

# **Nuclear Science User Facilities**

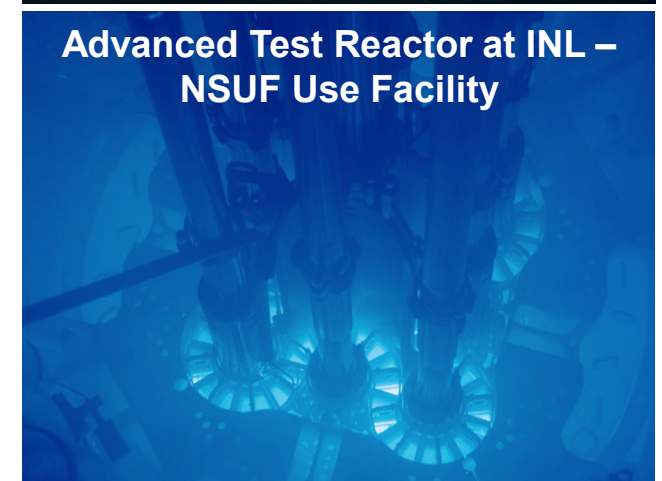
**Christopher Barr, PhD**  
**NSUF Federal Program Manager**






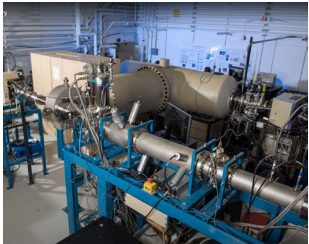

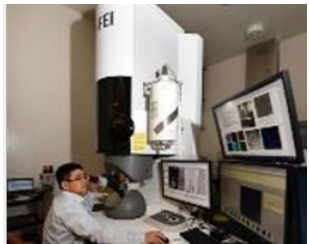



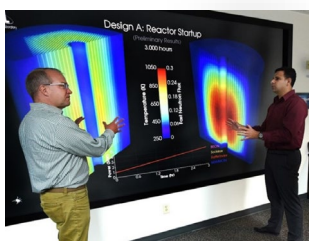
# Nuclear Science User Facilities (NSUF)

## Program Overview:

- 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.
- Produce the highest quality research results that will impact and increase understanding of advanced nuclear energy technologies important to DOE-Office of Nuclear Energy (NE) and support national priorities by adapting to the needs of DOE-NE programs, industry, and new innovative concepts.
- Provide mechanisms for research organizations to collaborate, conduct irradiations and post irradiation analyses, and utilize high performance computing



# User Access: Infrastructure and Capabilities

 <p>Neutron Reactors</p>		<p>Reactor facilities at national laboratories and universities including the Advanced Test Reactor at INL</p>
 <p>Gamma &amp; Ion Irradiation</p>		<p>Gamma irradiation facilities and ion beam facilities at national laboratories and universities</p>
 <p>Post-Irradiation Examination</p>		<p>Multiple hot cell and broad post-irradiation examination facilities including advanced characterization methods</p>
 <p>Beamlines</p>		<p>Synchrotron and pulsed neutron beamlines for nuclear fuel and materials studies</p>
 <p>Computational Resources</p>		<p>Scientific high-performance computing capabilities for advanced modeling and simulation at INL</p>



**Consortium-based** user facility model.

Available to industry, academia, and national labs for **non-proprietary R&D**

# NSUF – Program Background

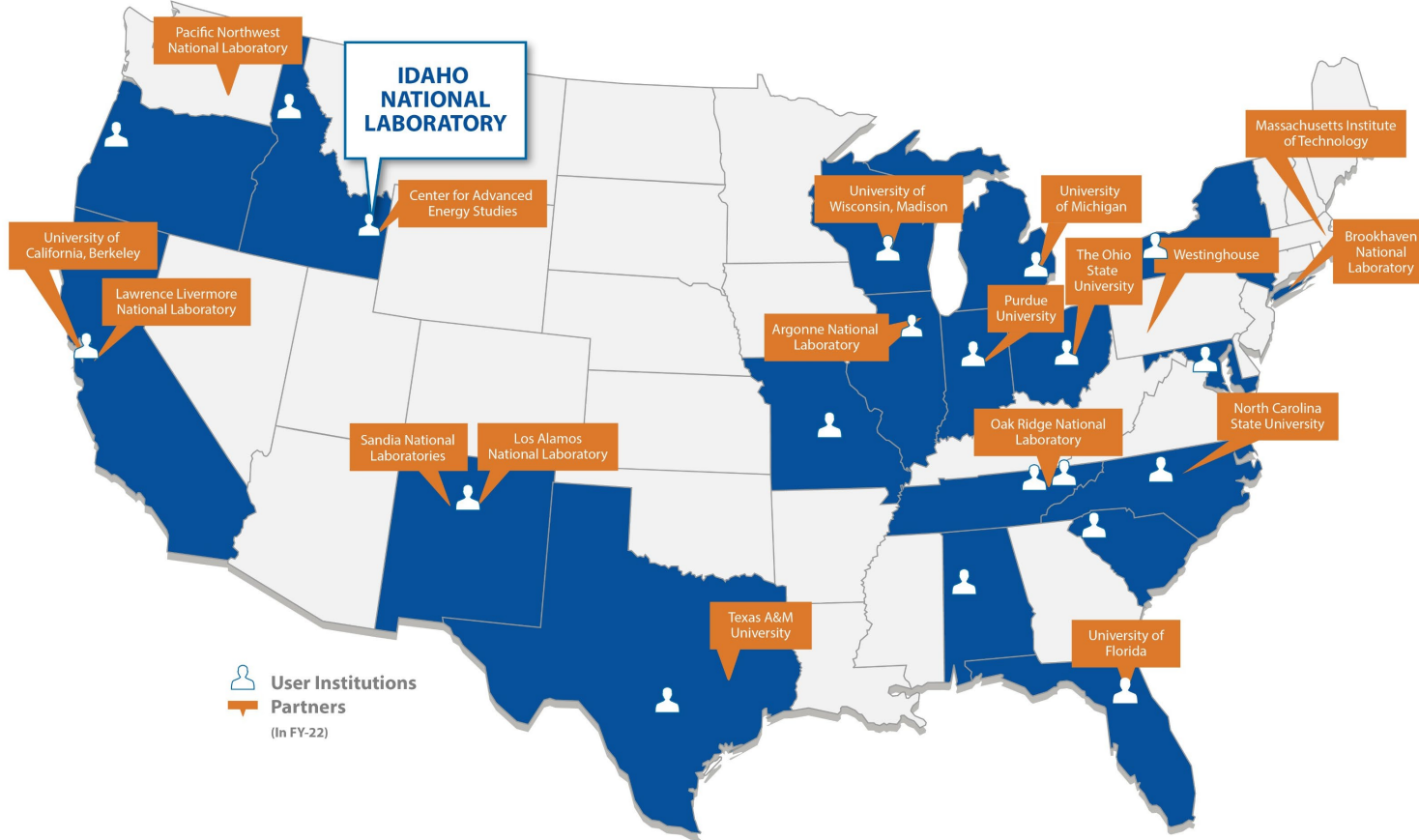
- Established 2007 as DOE Office of Nuclear Energy first & only user facility
- Founded at **Idaho National Laboratory (INL)** where it **remains lead and primary institution**
- NSUF operates as typical US user facility (**non-proprietary research, no cost to user, competitive proposal processes, no funding to users**) but also some unique aspects
- Unique aspects of NSUF:
  - Consortium model instead of single institution
  - Longer programs to accommodate timeframe of neutron irradiations and post-irradiation examination (PIE)



2014



# Partner Facilities Overview: Consortium of Partner Facilities



Reflects a subset of existing NSUF partners with active projects

Partner sites enable unparalleled facility access and technical expertise to enable innovation and emergent nuclear materials R&D

# Competitive and Open User Access



## Consolidated Innovative Nuclear Research (CINR)

- Neutron (ATR, TREAT, HFIR, university reactors), ion, and gamma Irradiations
- Irradiations and/or PIE
- Large and complex irradiation campaigns, up to 7 years
- Access to large nuclear fuel and materials library (NFML)

## Rapid Turnaround Experiments (RTE)

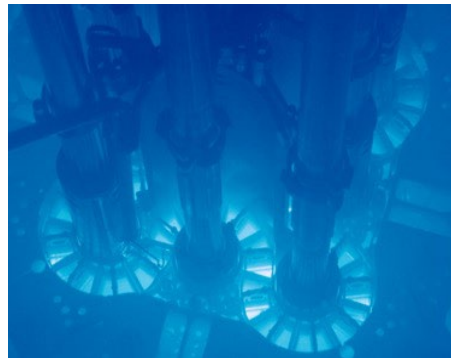
- Rapid user access - executed in 9 months
- NSUF will have 4 RTE calls in FY 24
- Small efforts, mostly PIE aimed at specific technical objectives to advance fundamental understanding and NE relevant efforts
- Access to large nuclear fuel and materials library (NFML)

# User Access Project – CINR Case Study

“Irradiation Studies on Electron Beam Welded PM-HIP Pressure Vessel Steel”

Objective: Assess the structural and mechanical integrity of electron beam welded powder metallurgy-hot isostatic pressed pressure vessel steel under service relevant irradiation conditions

**Multi-facility execution pathway with project organization and management at INL:**



**ATR Neutron Irradiation**



**Westinghouse**



**Hot Cell Facility  
Mechanical Testing**

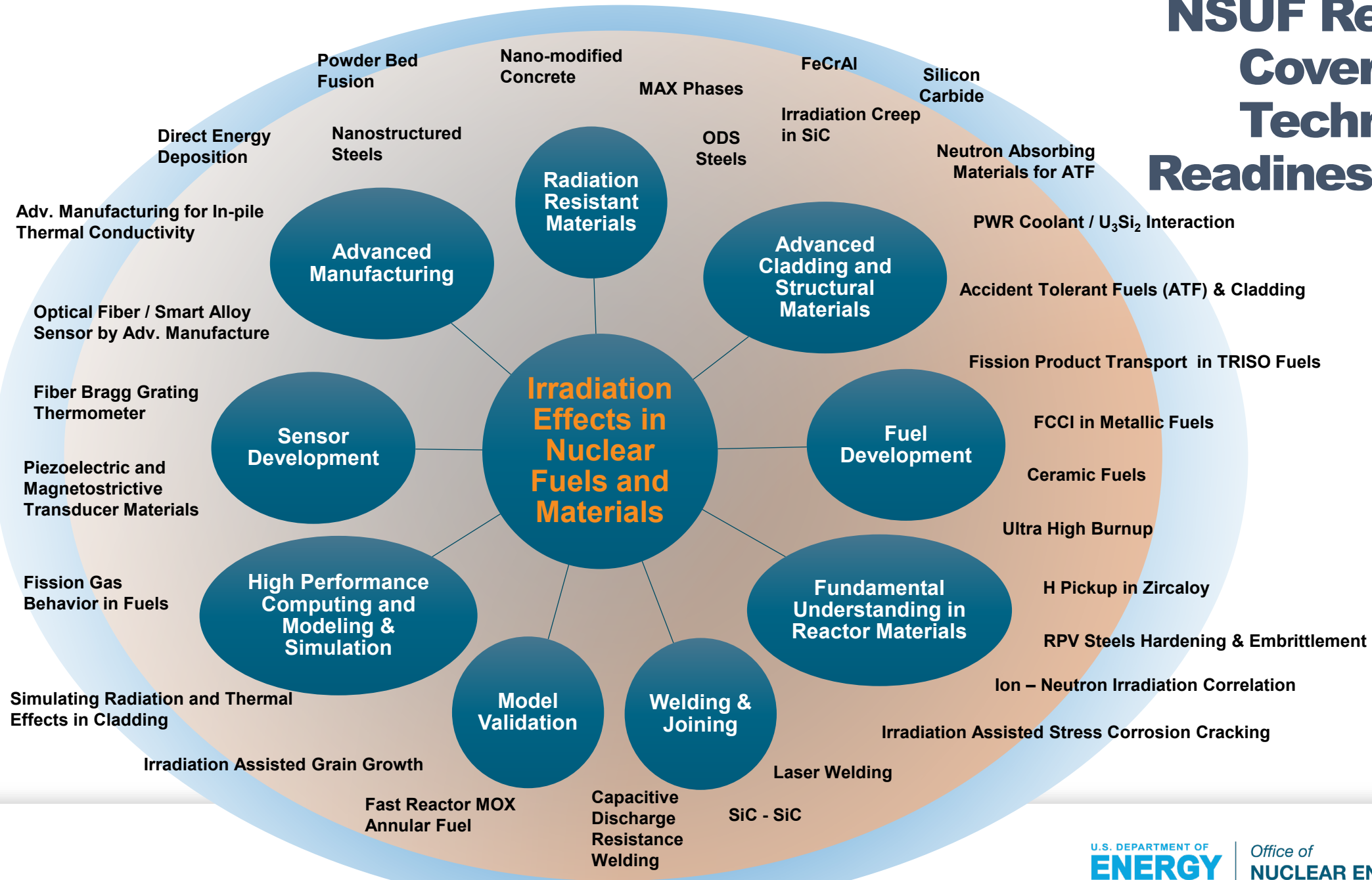


**Low-length scale  
characterization**



PI, co-PIs, and students engaged across the technical execution with prototypical user facility hands-on work at CAES Microscopy Lab (Idaho Falls, ID)

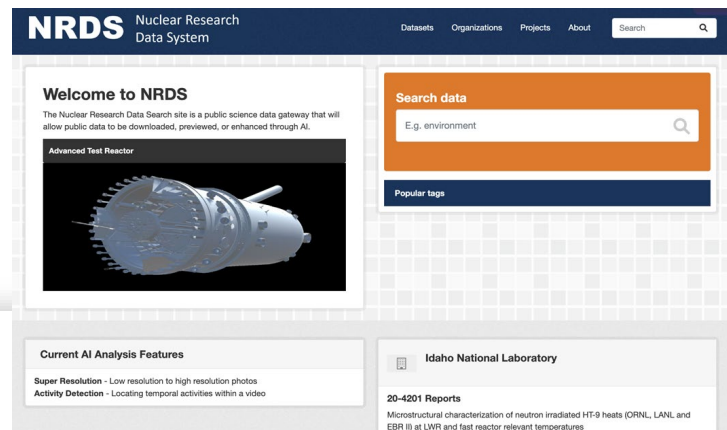
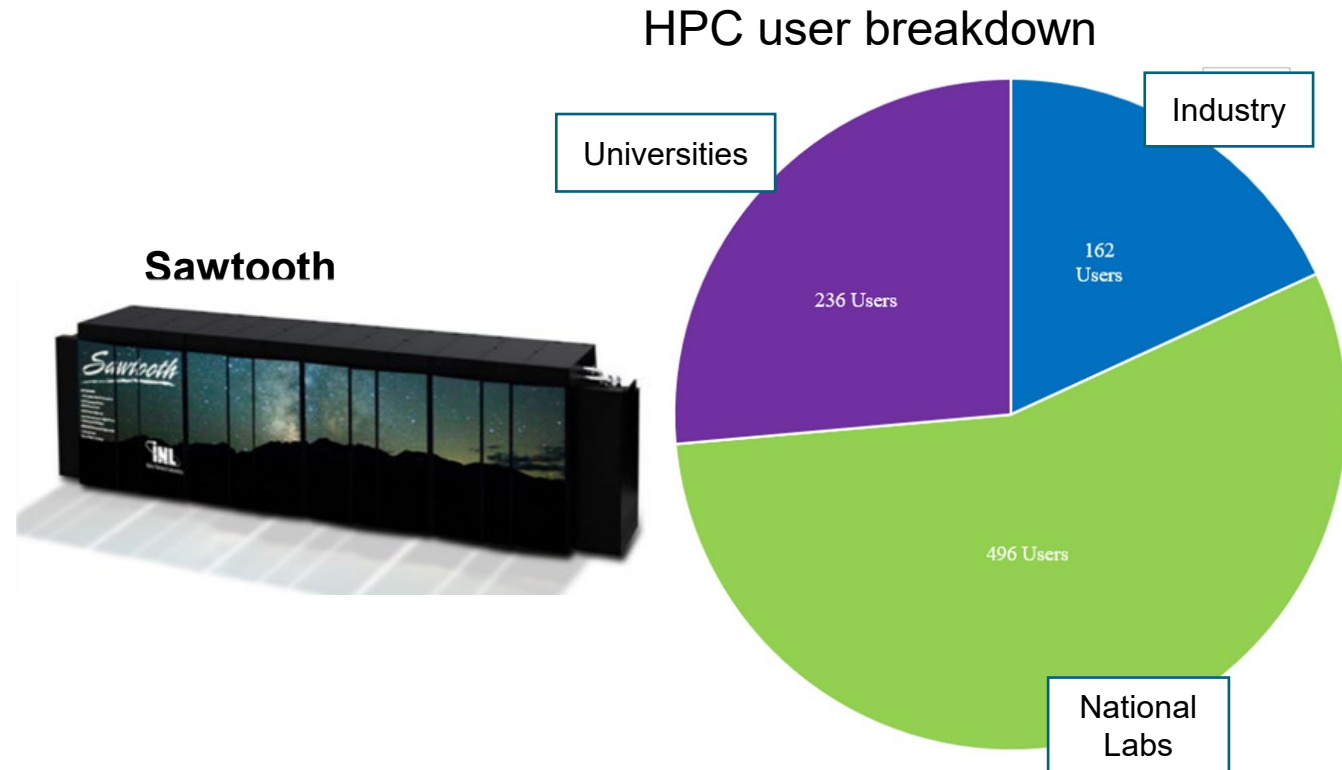
# NSUF Research Covers all Technical Readiness Levels





# NSUF – High Performance Computing (HPC)

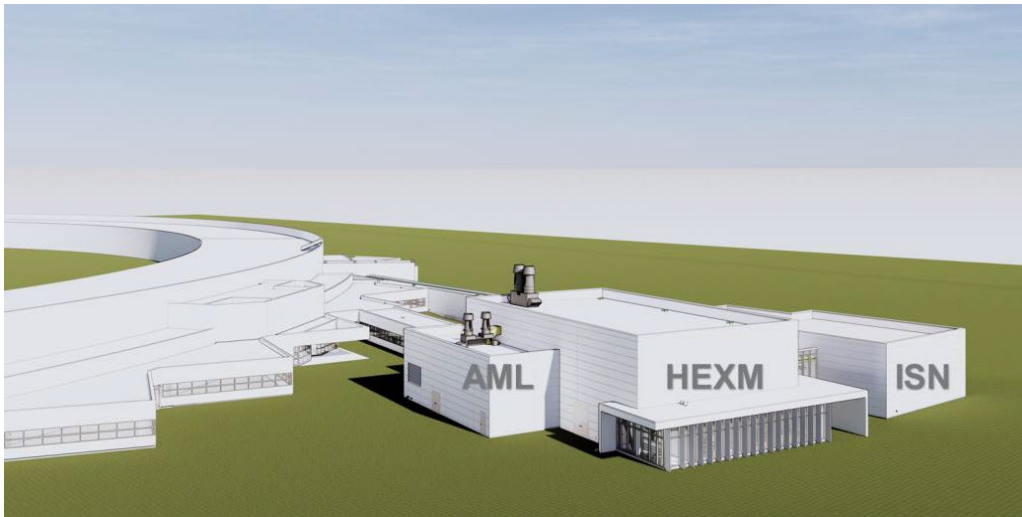
- NSUF-High Performance Computing resources at INL support a wide range of users and programs as a shared-use resource for national laboratories, universities, and industry
- **Supercomputers include Sawtooth (2020)**
- Nuclear Research Data System (NRDS) *under development*: tiered workspace for user access and ultimately public access of NSUF data (with FAIR principles)



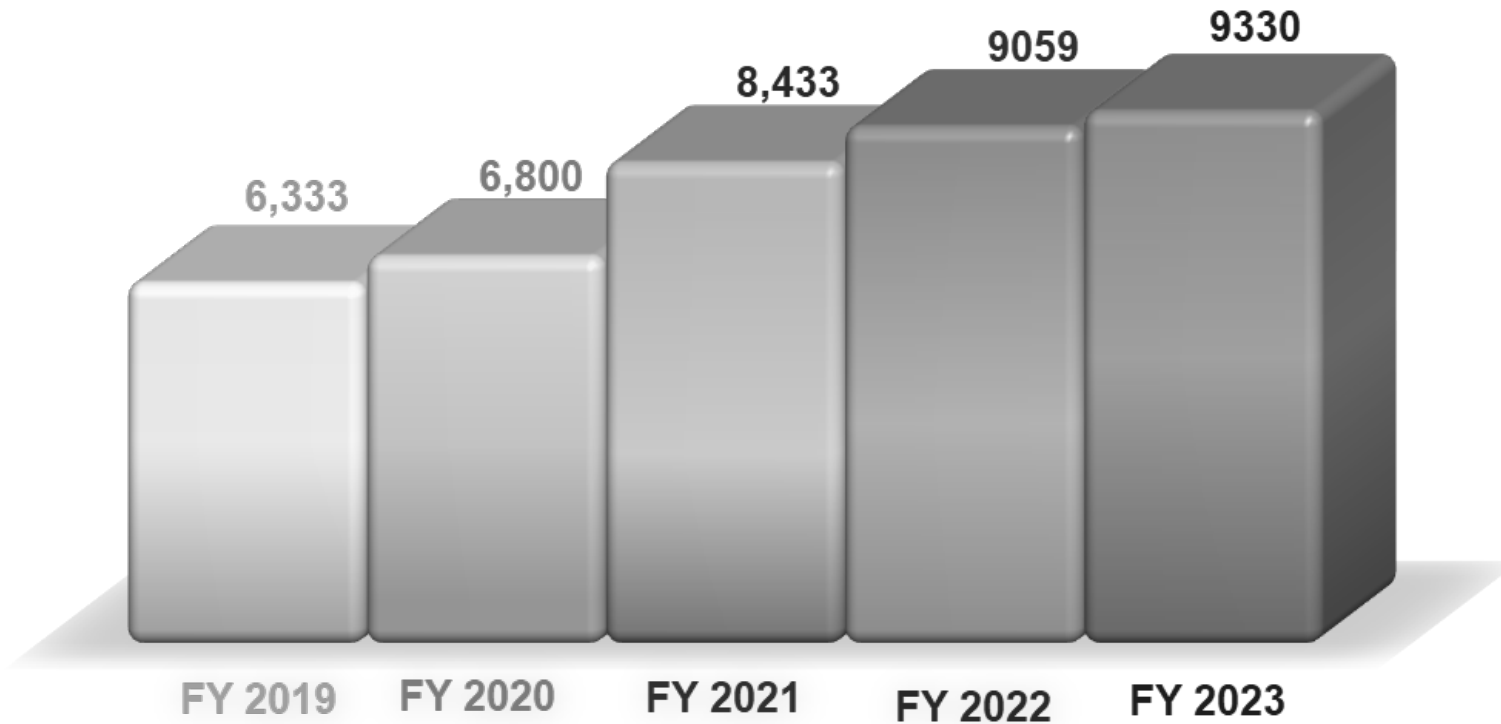
- HPC resources support industry by providing no-cost to user access to supercomputing resources
- 162 unique **industry** users used ~114 million core-hours in FY2022

# NSUF – Infrastructure Support

- NSUF has previously supported infrastructure development aimed at existing capabilities gaps
- Activated Materials Laboratory (AML) built during the Advanced Photon Source-Upgrade Project at Argonne National Lab where NSUF provided funding
- AML (preparation lab - not a beamline) facility is adjacent to a multi-purpose beamline called HEXM at APS – enabling key R&D of radiological materials



# NSUF – Nuclear Fuel and Materials Library



Library materials (example above) include reactor position, sample ID, material description, specimen type, dimensions, availability, and other useful information

The NFML is the largest open archive of high-value irradiated fuels and material from test, commercial, and decommissioned power reactors, and valuable donations from other sources. The library includes associated information such as compositions, irradiation conditions and publications.



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