INL/MIS-23-72015-Revision-0



# February 2023 NS&T Highlights

April 2023

Addison Marie Arave

Changing the World's Energy Future


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INL/MIS-23-72015-Revision-0

# February 2023 NS&T Highlights

**Addison Marie Arave**

**April 2023**

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**http://www.inl.gov**

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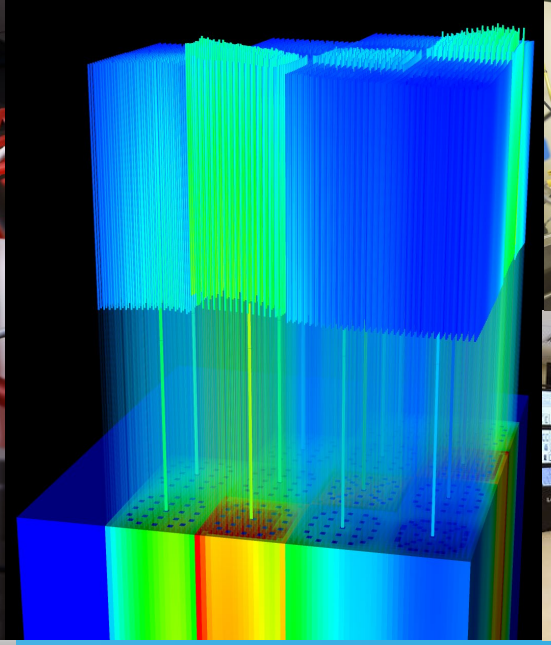
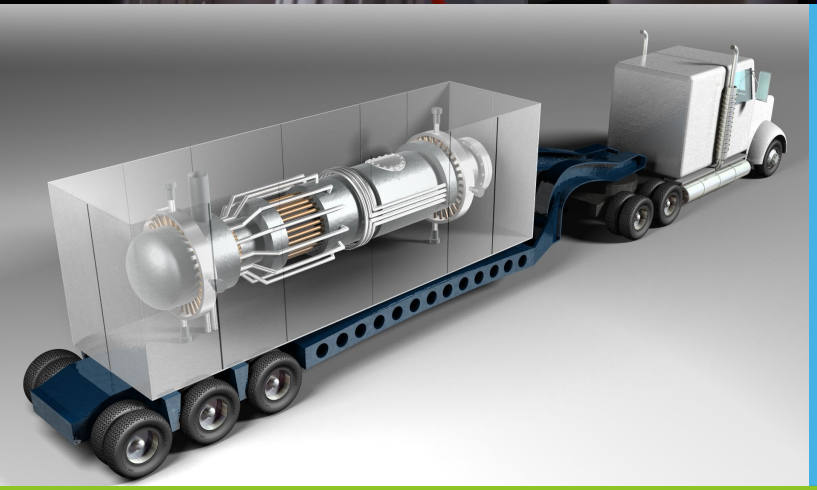


# Nuclear Science & Technology

## February 2023 Highlights

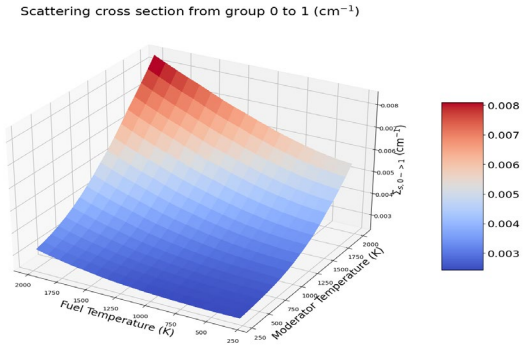
Idaho National Laboratory

Research Highlight

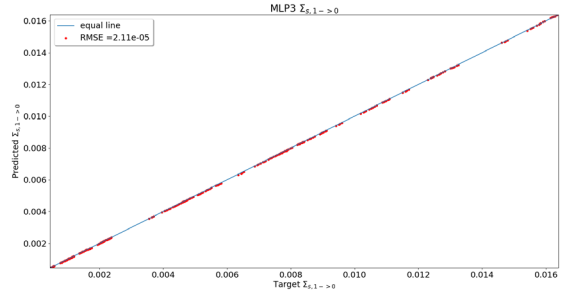
*DOE-NE Nuclear Energy Advanced Modeling and Simulation Program*

# Machine Learning Shows Potential for Improving Accuracy and Speed of Multi-physics Core Analyses

- Multi-physics core simulations in the Griffin reactor physics code traditionally rely on pre-generated parametrized multigroup cross-sections, which are interpolated during simulation using local conditions.
  - Generating these cross-sections is computationally costly since the current interpolation model is linear, and the number of calculations exponentially increase as a function of the number of feedback parameters (curse of dimensionality).
- Multigroup cross-sections were represented using fully-connected artificial neural networks (ANN) in the MOOSE (Multiphysics Object-Oriented Simulation Environment)-based Griffin reactor physics code.
- Applicability of this method was demonstrated on both a high-temperature gas reactor as well as a sodium-cooled fast reactor fuel assembly case.
- This new capability provides shorter simulation time with a lower cross-section reconstruction error, which is crucial when scoping time-dependent, multi-physics simulations of advanced reactors.




*Scattering cross-section vs. fuel and moderator temperature.*




*Artificial neural network-based cross-section model error.*

**Title:** Deep Learning for Multigroup Cross-Section Representation in Two-Step Core Calculations
**Authors:** Nicolas Martin, Zachary Prince, Vincent Labouré, Mauricio Tano-Retamales
**Journal:** Nuclear Science and Engineering
**Link:** https://doi.org/10.1080/00295639.2022.2159220

REACTOR SYSTEMS DESIGN & ANALYSIS | REACTOR PHYSICS METHODS & ANALYSIS
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*Space Nuclear Thermal Propulsion Project*

# SIRIUS-4 Space Nuclear Reactor Fuel Transient Experiment Analyzed for Thermal Stress

- The recent National Aeronautics and Space Administration (NASA) sponsored SIRUS-4 Transient Reactor Test (TREAT) experiment efforts looked at stresses and deformations during consecutive thermal cycles on the fuel stack using the MOOSE mechanics module. Consistent heating and cooling of the fuel element will induce thermal stress and provide information about stress-strain behavior of the materials.
- Thermal mechanics analysis of the problem (Figure 1) shows Von mises stress on the fuel stack which is proportional to the temperature gradient. At full power, large Von mises stress around the periphery of the coolant channels (the bright red spots in Figure 1) were noted to be greater than the yield strength of the fuel matrix, suggesting onset of plastic deformation.

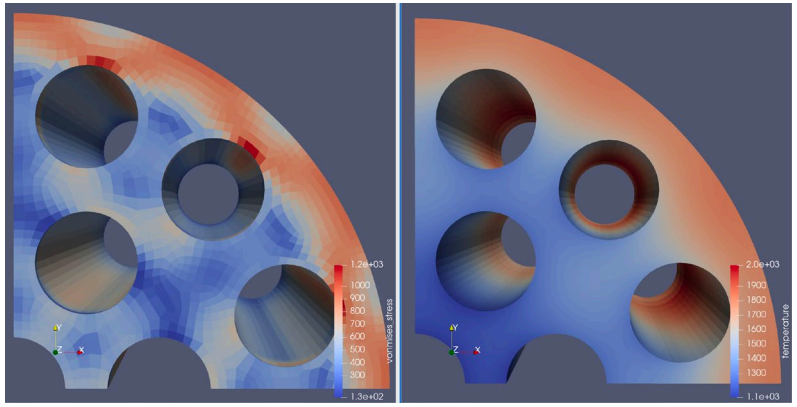
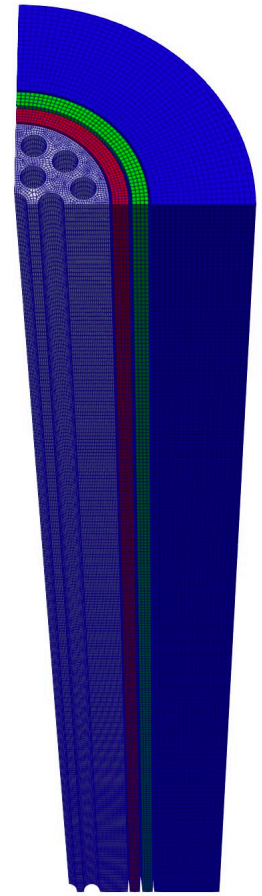



*Figure 1: SIRUIS-4 Von Mises (left) stress and temperature distribution (right) at full power in cycle 4.*

- This analysis provides important information about the plastic nature of the problem and its impact on the design. For example, large radial deformations could lead to gap closures during multiple operation cycles, resulting in contact stress, reduced heat transfer and fuel damage.
- Considering these observations, it is of interest to extend the analysis onto a nuclear thermal propulsion design for a more realistic problem.



*TREAT SIRIUS-4 Experiment.*

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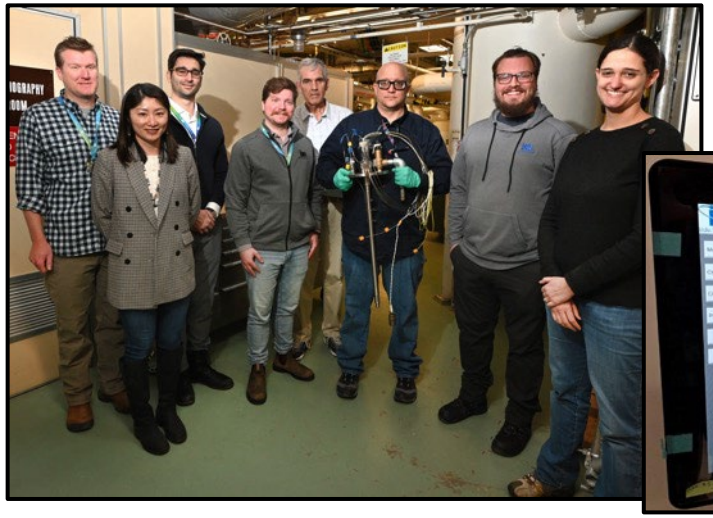
*Laboratory Directed Research and Development*

# Researchers Complete Fabrication and Testing of Prototype Salt Irradiation Vehicle

- INL is establishing an enriched-uranium salt irradiation capability to conduct fueled-chloride salt irradiation.
- The research team fabricated the prototype assembly loaded with unfueled salt and set up an “out-of-pile” (non-nuclear) commissioning test that mirrors prototypical conditions.
- The final experiment will be constructed in the coming months, with planned irradiation at the INL Neutron Radiography reactor this summer.

*Completed prototype assembly for salt irradiation experiment.*

*Installing the prototype irradiation vehicle in the out-of-pile test rig.*



*Project team with the prototype experiment.*


*Thermocouple readings during testing.*

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*Emerging Energy Market Analysis*

# INL Collaborates with Universities to Support Microreactor Program

- The Emerging Energy Markets Analysis (EMA) initiative met January 30-31, 2023 to review research supporting the microreactor program. Attendees developed regional-to-global strategies to help states like Alaska and Wyoming position themselves to attract and support the low-emissions industry.
- The EMA team, led by INL, is a collaboration with the University of Michigan (UM), University of Wyoming (UW), Massachusetts Institute of Technology (MIT), University of Alaska (UA), and Boise State University (BSU).
- The EMA initiative is dedicated to advancing the understanding of energy market options as the work transitions to new clean energy futures.
- For more information about EMA visit: https://ema.inl.gov/

*Left-to-right standing: David Shropshire (INL) ,Dr. Todd Allen (UM), Dr. John Parsons (MIT), Selena Gerace and Tara Righetti (UW), Alex Huning (Oak Ridge National Laboratory), Donna Kemp Spangler (INL).*

*Left-to-right seated: Richelle Johnson (UAA), Paul Kjellander (EMA), Dr. Steven Aumeier (INL), Marcio Paes Barreto (Wyoming Energy Authority), and Eugene Holubynak (UW).*

*Virtual attendance: Dr. Kathleen Araujo (BSU), Christi Bell (UAA), Cassie Koerner (BSU), and Jessica Lovering and Michael Craig (UM).*


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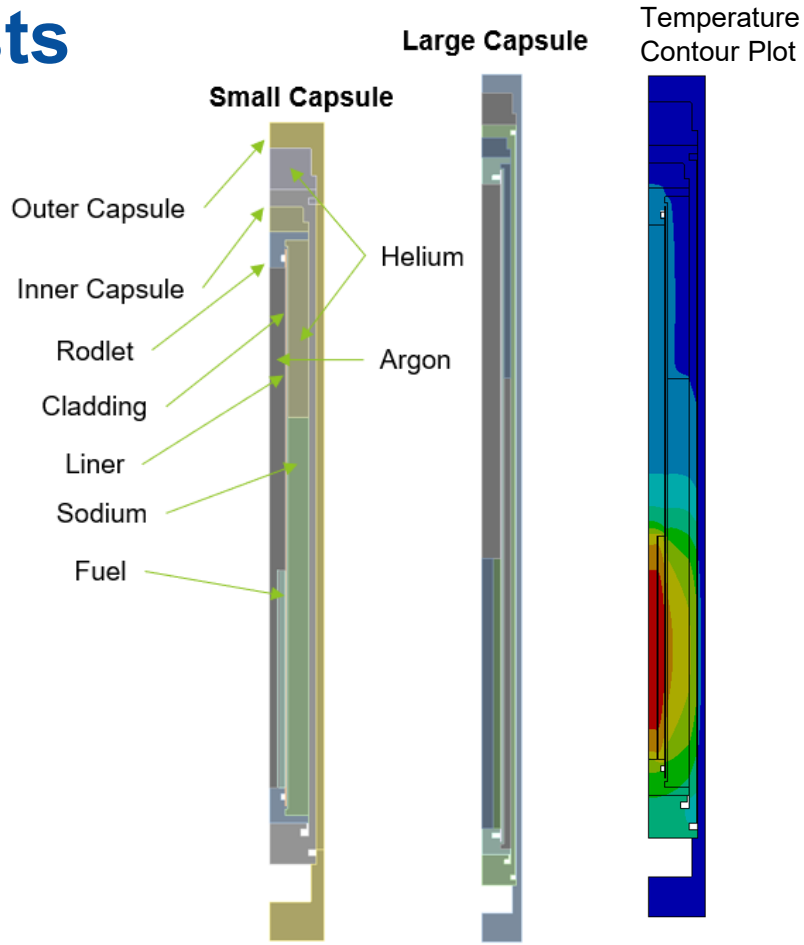
*Natrium Program*

# Fuel Experiments in the Advanced Test Reactor Inform Future Natrium Demonstration Reactor Tests

- The large diameter capsule (LDC)-1B experiment was designed to test the performance of TerraPower's Type-1B fuel. This will support future insertions of the lead test pins/lead test assemblies into the Natrium demonstration reactor.
- The LDC-1B fuel specimens will be irradiated in a static capsule in the Advanced Test Reactor "B" test locations.
- The LDC-1B fuel specimen liner temperature targets were achieved by performing parametric studies to optimize the design of the capsule gap dimensions and gas mixtures.
- The heat transfer models of the experiment capsule trains incorporated an extensive test matrix with variations in rodlet plenum volumes, fuel size, smear density, three gas gaps, and four gas mixtures.




**ANSYS Models**

TerraPower Capsules.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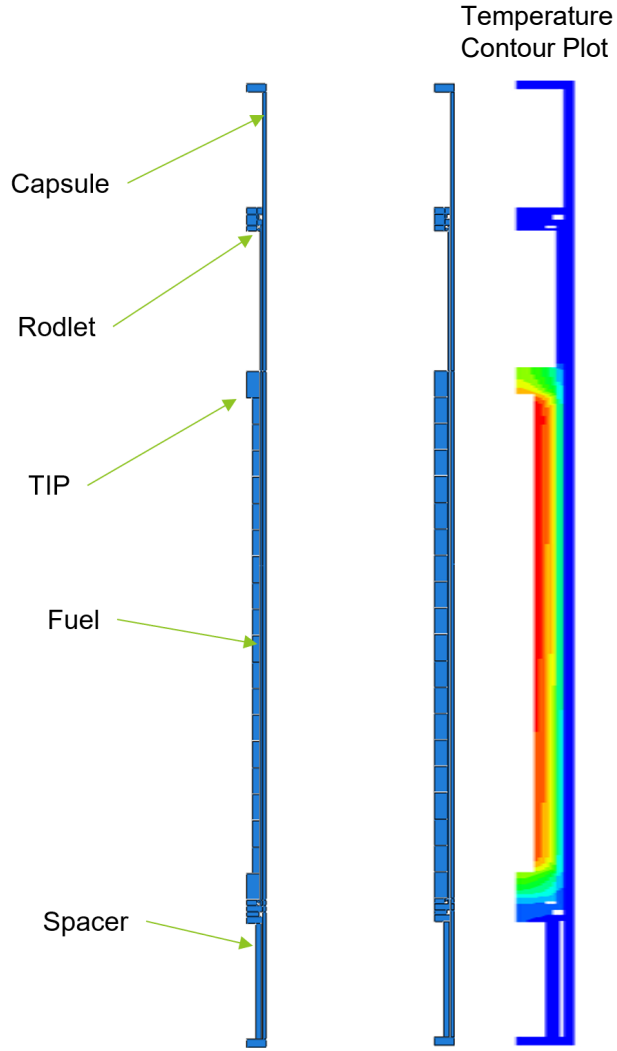
*Clean Core Thorium Energy Project*

# Heat Transfer Modeling Used to Analyze Thorium-Uranium Dioxide Fuel

- Clean Core Thorium Energy (CCTE) is pursuing the development of alternative nuclear fuels using thorium, primarily for pressurized heavy-water reactors and Canada deuterium uranium reactors. Idaho National Laboratory (INL) will be conducting irradiation testing on various mixed thorium-uranium oxide fuel samples to characterize the fuel performance.
- The fuel specimens will be irradiated in static capsules in the Advanced Test Reactor Inner-A and Outer-A test locations to achieve three different burnup targets.
- CCTE fuel temperature targets were optimized using the engineering simulation and 3D design software ANSYS.
- The finite element-based nuclear fuel performance code BISON was used to adjust gas gap mixtures to account for burnup-dependent fission gas release and improve programmatic temperature predictions.




Clean Core Thorium Energy Capsules.

REACTOR SYSTEMS DESIGN & ANALYSIS | IRRADIATION EXPERIMENT THERMAL HYDRAULICS ANALYSIS
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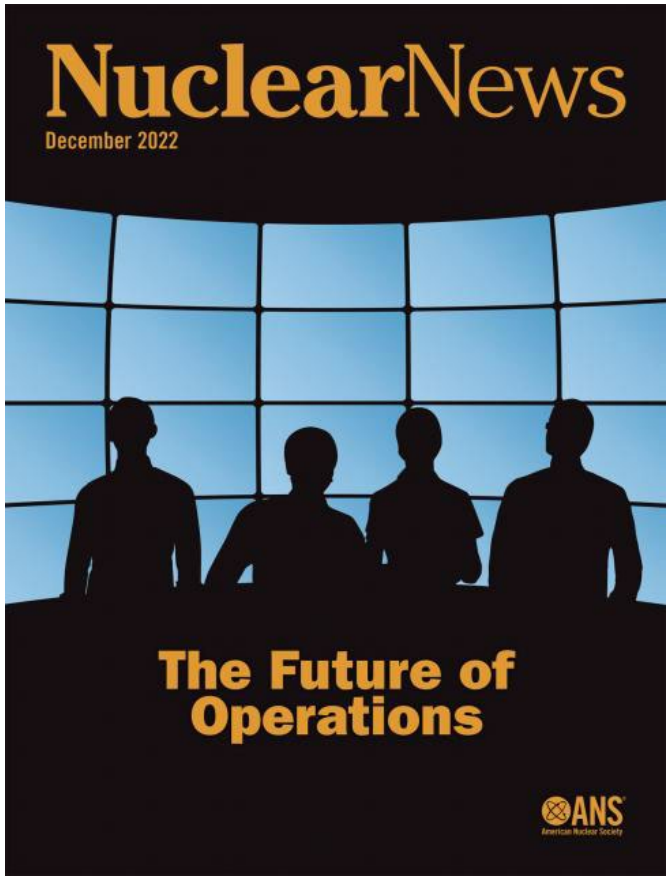
DOE-NE Light Water Reactor Sustainability Program

# Integrated Operations for Nuclear Project Featured in American Nuclear Society Nuclear News

- The American Nuclear Society Nuclear News article, *INL researchers develop strategies to keep today's nuclear power fleet profitable*, describes the Integrated Operations for Nuclear (ION) methodology, research, goals, and outcomes.
- ION was developed by Light Water Reactor Sustainability Program researchers at INL. It uses technology innovation and commonsense business practices to lower the maintenance and operation expenses of U.S. nuclear plants.
- The goal is to reduce existing nuclear power plant expenses by 30% by deploying first generation technologies within three to five years. Xcel Energy has already begun implementing ION at two of its nuclear power plants—Monticello and Prairie Island.
- According to Gene Foote, Xcel Energy's director of nuclear strategy and performance, ION has successfully and substantially reduced its operations and maintenance costs.




*Click here to view the article.*

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LWRS LIGHT WATER REACTOR SUSTAINABILITY

*DOE-NE Light Water Reactor Sustainability Program - Cooperative Research and Development Agreement with Constellation Energy Generation*

# Conceptual Verification Report Submitted to the Nuclear Regulatory Commission for Limerick Safety-Related Instrumentation and Control Upgrade to Human-System Interfaces

- In collaboration with Constellation, Westinghouse, and CORYS, INL prepared the partial scope simulator for and coordinated the execution of Conceptual Verification (CV) during the week of December 5, 2022.
  - This included an evaluation of human-system interfaces (HSIs) that support manual operator actions impacted by the safety-related digital instrumentation and control upgrade project scope.
- INL, working with Constellation, finished the CV report in early February 2023.
  - This enabled Constellation to meet its commitment to submit this report to the Nuclear Regulatory Commission in support of its license amendment request prior to its due date of February 9.
- CV performance and report submission were key milestones enabling the preliminary validation of new digital HSIs and associated procedure changes, which occurred during the week of February 20.

*Limerick Generating Station.*

*HSI conceptual verification with plant operations personnel at INL Engineering Innovation Laboratory.*


Paul.Hunton@inl.gov

LWRS LIGHT WATER REACTOR SUSTAINABILITY

*DOE-NE Light Water Reactor Sustainability Program - Cooperative Research and Development Agreement with Constellation Energy Generation*

# INL Hosts Preliminary Validation of Limerick Safety-Related Instrumentation and Control Upgrade Human-System Interfaces

- Preliminary Validation (PV) demonstrates new digital human-system interfaces (HSIs) and related procedures, ensuring impacted manual actions in the Limerick Licensing Basis can be successfully performed.
- Working with Constellation, Westinghouse, and CORYS, INL prepared the Human-Systems Simulation Laboratory (HSSL) for PV during the week of February 20, 2022.
- Four auditors from the Nuclear Regulatory Commission (NRC) as well as the Department of Energy Office of Nuclear Energy (DOE-NE) attended.
- Initial NRC feedback communicated that there were no safety findings and the process used for PV was valid.
- PV results will be submitted to the NRC to support a safety determination for the human factors engineering portion of the Limerick safety-related instrumentation and control upgrade license amendment request.

*Human-system interface Preliminary Validation with Constellation Limerick, INL, Nuclear Regulatory Commission, and Department of Energy personnel at INL Human-Systems Simulation Laboratory.*


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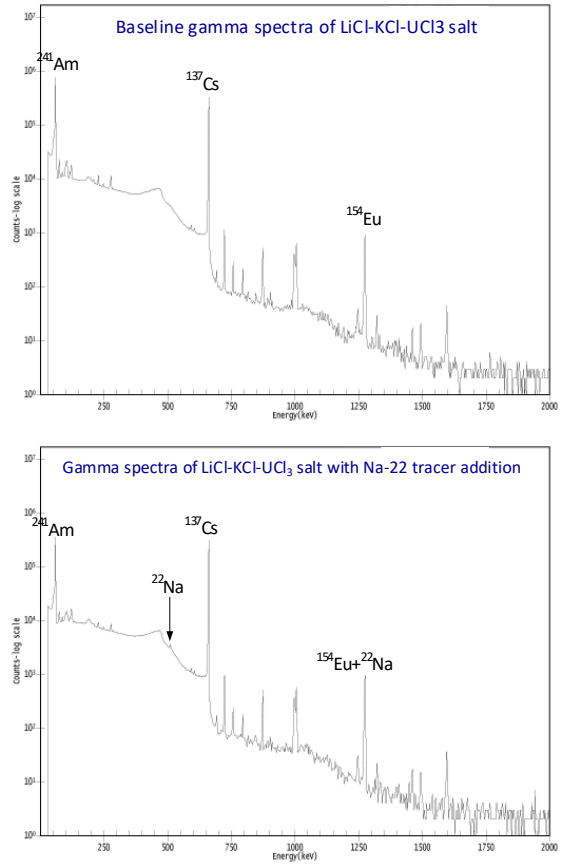
LWRS LIGHT WATER REACTOR SUSTAINABILITY

Research Highlight

*DOE-NE Material Protection, Accounting, and Control Technologies*

# First Demonstration of Tracer Dilution Technique for Total Mass Determination of Molten Salt Systems

- The operation of molten salt reactors requires accurate tracking of the total mass of the molten salt system for safety purposes.
- A new radioactive tracer dilution (RTD) technique has potential for application to safeguards-by-design for pyroprocessing spent nuclear fuels and advanced molten salt reactors.
- This Na-22 based RTD technique, coupled with gamma spectroscopy has been successfully developed and demonstrated for the first time. The demonstration provided total mass measurement in an 8-kg LiCl-KCl-$UCl_3$ salt system in a scalable pyroprocessing facility for uranium electrorefining.
- Currently, this technique is being evaluated for accuracy and scalability in a 60-kg LiCl-$Li_2O$ salt system for spent oxide fuel reduction.




*Gamma spectra of baseline (top) and Na-22 spiked (bottom) LiCl-KCl-$UCl_3$ salt.*

**Title**: Development, Feasibility, and Uncertainty of Radioactive 22Na Tracer Dilution and Gamma Spectroscopy for Mass Determination of Molten Salt for Pyroprocessing Spent Nuclear Fuels
**Authors**: Guoping Cao, Brian Storms, Magen E. Coleman, Robert Hoover, Shelly Li
**Journal:** Journal of Radioanalytical and Nuclear Chemistry
**Link**: https://doi.org/10.1007/s10967-023-08790-y

Advanced Technology of Molten Salt, Fuel Cycle Science and Technology Division
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# Ruchi Gather Recognized by INL National University Partnership for Outstanding Research Contributions

- Ruchi Gakhar Ph.D., an engineer in Fuel Cycle Science and Technology, has been recognized for her contributions to the advancement of molten salt science and engineering. The article, “Strong Women in Science,” emphasizes the courage and discipline that was required for Dr. Gakhar to leave her home in India to pursue her dream of completing her doctoral studies in engineering.
- After completing her doctorate in materials science and engineering at University of Nevada Reno in 2016, she started her postdoctoral research in molten salt chemistry using spectroscopic techniques. She came to INL as a Russell L. Heath Distinguished Postdoctoral Associate.
- In 2021, Dr. Gakhar received a Laboratory Director Award in the Early Career Exceptional Achievement category. She is currently leading many projects as principal and co-principal investigator, in charge of Laboratory Directed Research and Development proposals and research funding.

NATIONAL UNIVERSITY PROGRAMS

NUP News

FEBRUARY 2023

**Director’s Note**

During Black History month we celebrated the legacy of Abraham Lincoln and Frederick Douglas, the contributions of civil rights leaders and noteworthy African American experiences. Historically Black Colleges and Universities promote Black history year-round not only in February, and INL provides opportunities and support for minority-serving institutions students and faculty through university programs. In March, we’ll acknowledge International Women’s Month. International Women’s Day is celebrated around the world on March 8. March is also Women’s History Month. It is a call for positive change advancing women, education and equality. It is when we acknowledge women’s achievements in all areas. INL has been a strong advocate for women in the lab that keeps growing and bringing outstanding results for our science and technology world. We are sharing a little bit about how amazing women in our lab keep pushing the bar higher. Women rock!

Thank you,
*Michelle Bingham*

**Strong Women in Science**

Former distinguished postdoc Ruchi Gakhar

Ruchi Gakhar is an INL scientist who has been part of our full-time staff since December 2018. She is an inspiration and model of determination, perseverance and talent. Gakhar is one of many brilliant women working at the lab and part of a growing leadership of strong women in science worldwide.

We are highlighting her story of moving away from India and studying, working and raising her children abroad while remaining focused on her dreams, no matter how hard it was. Her dream was to finish her doctorate degree then do something for herself. Her main supporter was her husband, who always believed in her potential and kept pushing her. “Chase your dreams,” he often said.

“I come from a big family in India, and it was difficult to move to a new country and live alone since my husband and I were in different cities due to visa issues. Even during pregnancy and my daughter’s birth I was alone,” said Gakhar. She later managed her time between caring for her baby and her Ph.D. work. Gakhar is now a mother of two.

After completing her doctorate degree in materials science and engineering at University of Nevada Reno in 2016, she started her postdoctoral research in molten salt chemistry using spectroscopy techniques. She came to INL as a Russell L. Heath Distinguished Postdoctoral Associate. She was provided the opportunity to lead her own project and had a significant support from her mentor Steve Frank, her manager Ken Marsden and INL scientists who wanted her to succeed.

In 2021, Gakhar received a Laboratory Director Award in the Early Career Exceptional Achievement category. She is currently leading many projects as principal and co-principal investigator, in charge of Laboratory Directed Research and Development proposals and research funding.

“I see more and more women in science, their participation is growing, and they have more impact and powerful roles,” said Gakhar. She was the first woman in her department when she started at INL, now she is proud to collaborate directly with six women scientists and around 345 total at the lab, plus many postdocs.

Since 2017, INL’s workforce expanded by 38.5%, from less than 4,200 to nearly 5,700. During this same period, the number of women employees expanded by 50.1%, from less than 900 to more than 1,300. Since then, INL has meaningfully expanded the number of women in management (up 106%) and science, engineering and computing (up 42.7%).

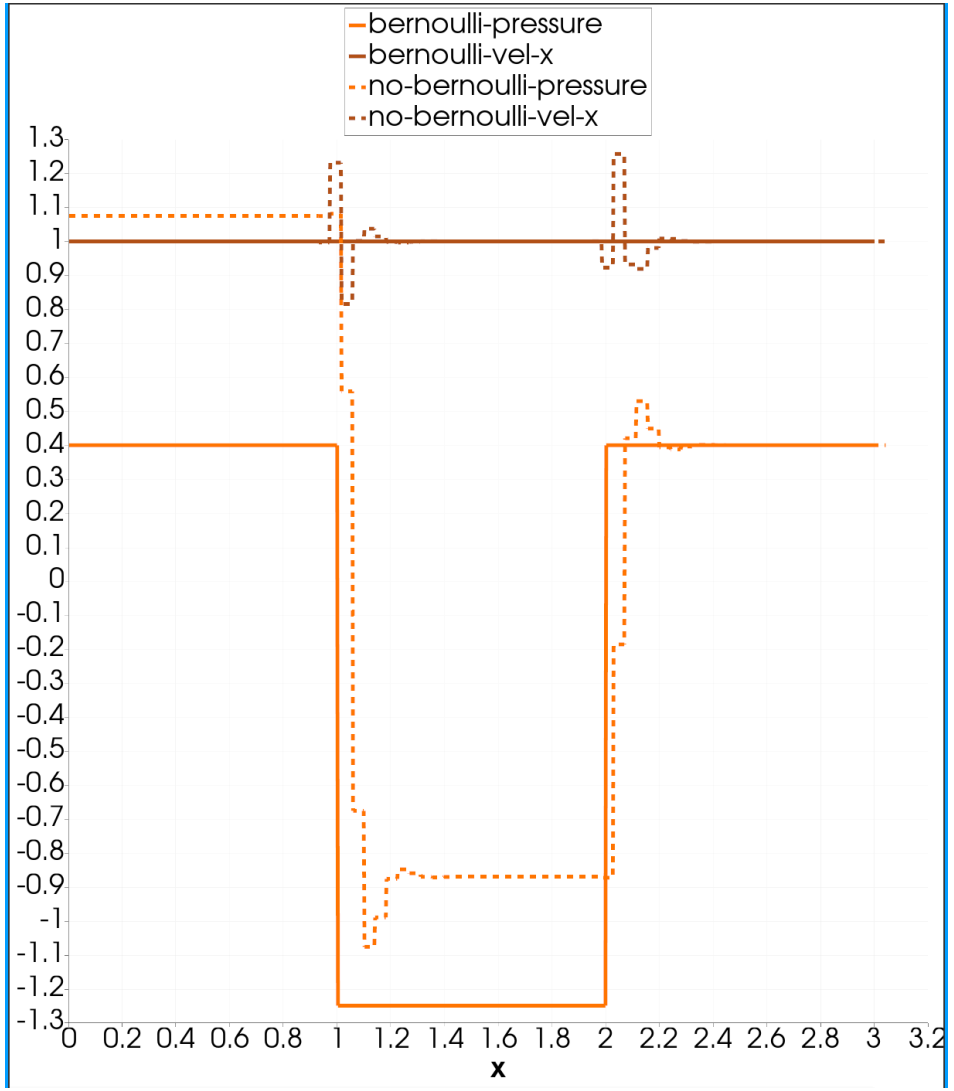
*Honoree Ruchi Gakhar Ph.D. and the “Strong Women in Science” article (left).*

Research Highlight

*DOE-NE Nuclear Energy Advanced Modeling and Simulation Program*

# Pressure Drop Across Material Porosity Changes Accurately Simulated with New MOOSE Model

- Porosity describes how much room there is for fluid to flow in a material.
- Many flows in proposed advanced reactor concepts should obey Bernoulli's principle, which describes the relationship between pressure and fluid speed as the fluid moves through the reactor.
- Most modeling strategies fail to capture Bernoulli's principle when porosity changes at interfaces between different materials. This can result in inaccurate calculation of pressure changes through the reactor.
- In MOOSE (Multiphysics Object Oriented Simulation Environment), we have developed a new strategy for calculating pressure and fluid velocity at porosity changes which satisfies Bernoulli's principle.
- This opens doors to new levels of accuracy in modeling of advanced reactor types, such as pebble bed reactors, which have the described porosity changes.




*Three porosity region test case. Pressure should change by 1.65 from left to center regions and then return to the same value as on the left in the right region. Superficial velocity should be constant. Dashed lines indicate results for a standard modeling technique. Solid lines represent results with MOOSE's new strategy for handling porosity changes.*

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# Podgorney to Serve on University Of Idaho College of Science Advisory Board

- Robert Podgorney was asked to serve of the University of Idaho College of Science Advisory Board.
- Individuals on the advisory board volunteer their time to help guide college programs, curriculum and strategic goals.
- As a member of this diverse group, Podgorney will contribute his input and expertise to long-term planning efforts for the college.

Newly appointed University of Idaho College of Science Advisory Board member, Robert Podgorney.

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*DOE-NE Nuclear Science User Facilities, Advanced Fuels Campaign*

# Research Team Assembles First Five Nuclear Science User Facilities Experiment Campaign Rodlets

- The Nuclear Science User Facilities (NSUF) chromium-coated zircaloy reactivity-initiated accidents (CCZ-RIA) experiment campaign will investigate the thermal, mechanical, and irradiation response of chromium (Cr)-coated zirconium (Zr) alloy accident tolerant fuel claddings under prototypical conditions, compared to uncoated Zr-alloy cladding.
- Cr coatings are deposited using cold spray or physical vapor deposition and will isolate the zirconium cladding from the primary coolant water.
- The campaign consists of uranium dioxide-fueled rodlets assembled into six capsules for irradiation within the Transient Reactor Test Facility.
  - Two capsules containing a rodlet with uncoated Zr-alloy cladding.
  - Four capsules, each containing a rodlet with Cr-coated Zr cladding with one coated using physical vapor deposition and three using cold-spray.
- The team assembled and inspected the first five rodlets. Each rodlet contains six solid fuel pellets, two annular fuel pellets, two insulator pellets, springs, and a centerline thermocouple.
- The first two capsules with the baseline Zr rodlets, NSUF CCZ-Zr-2 and CCZ-Zr-3, will complete assembly in March 2023.

*Rodlet internals and a fuel pellet dimension.*

*Completed rodlet assembly with cold spray Cr-coated zircaloy.*

NSUF Nuclear Science User Facilities

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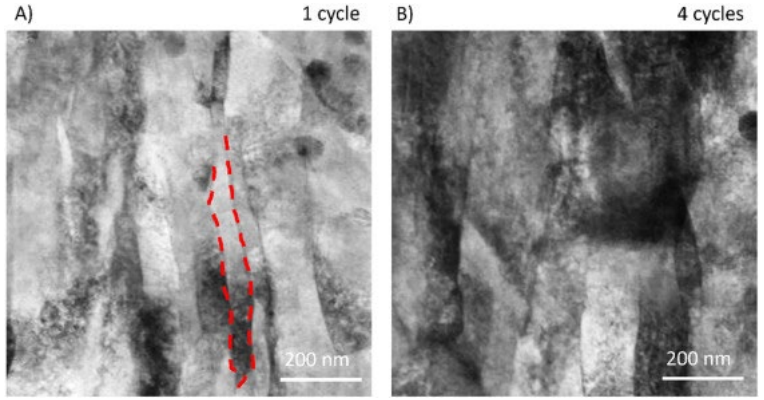
*DOE-NE Nuclear Science User Facilities*

# Researchers Study Zirconium-Based Alloys to Increase Reactor Safety

- Corrosion of metals is a critical material challenge in the high-temperature aqueous environment of light-water reactors, leading to degraded mechanical strength, deteriorated structural integrity, and potentially threatening reactor safety.
- Advanced cladding has been developed by alloying a base of zirconium with iron, tin, and niobium to increase corrosion resistance, reduce hydrogen uptake, and increase mechanical strength to prolong the reactor lifetime and lengthen fuel cycles between reloading.
- Samples of previously irradiated advanced stress-relief annealed ZIRLO™ cladding, provided by Westinghouse, were prepared for characterization at the Irradiated Materials Characterization Laboratory (IMCL) and the Center for Advanced Energy Studies as part of a Nuclear Science User Facilities Rapid Turnaround Experiment.
- INL instrument scientists utilized advanced characterization capabilities at the IMCL to investigate changes in the cladding microstructure following neutron irradiation.
- Microstructure and chemistry strongly affect performance of the cladding. They observed that certain alloying elements had migrated from their initial location to segregate at the grain boundaries.
- This behavior can have competing effects on performance of the protective oxide layer on the cladding. Niobium segregation improves the corrosion resistance by increasing the strength and reducing the formation of micro-cracks during oxide phase transformation. But tin segregation reduces the corrosion resistance by decreasing the strength and destabilizing the oxide structure.




*Bright field Scanning Transmission Electron Microscopy (STEM) images showing the metal grain structure of stress-relief annealed ZIRLO™ at (A) 1 cycle and at (B) 4 cycles. The red dash lines highlight grain boundaries.*

**Title**: STEM/EDS and APT study on the microstructure and microchemistry of neutron irradiated ZIRLO™
**Authors**: Zefeng Yu, Adrien Couet (University of Wisconsin - Madison), Mukesh Bachhav, Fei Tang, Lingfeng He (INL), Megha Dubey (Boise State University and Center for Advanced Energy Studies)
**Journal:** Journal of Nuclear Materials
**Link**: doi.org/10.1016/j.jnucmat.2022.154139

*DOE-NE Nuclear Science User Facilities*

# Nuclear Science User Facilities Awards Approximately $1.42M to Advance Nuclear Science and Technology

- The Nuclear Science User Facilities (NSUF) has awarded the first round of Rapid Turnaround Experiment (RTE) awards for FY 2023 totaling approximately $1.42M.
- Twenty-four proposals were awarded to support nuclear science and technology advancement by providing access to world-class capabilities at no cost to the researcher.
- Five INL researchers will receive access funding for their projects, including four researchers from the INL Nuclear Science & Technology directorate.
- These awards went to 10 principal investigators from universities, one from industry, two from international entities, and 11 from national laboratories.
- The NSUF has already opened the next RTE call and is expected to select award winners from the next round of proposals by mid-May, with a third round awarded in October.


*NSUF's Rapid Turnaround Experiment announcement. Click here to learn more about the awarded projects.*

NUCLEAR FUELS & MATERIALS
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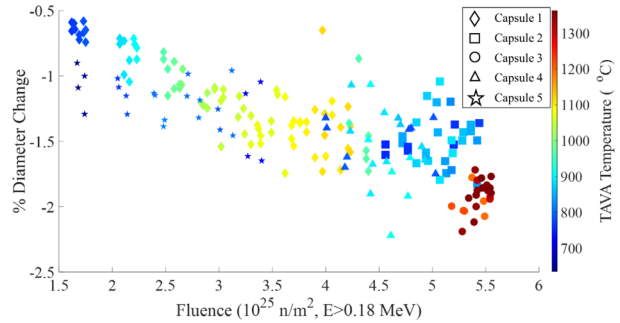
NSUF Nuclear Science User Facilities

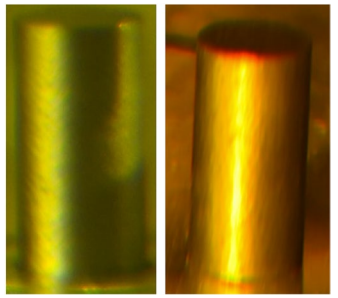
*DOE-NE Advanced Gas Reactor Fuel Qualification Program*

# Major Phase of Post-irradiation Examination Completed for Final TRISO Fuel Qualification Test

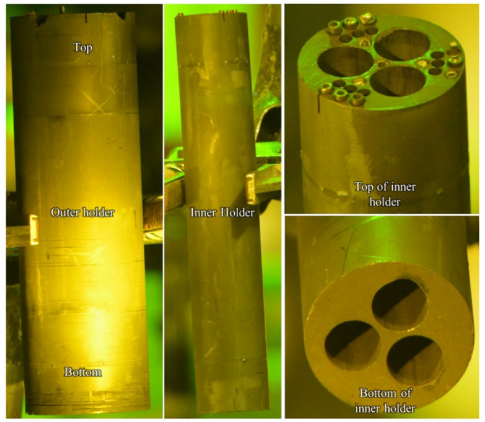
- To support qualification of tristructural isotropic (TRISO) fuel for high-temperature reactors, this initial two-year phase of post-irradiation examination (PIE) assessed the condition of the AGR-5/6/7 fuel and irradiation test train.
- The test train was sent from the Advanced Test Reactor to the Materials and Fuels Complex for nondestructive exams, disassembly of the five capsules, and dimensional measurements of the graphite components and all 194 fuel compacts.
- The INL report documents these activities and the results, representing two years of effort.
- The final dimensions of the fuel and graphite components in the test train will be used to refine the thermal calculations for this experiment.
- Extensive fuel destructive exams and post-irradiation heating tests in inert and oxidizing atmospheres are in progress.




*Fuel Compact Diameter Change.*



*Capsule 5 Fuel Compacts.*




*Capsule 3 Fuel Holder Exams.*

**Title**: AGR-5/6/7 Irradiation Disassembly and Metrology First Look
**Authors**: J.D. Stempien and L. Cai
**Link**: https://edms.inl.gov/pls/edms/toto.dmx_3?f_doc=8976634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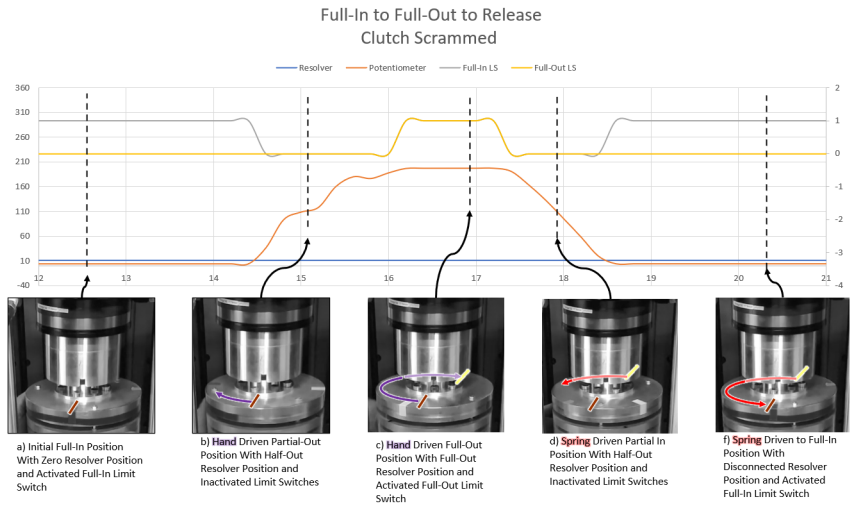
Research Highlight

*DOE Microreactor Program*

# MARVEL Control Drum Qualification Test Validated Performance Calculations

- Researchers refined the Microreactor Applications Research Validation and EvaLuation (MARVEL) Control Drum system design and developed and validated methods, which will be leveraged in listed system qualification procedures needed prior to MARVEL startup:
  - Phase I: Assembly and Checkout
  - Phase II: Functional Testing
  - Phase III: Acceptance Testing
- The employed Advanced Sensor and Instrumentation (ASI) program's double delta deflection/force/torque application platform applied deflections commensurate of those expected by MARVEL's operating environment to a control drum prototype of commensurate geometry, inertias, boundary conditions, and resistances.
- Investigation results revealed that spherical bearings better accommodated the expected deflections.
- Time response data validated component sizing calculations and demonstrated the system's control and passive insertion capabilities as achieved via torsional spring under the following conditions:
  - Clutch disengaged
  - Back drive motor (clutch engaged)
  - Laterally deflect at the top of drum up to ½"




*Full-In to Full-Out to Release Steps and Response Profile.*

*MARVEL Control Drum Prototype in ASI Double Delta Platform.*

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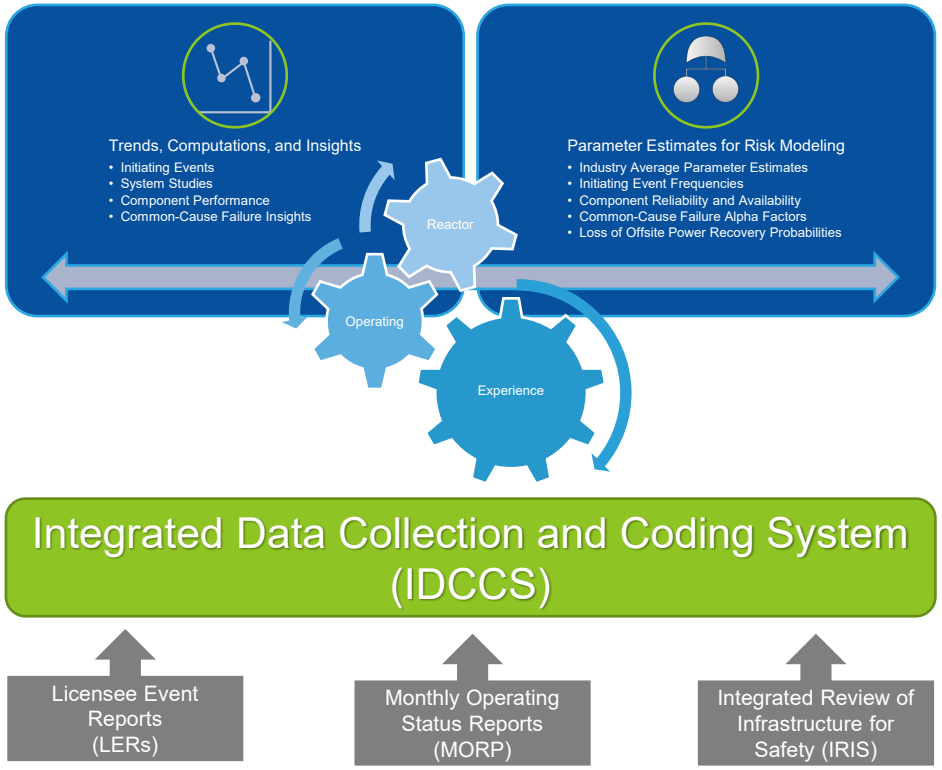
MRP Microreactor Program

IDAHO NATIONAL LABORATORY

*US Nuclear Regulatory Commission*

# New Web Application Solidifies Cornerstone of Probabilistic Risk Assessment Data Collection and Coding Activities

- A new Integrated Data Collection and Coding System (IDCCS) application is now in operation. The system replaces an obsolete, decades old system with a maintainable, user-friendly web application.
- INL analysts use IDCCS to regularly review incoming licensee event reports and integrated review of infrastructure for safety records and code them for further study and insertion into a variety of vital reactor operating experience processes and products.
- These processes and products include key system/component performance evaluations and trends, common-cause failure insights, and initiating event frequencies.
- Quantitative parameter estimates are used as inputs to the United States NRC standardized plant analysis risk models covering domestic commercial nuclear power plants.





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