Nuclear Science User Facilities

Nuclear energy is a clean and affordable energy source that contributes to greenhouse gas reduction goals as a key component of the nation's energy portfolio. Nonetheless, continued research is needed to consistently progress. Specifically, it is important to understand how radiation affects existing and proposed reactor materials over time.

The Nuclear Science User Facilities (NSUF) offers unparalleled research opportunities for nuclear energy researchers. Users are provided no cost access to world-class nuclear research facilities, technical expertise from experienced scientists and engineers, and assistance with experiment design, assembly, safety analysis and examination.

The Value of NSUF

- The Department of Energy Office of Nuclear Energy's first and only user facility.
- Merges the national nuclear research infrastructure with intellectual capital to pair the best ideas with the needed capability.
- Integrates national laboratory, university and industry research to achieve goals that benefit the nation.
- The extensive state-of-the-art nuclear research capabilities provided by the NSUF are typically beyond the reach of any individual laboratory.
- Access to the NSUF capabilities is through an open competitive review process.

Idaho National Laboratory NSUF Capabilities

Advanced Test Reactor Complex ●

Advanced Test Reactor (ATR)

Water-cooled, high-flux test reactor, with a unique serpentine design that allows large power variations among its four separate core sections.

Capabilities:

- Peak thermal flux is $1x10^{15}$ n/cm^2-sec and fast flux is $5x10^{14}$ n/cm^2-sec when operating at full power of 250 MW. (ATR typically operates at about 110 MW.)
- 77 irradiation test positions, hydraulic shuttle irradiation system, pressurized water reactor (PWR) loops.

Center for Advanced Energy Studies ●

Microscopy and Characterization Suite (MaCS)

- Equipped to handle low-level radiological samples and nonradiological samples.
- Focused Ion Beam (FIB), Local Electrode Atom Probe (LEAP) Tomography, Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM) Electron Backscattered Diffraction (EBSD).

Materials & Fuels Complex ●

Hot Fuel Examination Facility (HFEF)

Heavily shielded, alpha-gamma inert atmosphere hot cell facility designed for remote examination of highly irradiated fuels and materials.

Analytical Laboratory (AL)

Analysis of irradiated and radioactive materials via inductively coupled plasma mass spectrometry (ICP-MS), optical emission spectrometry (ICP-OES), ICP-MS dynamic reaction cell (DRC), X-ray diffraction (XRD), thermal ionization mass spectrometry (TIMS) and thermal analysis including: Thermogravimetric Analysis, Differential Thermal Analysis, Differential Scanning Calorimetry and Laser Flash Analysis.

Electron Microscopy Laboratory (EML)

Radiological facility containing optical, scanning and analytical electron microscopes. It also has a focused ion beam capable of preparing and analyzing fresh and irradiated nuclear materials and fuels samples.

Fuels and Applied Sciences Building (FASB)

Two heavily shielded irradiation-assisted stress corrosion cracking (IASCC) test rigs and instrumentation for lower level radiological thermophysical and thermomechanical property measurements.

Quick Reference

- ● Reactor
- ● Post-irradiation Examination (PIE)
- ● Beamline

Partner Facilities

Illinois Institute of Technology

The Materials Research Collaborative Access Team (MRCAT) at Argonne National Laboratory's Advanced Photon Source

X-ray diffraction, X-ray absorption, X-ray fluorescence and 5μm spot size fluorescence microscopy.

Massachusetts Institute of Technology

Massachusetts Institute of Technology Reactor (MITR)

- Six megawatt tank-type research reactor with in-core irradiation positions, pneumatic transfer system and graphite-reflector irradiation positions.

North Carolina State University

PULSTAR Reactor, Nuclear Services Laboratory, PULSTAR Reactor Facility

- One megawatt pool-type reactor with in-core irradiation facilities for neutron activation analysis, irradiation and instrumentation testing.
- Irradiation beam port facilities for neutron powder diffraction, neutron imaging, an intense positron source and an ultra-cold neutron source.

Oak Ridge National Laboratory

High Flux Isotope Reactor (HFIR), Hot Cells, Radiological Laboratories, Low Activation Materials Development and Analysis (LAMDA) Facility

- Materials irradiations, neutron activation analysis (NAA) and gamma irradiation.
- Materials analysis, chemical processing and fuels research.
- Refractory element test stands for tensile testing, optical and scanning electron microscopes, thermal diffusivity and density measurement equipment.

Pacific Northwest National Laboratory

Radiochemistry Processing Laboratory, Materials Science and Technology Laboratory, Hot Cells

- Experiment hardware design, fabrication and assembly, testing facilities for non-radioactive and radioactive structural materials, advanced characterization of unirradiated and irradiated fuels and materials.
- Capabilities include: TEM, SEM, and optical microscopy.

Purdue University

Interaction of Materials with Particles and Components Testing (IMPACT) Facility

Instruments include: low-energy scattering spectroscopy (LEISS), X-ray photoelectron spectroscopy (XPS), auger electron spectroscopy (AES), extreme ultraviolet reflectometry (EUVR), extreme ultraviolet (EUV) photoelectron spectroscopy and mass spectrometry.

University of California, Berkeley

Nuclear Materials Laboratory

Sample preparation, micro- and nano-indentation over a wide temperature range, and focused ion beam sample preparation for low- to medium-level radioactive samples.

University of Michigan

Irradiated Materials Complex, Michigan Ion Beam Laboratory

- Laboratories and hot cells for high-temperature mechanical properties and corrosion and stress corrosion cracking experiments on neutron irradiated materials in an aqueous environment and scanning electron microscopy for characterizing fracture surfaces after failure.
- 1.7 MV Tandetron accelerator with controlled temperature proton irradiation capabilities at energies up to 3.4 MeV as well as heavy ion irradiation.

University of Nevada, Las Vegas

Radiochemistry Laboratories

Optical microscopy, X-ray powder diffraction, Rietveld analysis, scanning electron microscopy, electron probe microanalysis, analytical transmission electron microscopy, X-ray fluorescence spectrometry.

University of Wisconsin, Madison

Characterization Laboratory for Irradiated Materials, Tandem Accelerator Ion Beam

- Scanning electron microscopy and transmission electron microscopy for post-irradiation examination for low- to medium-level radioactive samples.
- 1.7 MV terminal voltage tandem accelerator produces high-energy ions and features dual ion sources for producing negative ions with a sputtering source or with a radio frequency plasma source.
- Elastic recoil detection and nuclear reaction analysis.

Westinghouse

Materials Center of Excellence Laboratories (MCOE) Hot Cell Facility

- Testing environments for unirradiated and irradiated materials, extensive mechanical testing laboratory, corrosion and stress corrosion cracking lab, materials microstructure and chemical characterization instruments.

Distributed Partnership at a Glance

How to Gain Access to NSUF Facilities:

Access is awarded through a competitive peer-reviewed process.

Types of Projects

Major irradiation (neutron and ion), post-irradiation examination (PIE), and beamline experiments

- For large experiments that can be complex in nature and require neutron or ion irradiation and/or PIE or for research that is performed using the MRCAT at the Advanced Photon Source.
- Applications are submitted annually through the Department of Energy Office of Nuclear Energy Consolidated Innovative Nuclear Research (CINR) Funding Opportunity Announcement (FOA). (See NEUP.gov)

Rapid Turnaround Experiments (RTE)

- Rolling call that closes three times per year for reviews.
- RTEs offer researchers the opportunity to perform short-term analyses of a limited scope of work, use of an ion beam, or use of the PULSTAR reactor.
- Irradiation experiments that require the ATR, MITR, or HFIR reactors do not qualify as RTEs.

Find out more about the call schedules, guidelines, and additional information for each type of proposal on the NSUF website, nsuf.inl.gov.

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