Pacific Northwest
NATIONAL LABORATORY

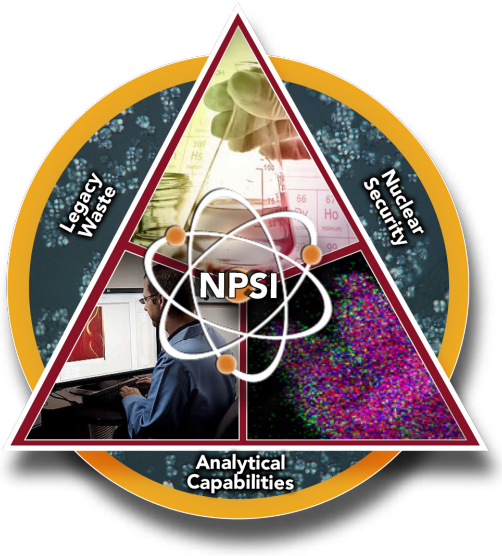
Nuclear Process Science Initiative (NPSI)

NPSI seeks to understand, harness, and exploit interfacial phenomena controlling the behavior of materials in nuclear processing

The Nuclear Process Science Initiative (NPSI) is a five-year, multi-million-dollar Pacific Northwest National Laboratory (PNNL) investment focused on building capabilities to:

- Enable resolution of the nation's legacy wastes from decades of weapons production.
- Develop new signature discovery approaches for nuclear forensics and nonproliferation.

Since it began in 2015, NPSI has been investing in people, programs and capabilities to advance the initiative's research aims and to help establish PNNL's Radiochemical Processing Laboratory (RPL) as a premier national resource for research and development test beds.



NPSI's three research thrusts are focused in legacy waste, nuclear security and analytical capabilities.

NPSI PROJECTS

To achieve intended outcomes, initiative activities are focused in three research thrust areas containing multiple projects, described below.

Science Thrust 1: Legacy Waste

PROJECTS
An In-situ Investigation of Gamma-AlOOH Dissolution under High pH Conditions (project completed in FY17)
Correlation of Colloidal Interactions and Macroscopic Rheology in Concentrated Electrolyte Solutions (project completed in FY18)
Particle-Filter Surface Interactions and Dynamics in the Presence of Cross-Flow (project completed in FY18)
Fundamental Insights into γ-Radiation Effects at Complex Oxide-Water Interfaces from First Principles Simulations (project completed in FY19)
Controlled Mineral Growth for Improving Tc-99 and I-129 Retention in Cementitious Waste Forms
Particle Size and Density Measurement

Science Thrust 2: Nuclear Security

PROJECTS
Modeling the Interfacial Effects, Partitioning, and Production Routes of Epsilon Particles in Uranium Oxide (project completed in FY18)
Ion Implantation and Characterization of Epsilon Metal Phase Formation in Ceria (project completed in FY19)

Interfacial Diffusion and CRUD Formation at the Liquid:Liquid Interface of Solvent Extraction Processes (project concluded in FY18)
Development of Phase Field Modeling to Predict Morphologies of Plutonium Oxalate (transitioned to another research effort in FY18)
Fundamental Understanding of Nucleation Processes to Assess Solution Stability and Phase Growth and Genesis (project completed in FY18)
Monitoring Diffusion of Actinide Daughters and Granddaughters in Metals for Chronometer Applications (project completed in FY18)
Characterization of Carbonaceous Surface Deposits on Irradiated Iron Aluminide (FeAl3) Coatings

Science Thrust 3: Analytical Capabilities

PROJECTS
A Coupled Radiation Source/Liquid Cell AFM to Study Radiation-Induced Interfacial Processes
Determining Radiolytic Transient Intermediates and Interfacial Species and Their Roles in Aluminum Oxyhydroxide Reactivity
Characterization of Radiation Induced Materials Defects Across Scales
Damage Mechanisms and Defect Formation in Irradiated Model Systems
Dissolution of Spent Nuclear Fuel: An In-situ and Atomic Resolution TEM Study

KEY NPSI RESOURCE: PNNL'S RADIOCHEMICAL PROCESSING LABORATORY (RPL)

The RPL is a multi-user, multi-program Hazard Category II Non-Reactor Nuclear Facility located at PNNL and stewarded by the U.S. Department of Energy. RPL is one of the nation's premier—and enduring—resources for applied nuclear science and technology. It offers one-of-a-kind capabilities for developing and deploying innovative radiological material processes and solutions. RPL's unique laboratories and instrumentation are underpinned by a team of distinguished researchers who are in the vanguard of nuclear science and technology and are credited with novel, groundbreaking discoveries and applied solutions.

ABOUT PNNL

At PNNL, interdisciplinary teams address many of America's most pressing issues in energy, the environment and national security through advances in basic and applied science. PNNL is managed by Battelle for the U.S. Department of Energy's Office of Science.

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U.S. DEPARTMENT OF ENERGY