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Program

Enabling Future Research at INL

Leadership in Nuclear Energy (LINE) Commission

Twin Falls, ID

INL/MIS-23-74585

Battelle Energy Alliance manages INL for the
U.S. Department of Energy's Office of Nuclear Energy



Idaho National Laboratory

Several Potential Research and Development (R&D) Opportunities for INL

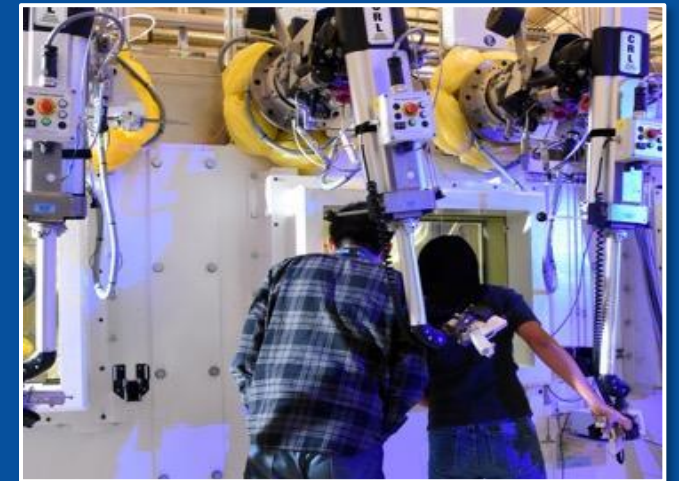
- IWTU has started up and successfully processed over 100 canisters
- **Commercial spent nuclear fuel (SNF)** receipt at INL is possible when the 2019 Supplemental Agreement is met
- Under the 2011 Memorandum of Agreement for commercial SNF
 - Up to 400 kgU/yr of commercial SNF for R&D purposes
 - Allows for a SNF library at INL
- **Non-commercial SNF** receipt at INL is still covered by original Idaho Settlement Agreement
 - Waivers would still be required for non-commercial SNF receipt



Byron Shipment – Spring 2025

- Next shipment from Byron expected in spring 2025
 - 4 – 16 fuel pins (<40 kgU)
 - Westinghouse’s coated cladding with doped fuel, irradiated for 3 full cycles in Byron
- INL will conduct R&D
 - Post-irradiation examination (PIE)
 - Fuel safety testing in Transient Reactor Test (TREAT) facility
 - Ramp testing in I-loops at the Advanced Test Reactor (ATR)
 - Samples preparation for furnace testing both at INL and Oak Ridge National Laboratory (ORNL)

Data is critical to Westinghouse for licensing of this accident tolerant fuel with the Nuclear Regulatory Commission (NRC)

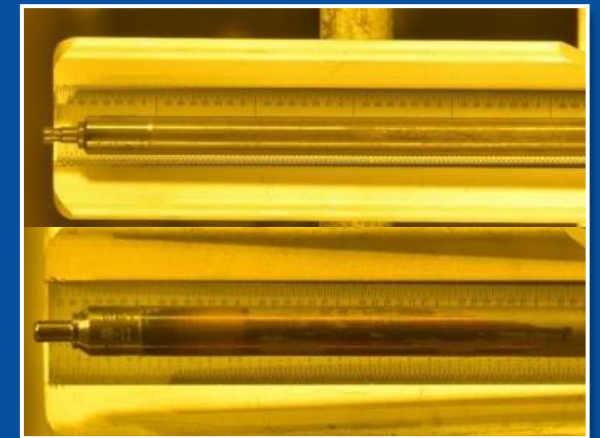


Advanced PIE capabilities

Vogtle Shipment – Fall 2025

- First shipment from Vogtle expected in fall 2025
 - 4 –16 fuel pins (<40 kgU)
 - Framatome's coated cladding with doped fuel, irradiated for three full cycles in Vogtle
- INL will conduct R&D
 - Post-irradiation examination
 - Fuel safety testing in TREAT
 - Ramp testing in I-loops at ATR
 - Samples preparation for furnace testing both at INL and ORNL

Data is critical to Framatome for licensing of this accident tolerant fuel with the NRC



Developing and testing accident tolerant fuel concepts.

Vogtle Shipment – 2028

- Second shipment from Vogtle expected in 2028
 - 4 –16 fuel pins (<40 kgU)
 - Westinghouse’s coated cladding with doped fuel, irradiated to extended burnup (>current regulatory limit of 62 GWD/MTU)
 - First use of LEU+, i.e., low enriched fuel over 5%
- INL will conduct R&D
 - Post irradiation examination
 - Fuel safety testing in TREAT
 - Ramp testing in I-loops at ATR
 - Samples preparation for furnace testing both at INL and ORNL

Data will be used for Westinghouse to license extended burnup of their accident tolerant fuel technology

INL's Spent Fuel Challenges

Competing national labs, mainly ORNL and Pacific Northwest National Laboratory (PNNL), have received over \$80M from DOE to develop their hot cell and PIE capabilities

- **Newer examination capabilities** at other laboratories
- Created years of **relationships with leading technical staff** at other laboratories
- Allowed **development of competing workforces**

Fortunately, INL continues to have broad state and DOE support for these activities

- Utilities and private companies **want to work at INL**
- Due to continued DOE-NE and Congressional support, **INL still has unique facilities available nowhere else in the U.S.**
- **Need certainty on shipments for INL to be successful**

New Spent Nuclear Fuel R&D Opportunities

- Current light water reactor (LWR) fleet
 - Accident Tolerant Fuels
 - High Burnup Fuels
- Future advanced reactor fleet
- Research reactor and other DOE complex-wide SNF
 - Includes national management of fuel to allow research reactors to continue to operate
- Future fuel cycle opportunities (e.g., high assay low-enriched uranium (HALEU) production, SNF recycling)



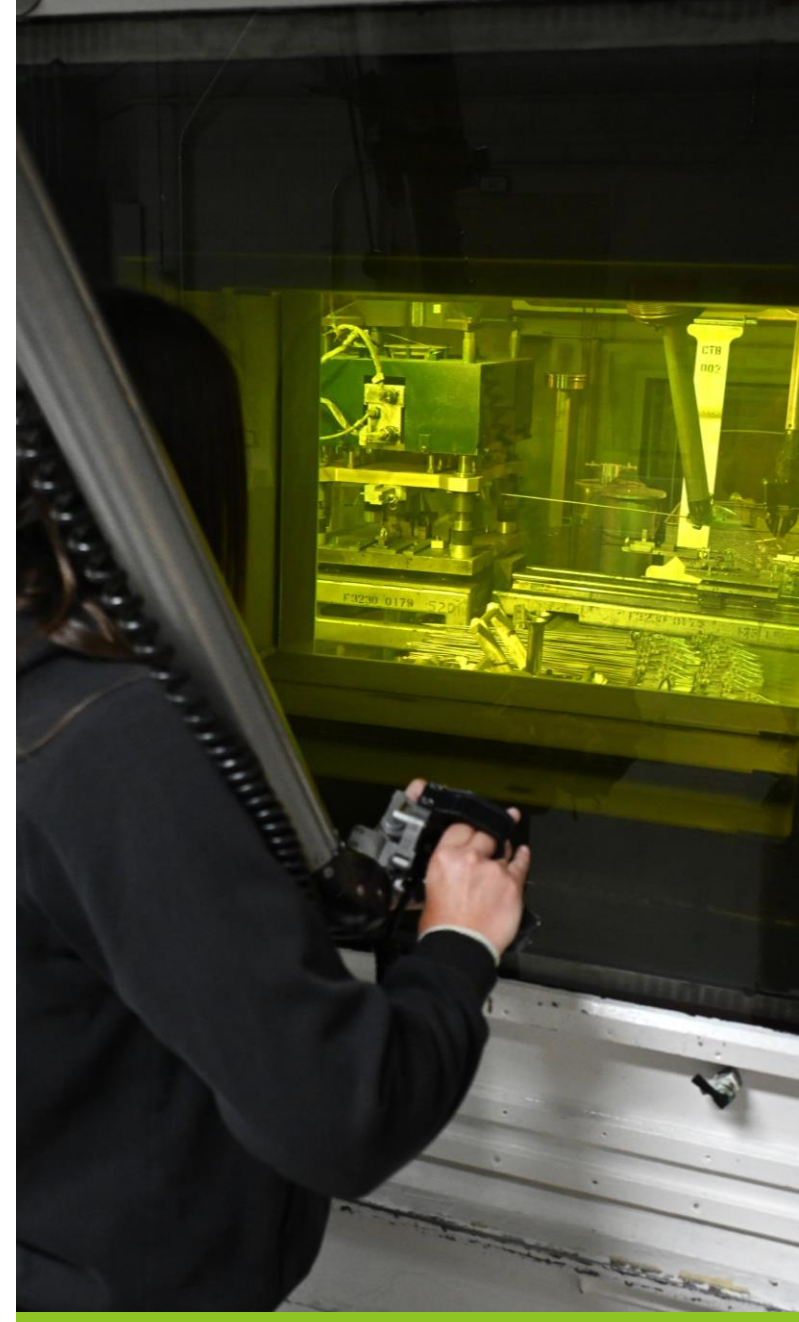
21 Operating Nuclear Plants Need High-Burnup Demonstration Cask Data

- Cask is loaded with spent fuel at North Anna in Virginia
- Data (and thus shipment) is needed by 2027
- INL has only properly-sized facilities in the U.S. to do the work
 - Large hot cell (CPP-603) for fuel transfer
 - PIE facilities at Hot Fuel Examination Facility
- Two plants (Prairie Island, MN & Calvert Cliffs, MD) will be in default of their NRC spent fuel storage license in 2028 unless data is collected.
 - 19 more plants could be in non-compliance starting in 2029
- Several additional R&D projects are of interest to DOE and the industry if cask is received at INL
 - Aging management, instrumentation, safeguards and security applications



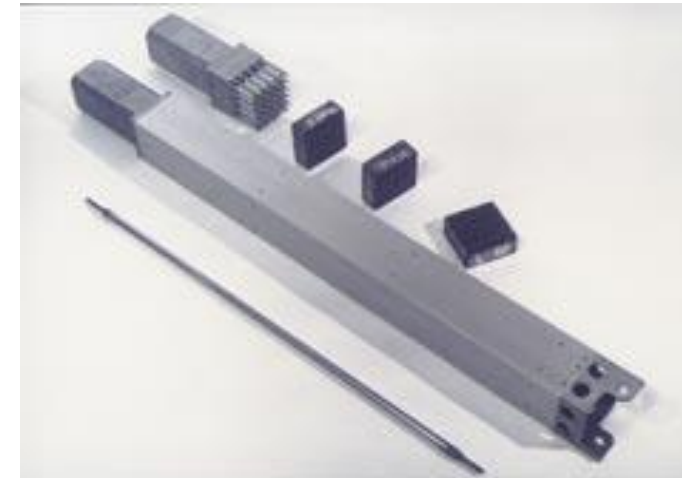
Mixed Oxide and UO₂ Fuel Pins at Sandia National Laboratories

- 27 pins are currently stored at Sandia National Laboratories (<7 kgHM)
 - 16 PNL mixed oxide (MOX), stainless steel clad pins (originally irradiated in EBR-II)
 - 11 Belgium Reactor-3 UO₂ zirconium-clad pins
- Loaded in a transportation basket in 2013/2014
 - Ready for shipment ASAP
- Current storage facility at SNL cannot deactivate and decommission until this last shipment occurs
- Potential future R&D mission could include MOX material in our SNF library for future fuel cycle activities



University Research Reactors Needs in the Next ~3 Years

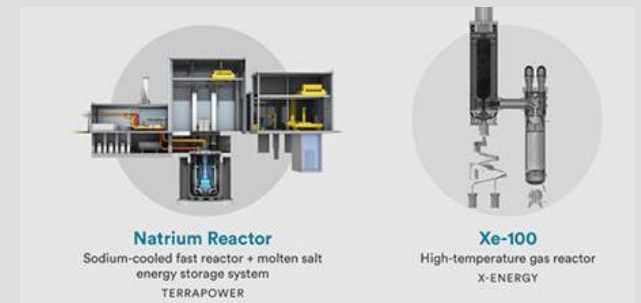
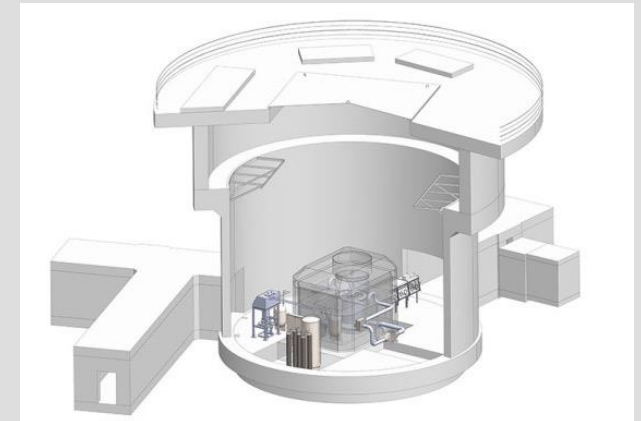
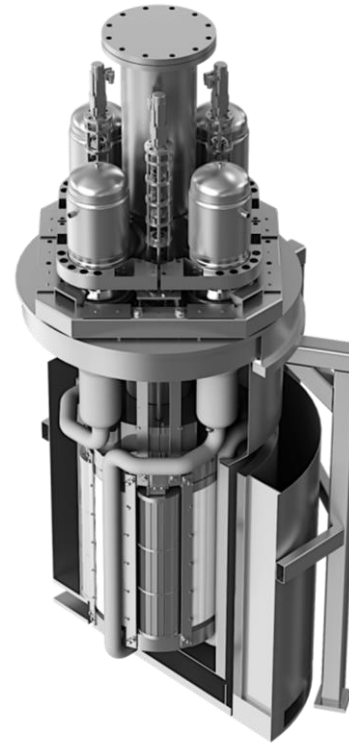
- **Penn State University**
 - **Shipment Date:** ASAP
 - **Shipment Amounts:** 64 TRIGA SNF elements in 1 shipment (~12 kgU)
 - Penn State needs alternative storage options
- **Texas A&M University**
 - **Shipment Date:** Before 2025
 - **Shipment Amounts:** TBD
 - Texas A&M needs alternative storage options
- **North Carolina State University**
 - **Shipment Date:** 2026 as part of refueling activity
 - **Shipment Amounts:** 30 PULSTAR fuel assemblies (~380 kgU)
- **~One shipment per year is needed going forward**
 - University of California at Davis, University of Texas, University of Utah



TRIGA fuel

Available Advanced Reactor Opportunities

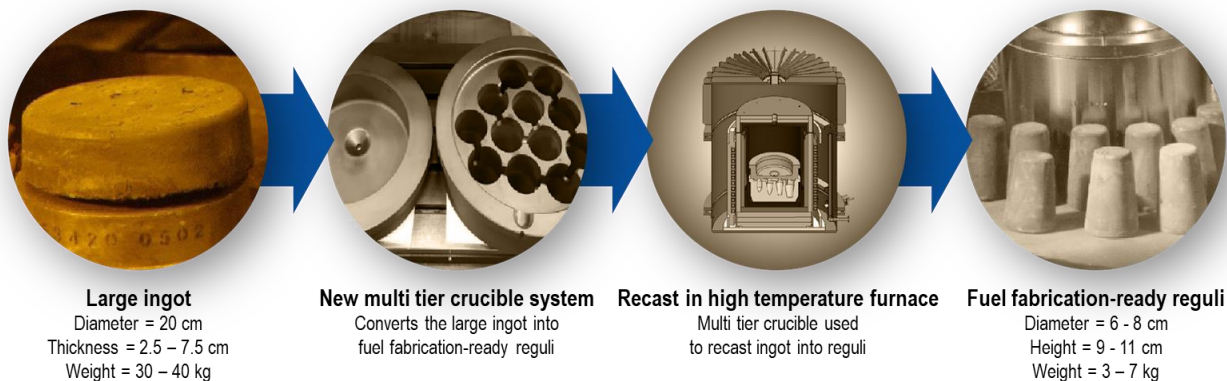
- PIE of microreactors at INL site will occur
 - Demonstration of Microreactor Experiments (DOME) test bed
 - Laboratory for Operations and Testing in the U.S. (LOTUS) test bed
 - Microreactor Applications Research Validation and Evaluation Project (MARVEL)
- PIE of non-Idaho DOE's Advanced Reactor Demonstration Program projects is a future opportunity
 - Sodium
 - TRISO-X



Opportunities to Recycle SNF and Make High Assay Low Enriched Uranium (HALEU)

Additional spent fuel could be recycled once EBR-II is finished

- Produce valuable HALEU for advanced reactors
- Demonstrate instrumentation and monitoring techniques
- Deploy additional safeguard approaches on actual processes to strengthen international leadership
- Develop new and advanced recycling technologies



Up-blended UO₂ powder.



Idaho National Laboratory

Battelle Energy Alliance manages INL for the U.S. Department of Energy's Office of Nuclear Energy. INL is the nation's center for nuclear energy research and development, and also performs research in each of DOE's strategic goal areas: energy, national security, science and the environment.