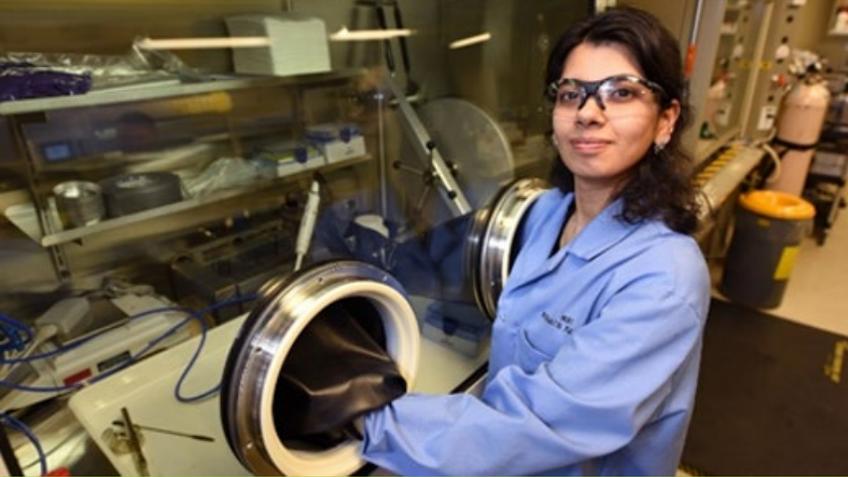


November 23, 2021

Dr. Jess Gehin

Associate Lab Director, Nuclear
Science and Technology

Jess.Gehin@Inl.gov



National Laboratory Role for Developing and Deploying Advanced Reactors

National Laboratories Support Advanced Reactor Demonstrations

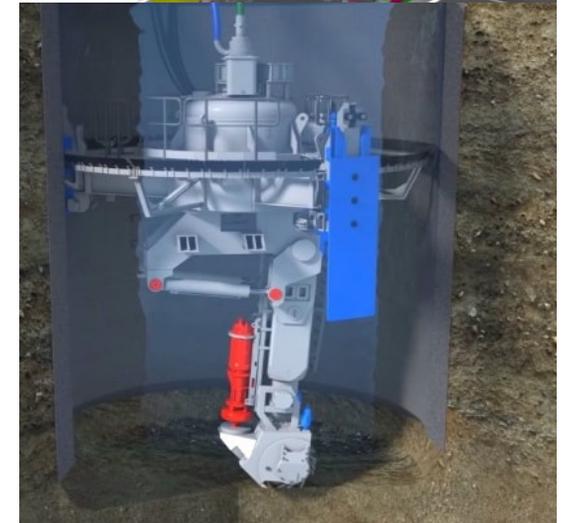
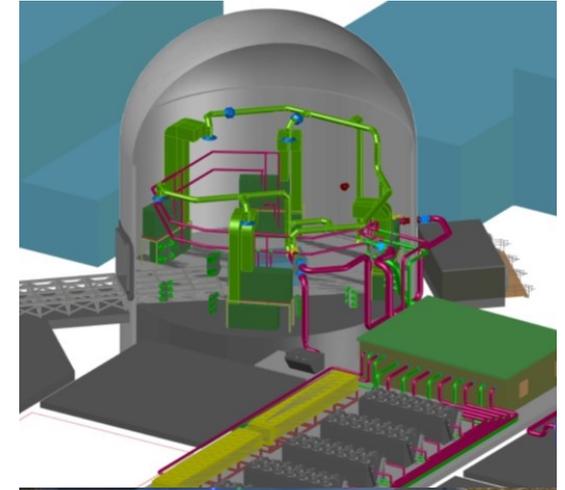
- Private-public partnerships that combine private-sector development with laboratory expertise and capabilities.
- Laboratories are supporting private sector advanced reactor demonstrations directly and within the Advanced Reactor Demonstration Program).
- Broad research performed by laboratories and universities under DOE Office of Nuclear Energy R&D programs provides base technology and capabilities.



National Reactor Innovation Center

Enabling Reactor Demonstrations

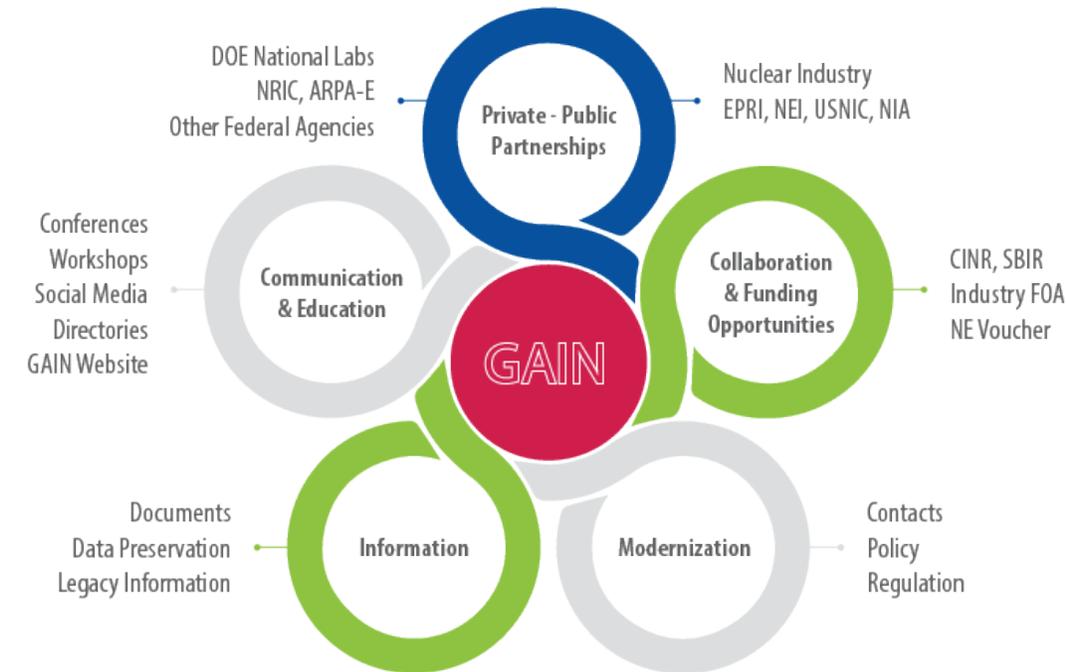
- Established in 2019 by the DOE Office of Nuclear Energy with the purpose to provide the capabilities to support development and demonstration of advanced reactors
- Enabling reactor developers through:
 - Test beds
 - Demonstration Sites
 - Experimental Facilities
 - Resource team support
- Addressing cost and markets:
 - Advanced Construction Technologies
 - Integrated Energy Systems
 - Digital Engineering



Gateway for Accelerated Innovation in Nuclear – Functions and Goals



- 1. Provide nuclear industry entities access** to financial support opportunities and national laboratory capabilities
- 2. Work with industry** to identify gaps, gather needs, and develop viable paths forward to inform DOE research programs and remove barriers for industry.
- 3. Complete the key portions of a modernized** risk-informed regulatory framework enabling deployment of advanced nuclear energy technologies.
- 4. Facilitate the advanced nuclear industry's access** to information to support their technology commercialization efforts.
- 5. Contribute tailored, factual information** to key stakeholders to motivate the integration of clean nuclear energy for long-term success.



Advanced Reactor Technologies Research and Development

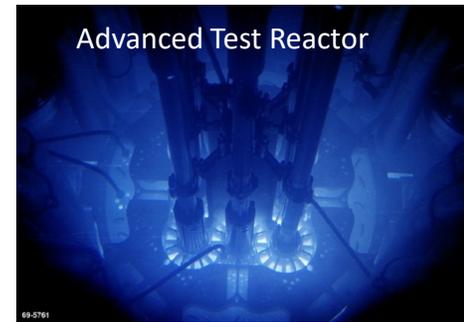
- Targeted R&D on advanced reactor technologies
 - Fast reactors
 - Molten Salt Reactors
 - High-temperature gas-cooled reactors
 - Microreactors
- Research focuses on:
 - Fundamental technologies and design methods
 - Interactions of diverse reactor coolants with materials and components
 - Advanced energy conversion
 - Research to enhance safety and reduce regulatory risk
 - Experimental validation of models



MARVEL Microreactor

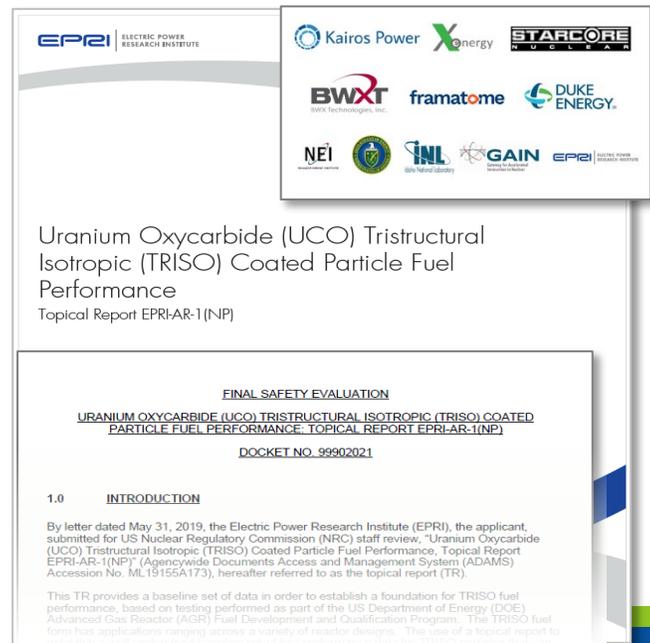
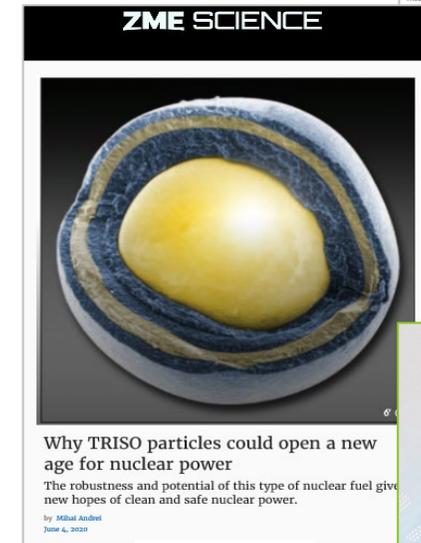
Nuclear Fuels, Materials and Sensor R&D

- **Advanced Materials and Manufacturing Technologies (AMMT)**
 - Combined materials and advanced manufacturing program
 - Accelerate the use of new materials and production technologies in nuclear systems
- **Nuclear Science User Facilities (NSUF)**
 - Experiments awarded competitively to university, industry, and laboratory researchers in nuclear facilities at 20 partner institutions, including ATR, TREAT, HFIR, MITR, and BR2 reactors
- **Advanced Sensors and Instrumentation (ASI)**
 - Development/implementation of instrumentation for irradiation experiments and in-reactor applications
- **Advanced Fuel Testing Capabilities**
 - Advanced Test Reactor Steady-State Irradiations
 - TREAT Transient fuel testing
 - Post-Irradiation Examination and Material Characterization
 - Accelerated fuel testing methodologies



TRISO Fuel Qualification

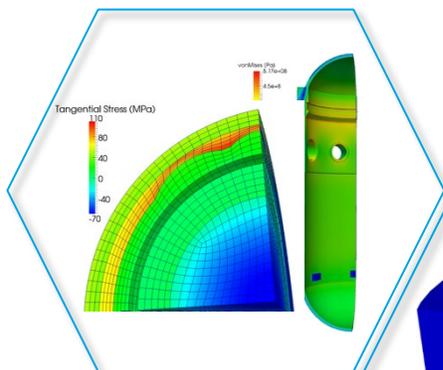
- TRISO fuel is being widely recognized as a robust fuel form under severe conditions
- Several advanced reactor designs are utilizing TRISO fuel (microreactors, HTGRs, salt-cooled reactors)
- EPRI, INL, and the NEI HTR Technical Working Group teamed to submit a topical report on TRISO fuel performance to NRC based on AGR-1 and AGR-2 data
- NRC issues final safety evaluation report in 2020
- Accelerate advanced reactor licensing by obtaining NRC acceptance of TRISO fuel qualification data



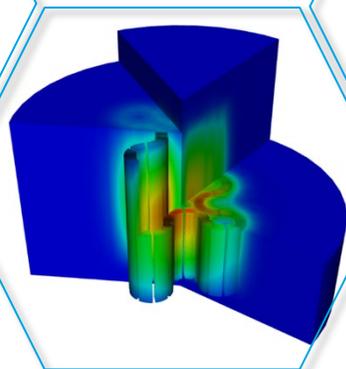
Nuclear Energy Advanced Modeling and Simulation

NEAMS is the DOE-NE mod sim program and is a multilab team effort that aims to develop and deploy predictive computer methods for the analysis and design of LWRs and non-LWRs.

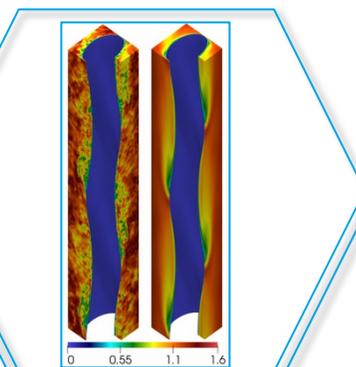
NEAMS core competencies:



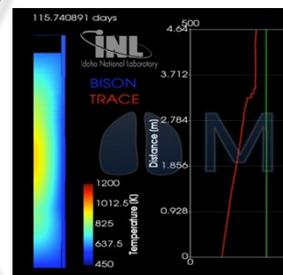
Multiscale fuel performance and structural materials degradation modeling:
BISON, GRIZZLY, YellowJacket



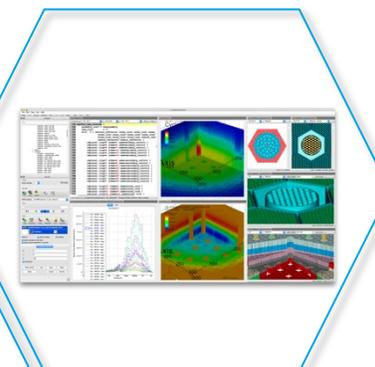
Reactor Physics:
GRIFFIN, MPACT, Shift



Multiscale thermal fluids:
CTF, SAM, PRONGHORN, Sockeye, Nek5000



Multiphysics:
MOOSE, VERA



Workflow Management:
Workbench

Key Success Metric: Use of NEAMS technology (either software or R&D) by stakeholder to improve how they “do business.”

Integrated Energy Systems

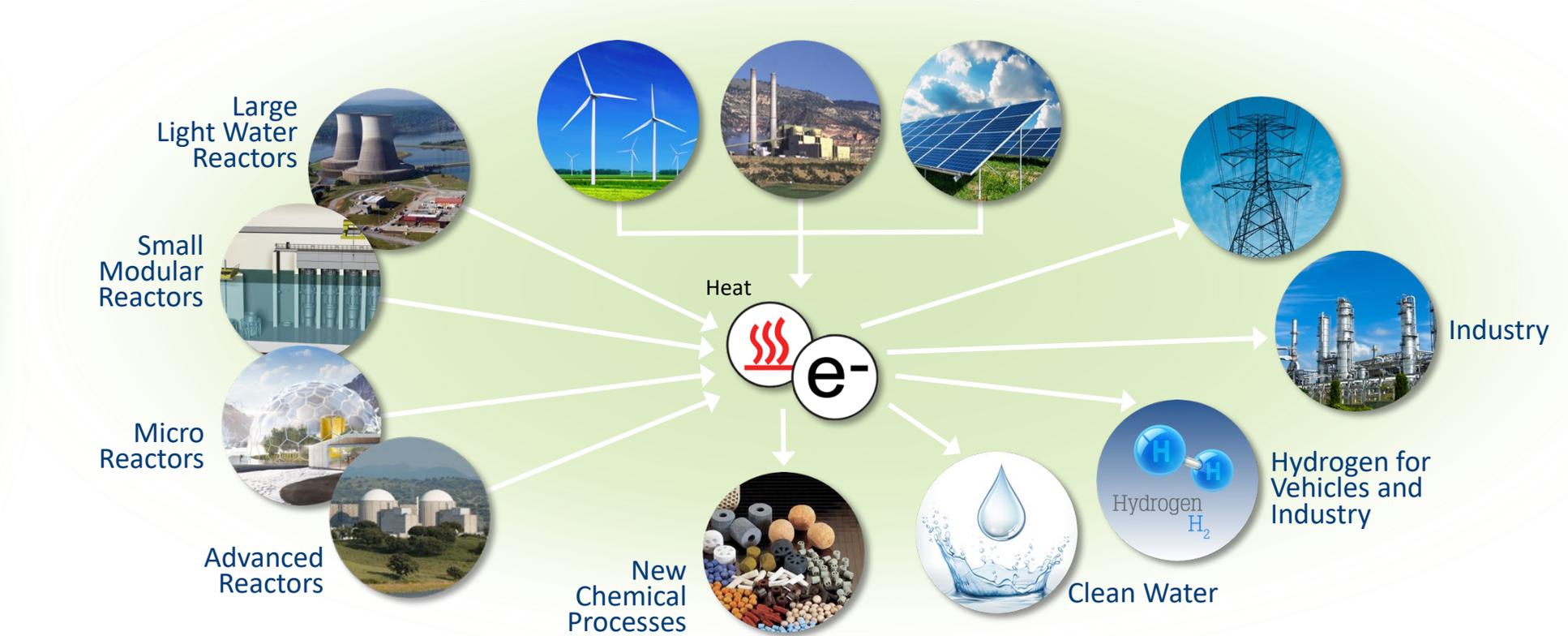
Today

Electricity-only focus



Potential Future Energy System

Enhanced energy system leverages contributions from low emission energy generation for electricity, industry, and transportation



Flexible Generators ❖ Advanced Processes ❖ Revolutionary Design



Idaho National Laboratory