projects
  - Library
- Search
- Calculator
- Lists
- Submissions
- Help

Irradiation Performance of Fe-Cr Base Alloys

Project

Is Approved	True
Project Type	Irradiation/PIE
Fiscal Year	2008
Project Code	08-92
Proposal	Irradiation Performance of Fe-Cr Base Alloys
Award Date	March 27, 2008
Organization	University of Illinois
RTE Num	92
NSUF Call	FY'08 Call for User Proposals
Tech Lead	Rory Kennedy
Irradiation Facility	ATR
PIE Facility 1	INL
PIE Facility 2	CAES, ORNL
Material Type	Ferritic-Martensitic Steels
Research Area	Cladding and Other Structural Materials
Document Name	08-92-Material-Compositions.xlsx

Specimens | Publications | Presentations

15 | Search...

ID	KGT	Description	Material	Facility	Specimen
2008-92-001	712	Model Alloys (bcc)	Fe-14Cr	EML	TEM
2008-92-002	721	Model Alloys (bcc)	Fe-12Cr-0.5C	HFEF	TEM
2008-92-003	720	Model Alloys (bcc)	Fe-12Cr-0.2C	HFEF	TEM
2008-92-004	714	Model Alloys (bcc)	Fe-12Cr	HFEF	TEM

Is Approved	True
Project	Irradiation Performance of Fe-Cr Base Alloys
Reactor	ATR
Reactor Position	A-11
Sample Id Code	2008-92-003
Capsule	UI-0.5-300A
Material Code	J
Material Name	Fe-12Cr-0.2C
Material Description	Model Alloys (bcc)
KGT Num	720
Specimen Type	TEM
Dimensions (mm)	10mm dia. X 0.2mm thick
Number Of Samples	1
Specimen Availability	Yes
Availability Date	July 30, 2014
Certification	Yes
Storage Facility	Hot Fuel Examination Facility
Planned Temp (°C)	300.00
Planned Dose (DPA)	0.5
Planned Flux (n/cm²s)	2.3E+14
Planned Environment	Helium/Argon
s Run Total Dose	
s Run Total Fluen	

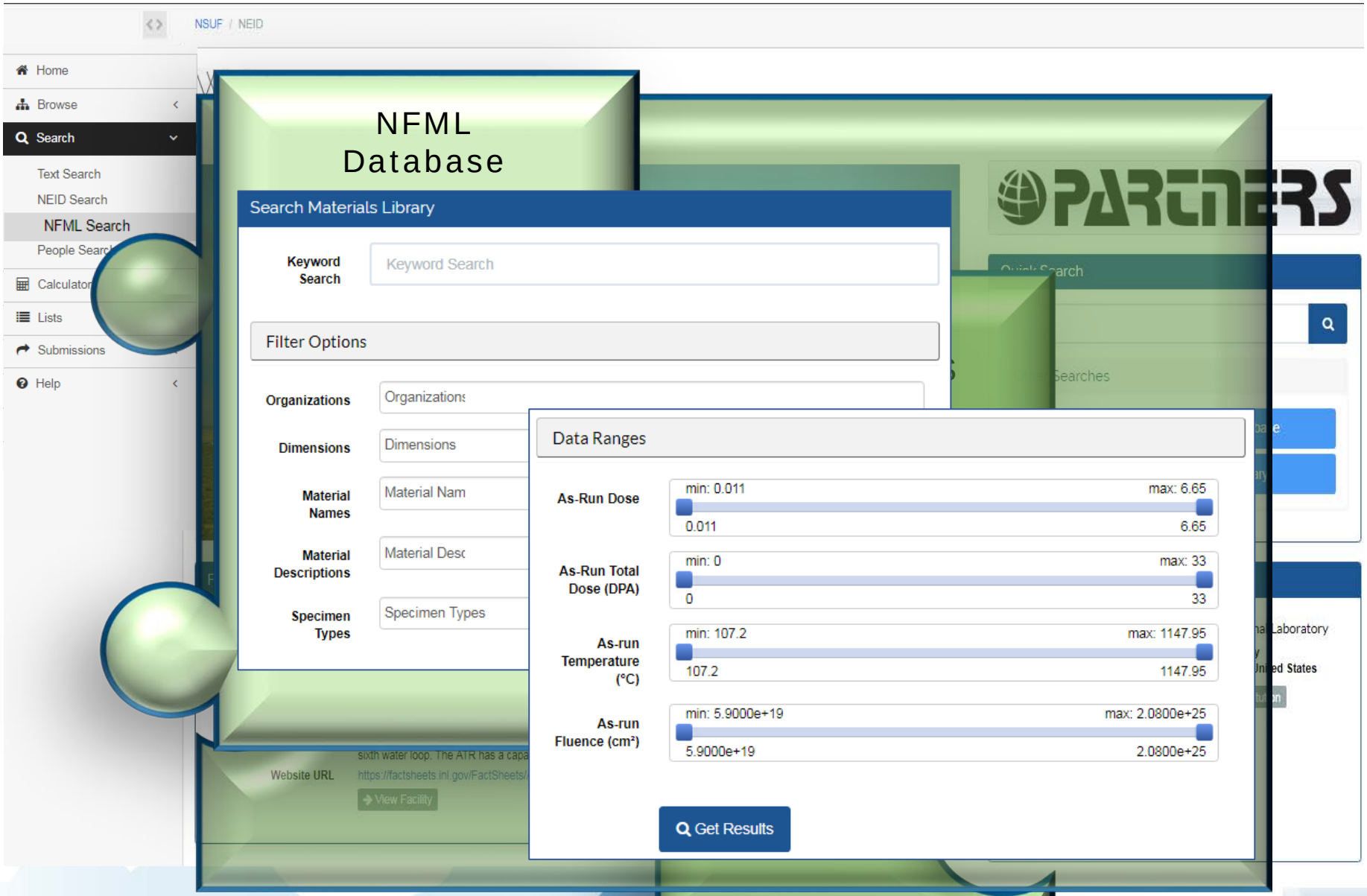
Cycles

15 | Search...

Cycle	As Run Temp	As Run Dose	As Run Fluence	As Run Flux
145B	357.00	0.6	2.23E+21	

Showing 1 to 1 of 1 entries Previous 1 Next

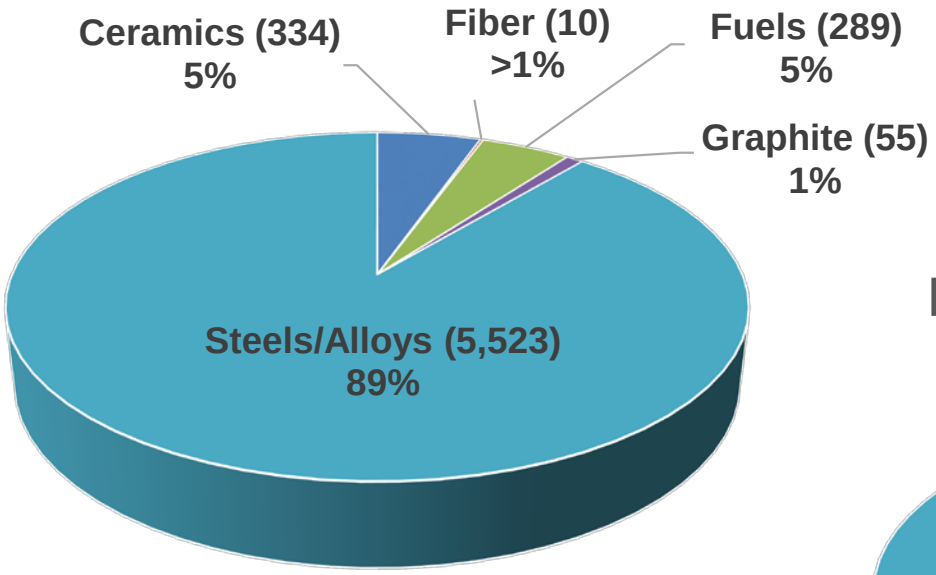
Nuclear Fuels and Materials Library
Search



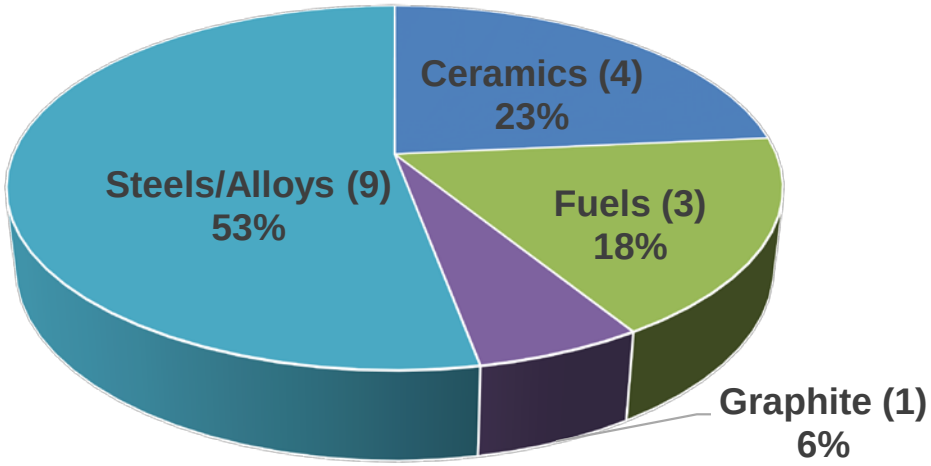
Nuclear Fuels and Materials Library

Online Inventory (~6,200 samples)

Material Type by Sample Count



Material Type by Project



Nuclear Fuels and Materials Library

Online Inventory (~6,200 samples)

Original Project	Reactor	Irradiated Materials	Specimen Geometry	Material Type	Sample Count
08-75	ATR	$MgAl_2O_4$, $Nd_2Zr_2O_7$, MgO, MgONdZr, Mg_2SnO_4	Diffusivity, TEM	Ceramics	120
08-92	ATR	Fe, Fe-Cr, HT9, MA-957 ODS, T91	TEM, Tensile	Steels, Alloys	768
08-96	ATR	Course & nanograined Cu, Ni, carbon steel, ODS	TEM, Hardness, Tensile	Steels, Alloys	80
08-139	ATR	commercial F-M alloys, model RPV steels, ODS alloys, cast austenitic SS	Diffusivity, TEM	Metals, Alloys	1,561
08-331	ATR	F-M & Austenitic SS, ODS alloys, refractory alloys, SiC, metallic glass	TEM, Tensile	Steels, Alloys, Metals, Ceramics	149
09-157	ATR	Al_3Hf, Hf_3Al-Al composite	Density, Diffusivity, TEM	Metal Alloys	160
09-197	ATR	Transuranic isotopes	Dissolved	Fuel	78
09-204	ATR	Ti_3Sic_2, Ti_3AlC_2, SiC	Resistivity, TEM, Tensile	Ceramics	153
10-242	ATR	DU, Mo, DU-7Mo, DU-10Mo, DU-10Mo w/Zr layer	TEM, Foils	Fuel	91

Nuclear Fuels and Materials Library Inventory

(~6,200 samples)

Original Project	Reactor	Irradiated Materials	Specimen Geometry	Material Type	Sample Count
12-357	MITR	Magnorestrictive, Piezoelectric sensors FeCoV, IrGa, Fe-Cr, Fe-Mn, Arnokrome, ZnO, BiTiO	Wire strip, Wafer	Ceramic, alloy	7
Hexblock	EBR-II	Legacy Hardware 304 SS	Hex Ducts, Reflector Blocks	Steels	226
SURV	EBR-II	Surveillance Capsules Austenitic SS, Inconel X-750, Ferritic SS, Ber;ylium, Aluminum, Bronze, Stellite	Tensile, Hardness, Bend, Impact, Spring	SS, Alloys	~482
Creep	EBR-II	AISI 316	capsules	SS	49
SAM-1	ATR	Nuclear grade graphite, SiO_2	Fiber optic sensors, disks	Graphite, fiber optics	66
LANSCE *(donatated)*	LANSCE	alloy 718, Type 316L, and Type 304L stainless steel, Fe9Cr-1Mo(T91), Al-6061-T6, and Al-5052-O)	TEM, Tensile, CT, Plate, Bend	SS, Alloys	2200
CNL *(donated)*	CANDU	Inconel X-750	Spring spacers	Alloys	19
LIBSUB *(donated)*	HFIR	TiC	Disks	Ceramics	3

Nuclear Fuels and Materials Library

Coming Soon!!!

Many projects from previous years' awards and recently awarded CINRs will become available in the next five to seven years (one year in dog years).

Project	Material Type	Status
09-153	RPV steel/alloys	Available, NOT ONLINE YET pedigree info not processed
10-224	Hydride Fuel	Available, NOT ONLINE YET pedigree info not processed
10-269	U_3Si_2 fuel	Available 2025, irradiation complete 2022
15-8242	PM-HIP alloys*	Available 2025, irradiation complete 2022
16-10537	Nanostructured A/F/M steels, HEA alloys	NFML material available 2020
16-10584	CAM 316 SS, Inconel**	Available 2021, irradiation complete 2018
16-10393	DMLM 316L, Alloy 718***	Available 2023, irradiation complete 2020
16-CR-17	SiC temperature sensors	Samples to be added online early FY 2019
18-14730	Thermoelectric materials & generators	Fabrication Phase, availability ~2025
18-14741	U-10Zr	Design Phase, availability ~2025
18-14749	Piezoelectric Materials for sensors	Design Phase, availability ~2025
18-14788	Additive Friction Stir Manufactured 316L	Design Phase, availability ~2025

Nuclear Fuels and Materials Library

Library donations (completion TBD)

- TerraPower: BOR 60 P038 & P043 TEM samples
- Naval Nuclear Laboratory: Irradiated & Unirradiated SiC, conventional, and nano-ferritic steels
- Westinghouse: Ex-plant 347 SS baffle bolts
- amazon: Zombie Raccoons & Killer Bunnies
- Oak Ridge National Laboratory: Samples from various programs including LWRS, Fusion, FCRD

Nuclear Fuels and Materials Library

Acquisition Criteria

Fuels and materials added to the NFML are subject to the following stipulations and criteria:

- DOE owns all material in the NFML. Acquisitions may require a transfer of ownership agreement between the donor and DOE. In general, the NSUF would take physical possession of the specimens, although other arrangements are possible.
- NSUF is the caretaker of the samples, holds them within the NFML, manages their utilization, and maintains sample pedigree documentation.
- The materials have demonstrated relevance to the nuclear energy research community.
- The materials complement the content of the NFML in uniqueness or need.
- There is strong supporting pedigree information in the form of available data, reports or peer reviewed journal publications.

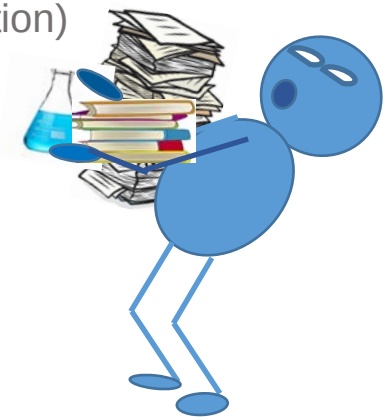
Proprietary materials may be accepted without sensitive information such as owner of materials, irradiation facility, etc. However, a pedigree including processing history, mechanical history, irradiation conditions, etc. must be included.

Nuclear Fuels and Materials Library

Acquisition Criteria (continued)

Pedigree information should include:

- General Information
  - Material or sample type
  - Institution
  - Point of contact
  - Material Type
- Sample Information
  - Irradiation Facility
  - Material Name
  - Sample Type
  - Number of Samples
- Irradiation Conditions (pre-irradiation and post-irradiation)
  - Dates of irradiation
  - Reactor position
  - Environment
  - Temperature
  - Dose or burn-up
  - Flux
  - Fluence



Nuclear Fuels and Materials Library

Current Operating Policy

1. Unless otherwise agreed to, the Department of Energy (DOE) owns sample specimens that are irradiated using NSUF support.
2. Unless otherwise agreed to, DOE owns the sample specimens offered to and accepted into the NSUF Sample Library by a third party. This will be effected through a transfer of ownership agreement between the donor and DOE.
3. NSUF is the caretaker of the sample specimens, holds them within its Sample Library, manages their utilization, and maintains specimen pedigree documentation.
4. Agreement to the policies of the NSUF Sample Library is required. If not agreed to, either the proposed sample specimens offered from a third party will not be accepted into the Sample Library or the project supporting the production of the sample specimens will not be awarded or supported by the NSUF.
5. Exclusive rights to samples for a 3-year period of PIE following the completion of the irradiation portion of an awarded experiment will be given to the project lead unless other conditions are agreed to, such as earlier open availability. After the 3-year period, samples will be made available to the general research community for subsequent proposals.
6. As a courtesy, subsequent proposers can be put in contact with the original project lead for collaboration. Original project leads may collaborate or not but may not deny access to library samples requested in an awarded proposal.
7. NSUF reserves the right to fabricate, irradiate and add sample specimens to the NFML as part of any NSUF-supported irradiation.
8. In the case of dispute over the admittance of sample specimens to the Sample Library, for which DOE-NE has supported or enabled in their production, the final arbiter of decision will reside with the DOE-NE Selection Officer.

Nuclear Fuels and Materials Library

Material Harvesting Workshop

Decommissioned power plants provide a valuable opportunity to harvest real-world material. Challenges include:

- Proactive vs. reactive harvesting:
  - Harvesting is not part of a decommissioning plans
    - Harvesting should be part of the critical path of decommissioning plans
  - Harvesting isn't currently a compliance or licensing activity for nuclear power plants
  - No financial incentive for nuclear power plants to harvest material
  - Research agencies must have funds available as opportunities present themselves
- Decisions and plans need to be made within the research community:
  - What materials are most valuable
  - Harvesting decisions must balance knowledge gain vs. costs (monetary and physiological (dose to workers)
  - What kind of international participation is available and what hurdles will be encountered

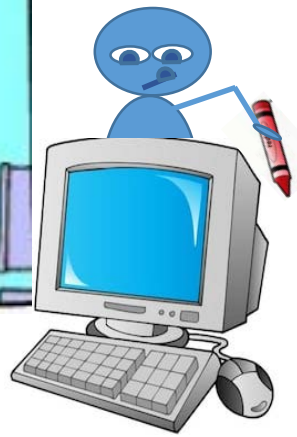
NFML should/could be the repository for harvested material

Nuclear Fuels and Materials Library

A Work in Progress

- NSUF Sample (SAM) irradiations are done specifically to populate NFML with relevant samples
- Request for Information (RFI) is always available for possible donations and suggested material irradiations (https://nsuf.inl.gov/Page/rfi_nfml_callsolicitation)

Comments and suggestions on the website and library are encouraged and welcome.



NUCLEAR FUELS AND MATERIALS LIBRARY

Contact Information

Kelly Cunningham

(208) 526-2369

Kelly.Cunningham@INL.gov

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