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 NS&T Chief Scientist



# Idaho National Laboratory – Creating a Secure, Resilient, Clean Energy Future

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



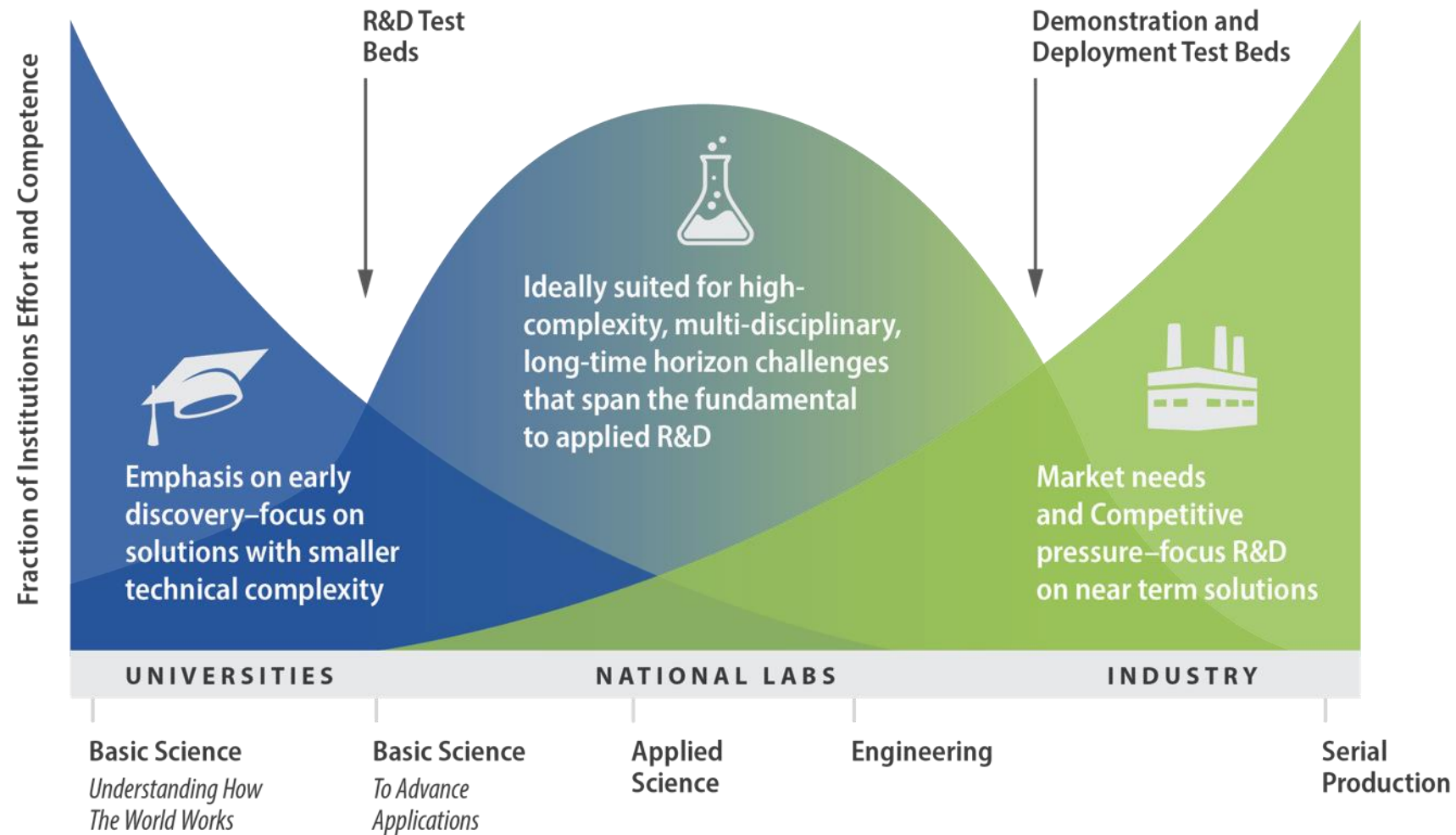
# Seventeen DOE National Laboratories



# “Spectrum” of DOE Laboratories



# DOE labs support the entire technology lifecycle





# Enabling energy dominance and security through research, development, and demonstration



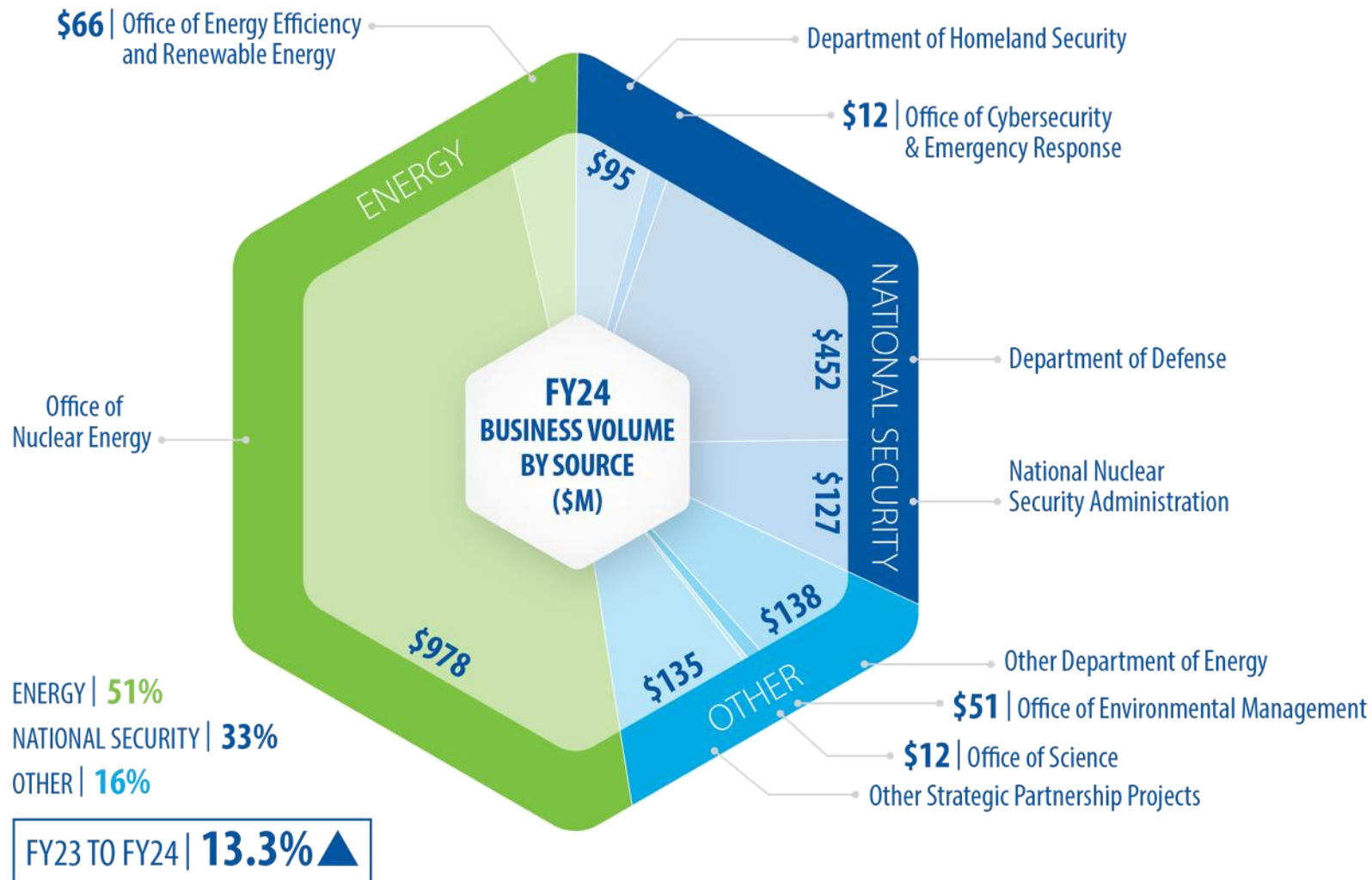
## VISION

To change the world's energy future and secure our nation's critical infrastructure.

## MISSION

To discover, demonstrate and secure innovative nuclear energy solutions, other clean energy options and critical infrastructure.

# Exceeded \$2B in business volume, 53% increase in past 5 years



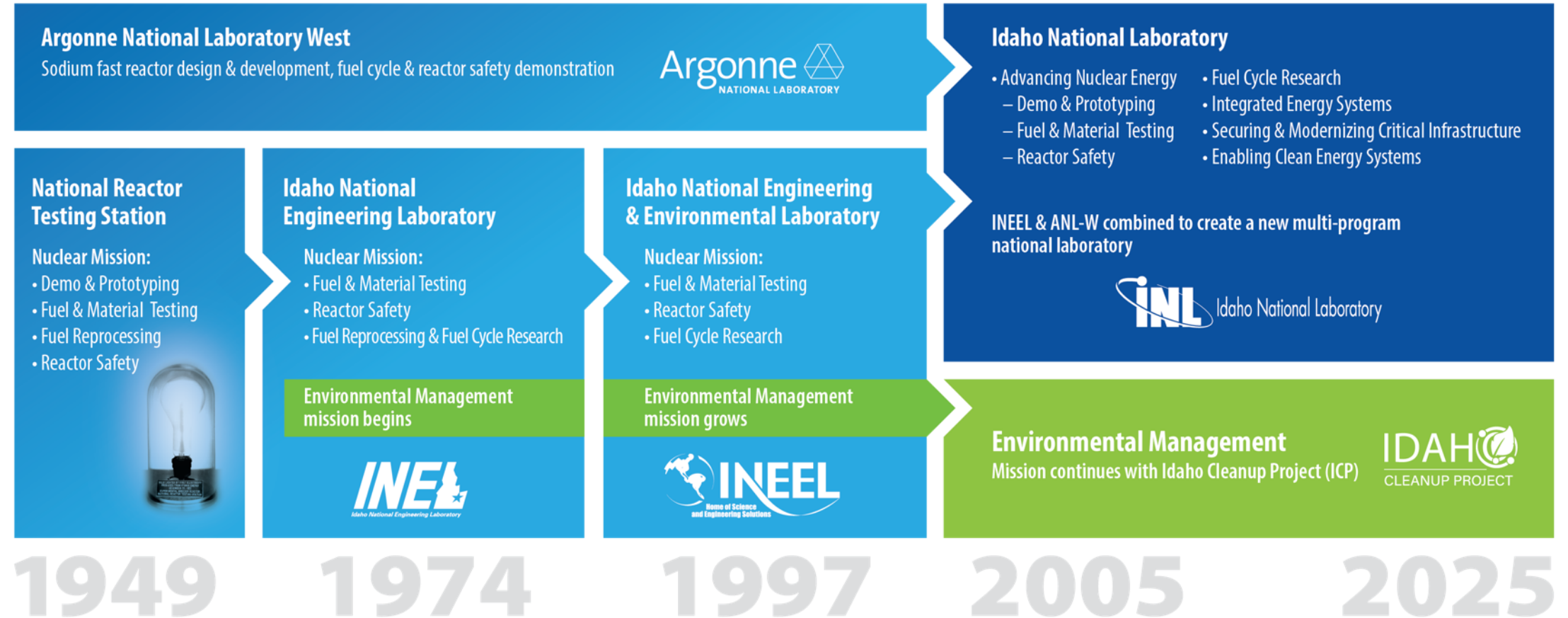
## FY24 OPERATING COST

DOE/NNSA Costs: \$1,372M  
 SPP (Non-DOE/Non-DHS): \$581M  
 CRADA: \$6M  
 DHS Costs: \$107M  
**Total: \$2,066M (\$1.823M FY23)**

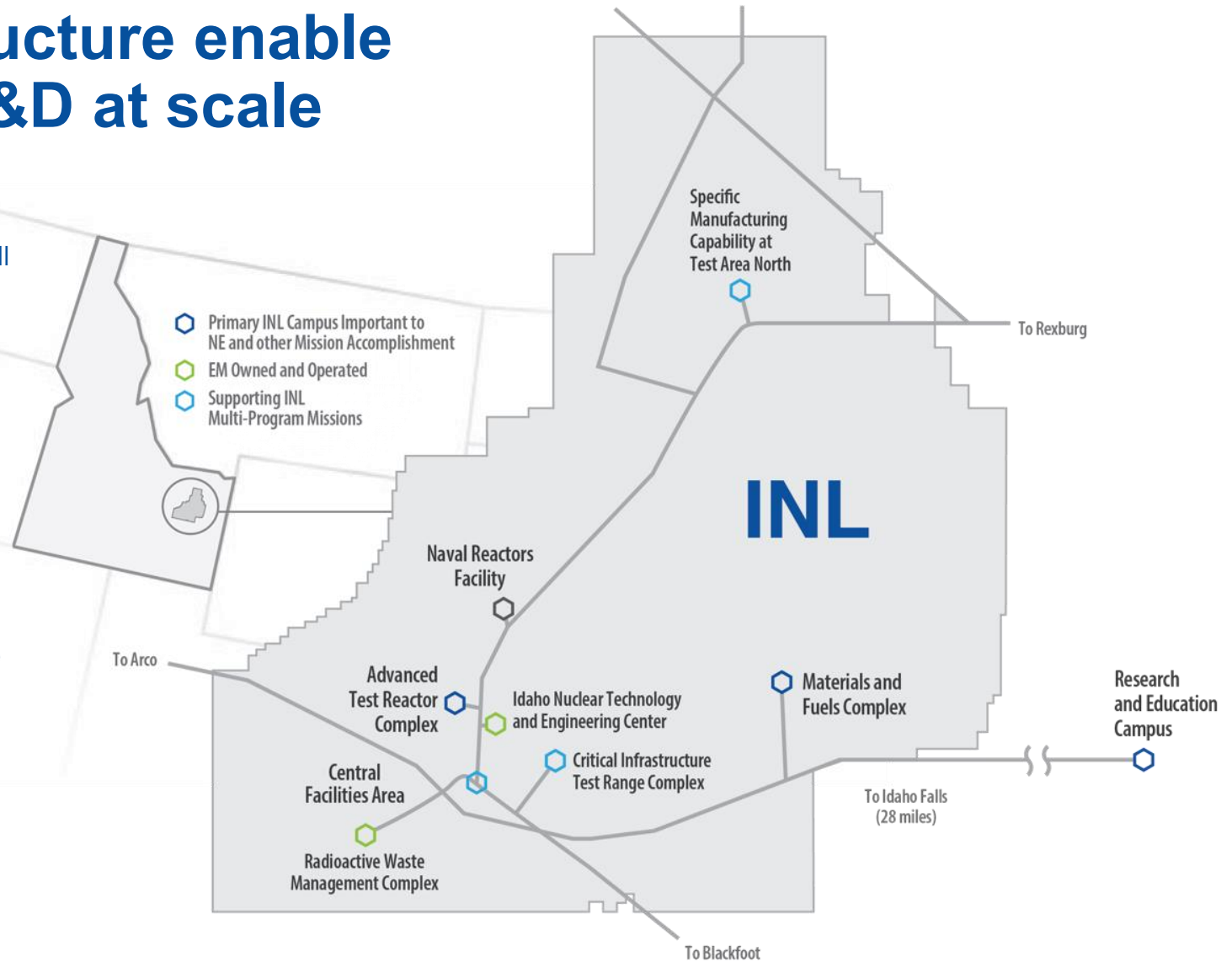
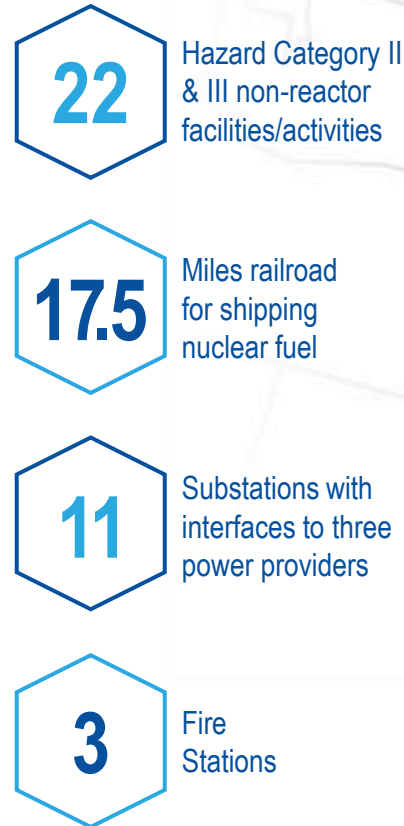
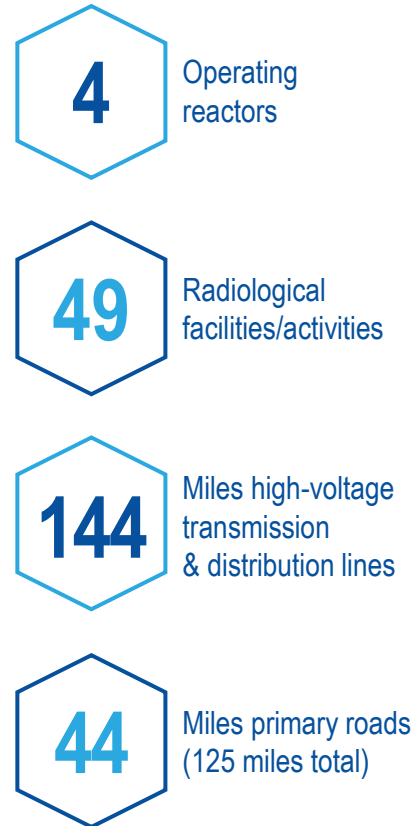
## FY24 HUMAN CAPITAL

6,475	Full-time equivalent employees
112	Postdoctoral researchers
69	Joint appointments
687	Interns
19	Graduate fellows
52	Visiting scientists
996	Facility users

# INL Evolution



# Unique site and infrastructure enable energy and security RD&D at scale





# Creating an abundant, affordable, secure, resilient energy future



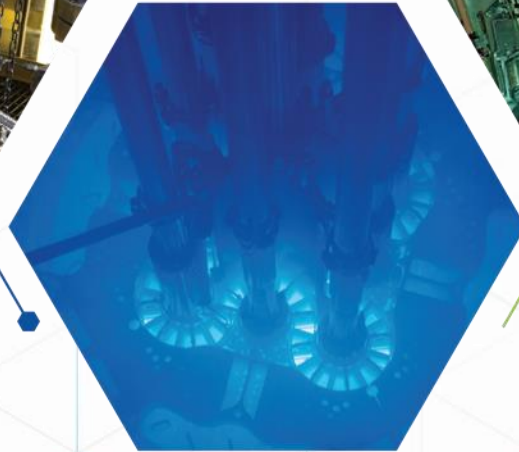
Advanced  
Test Reactor  
Complex



Energy &  
Environment  
Science &  
Technology



Nuclear Science  
& Technology

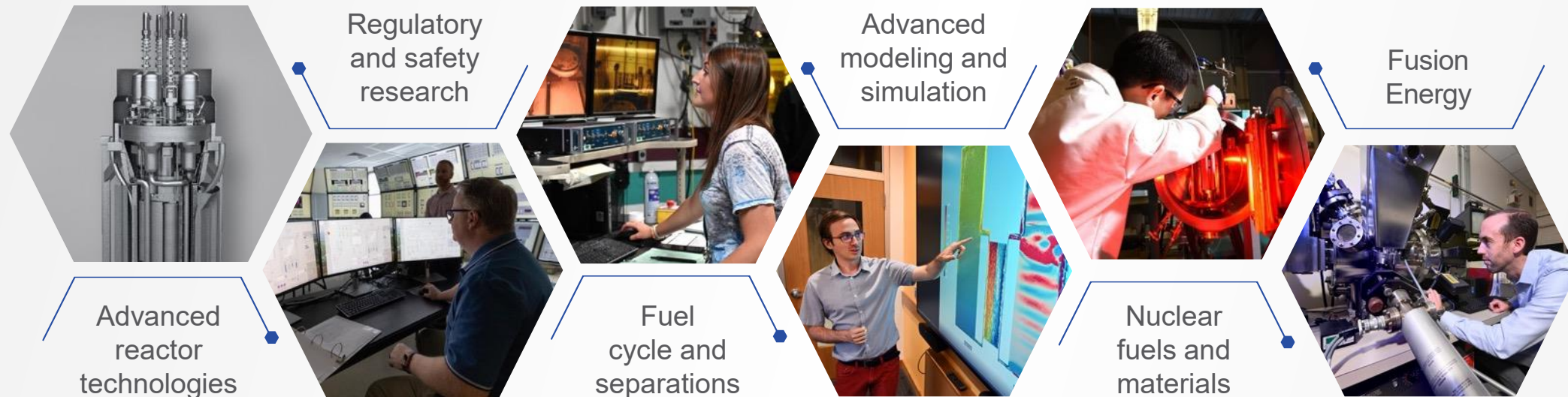


Materials and  
Fuels Complex



National &  
Homeland  
Security Science  
& Technology

# Sustaining the existing commercial reactor fleet and expanding deployment of nuclear energy



# Light Water Reactor *Sustainment*



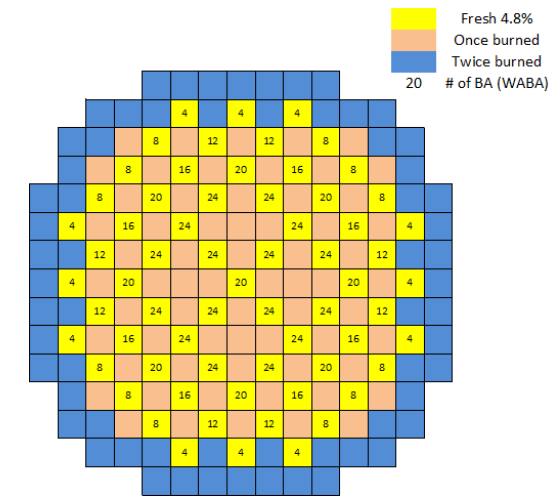


# Improving LWR Fuels

- Evaluations of accident-tolerant fuel with High Burnup
  - Objectives
    - Economic gains via extended refueling cycle, lower volume of new and spent fuel
- Plant Reload Optimization
  - Objectives
    - All-inclusive integrated framework for fuel reload analyses
    - Optimization of core configuration to minimize new fuel volume
  - Benefits of Risk-Informed Approach
    - Allows enhanced optimization of core configuration and further reduction of new fuel volume



Image Credit: U.S. Department of Energy  
([link](#))



Configuration of Reactor Core



# Nuclear H<sub>2</sub> Demonstration Projects



**2023**

Constellation:  
Nine-Mile Point NPP  
(~1 MWe LTE)



**2023–2024**

Energy Harbor:  
Davis-Besse NPP  
(~1–2 MWe LTE)



**~2024**

Xcel Energy: Prairie  
Island NPP ~150  
kWe steam

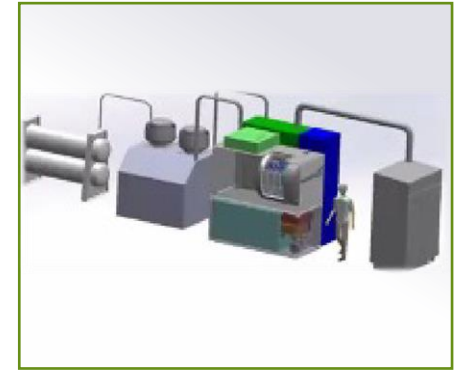
*Thermal &  
Electrical Integration  
(High-temperature  
steam electrolysis/  
Solid oxide  
electrolysis (SOEC))*



**~2024**

APS/Pinnacle West  
Hydrogen: Palo  
Verde Generating  
Station (~15–20  
MWe LTE)

*H<sub>2</sub> Production for  
Combustion and  
Synthetic Fuels*



FuelCell Energy:  
Demonstration at  
INL (250 kW)

*Nuclear energy  
and SOEC*

# Advanced Reactor *Expansion*



# Advanced reactor experiments, demonstrations, and test beds at INL



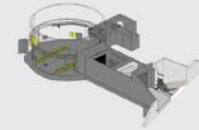
1

## Materials and Fuels Complex

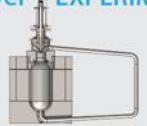
**DOME**  
NRIC | TEST BED



**LOTUS**  
NRIC | TEST BED



**MCRE**  
Southern Co. & TerraPower  
EXPERIMENT



2

## Transient Reactor Test Facility

**MARVEL**  
DOE | TEST REACTOR



3

## INL Site

**AURORA**  
Oklo | MICRO



4

## Critical Infrastructure Test Range Complex

**PROJECT PELE**  
DoD & BWXT | MICRO



# Advanced reactor size comparison

## Large-Scale Reactor

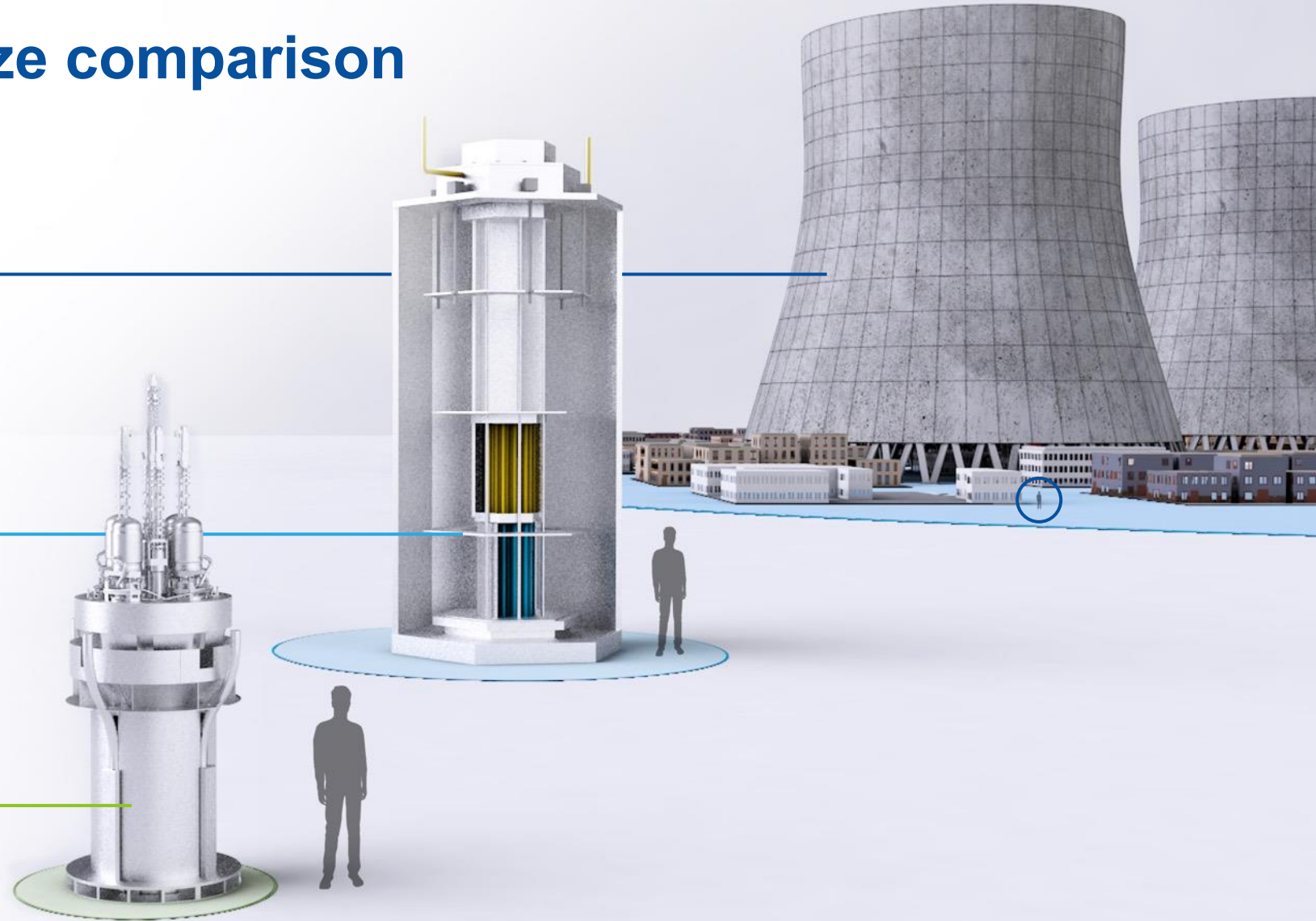
300 MW – 1,000+ MW  
1,500 ACRES

## Small Modular Reactor

20 MW – 300 MW  
50 ACRES

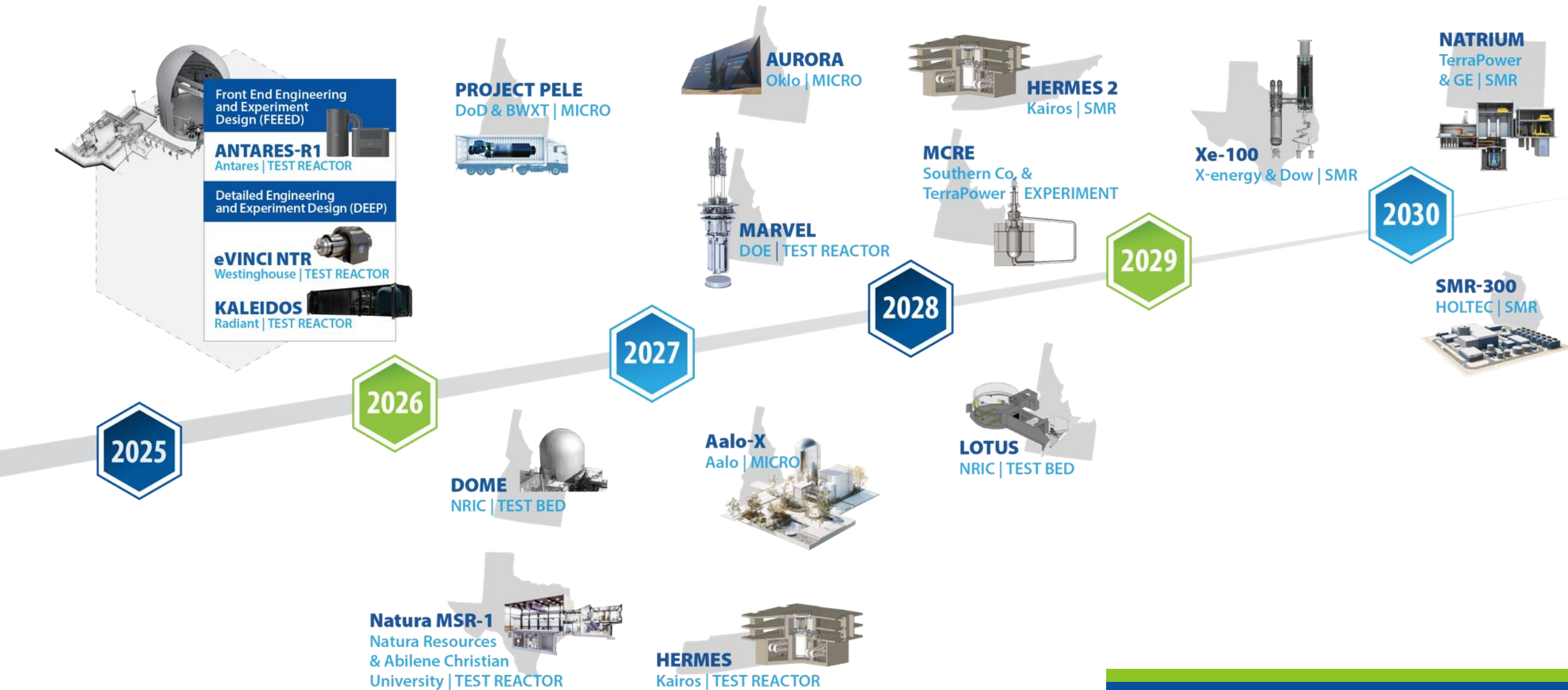
## Microreactor

1 MW – 20 MW  
LESS THAN AN ACRE





# Accelerating advanced reactor demonstration and deployment



# Enabling U.S. technological leadership

## Accelerating advanced reactor demonstration

- MARVEL
- Pele
- MCRE

## Revolutionizing space exploration

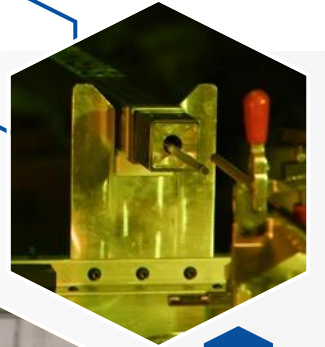
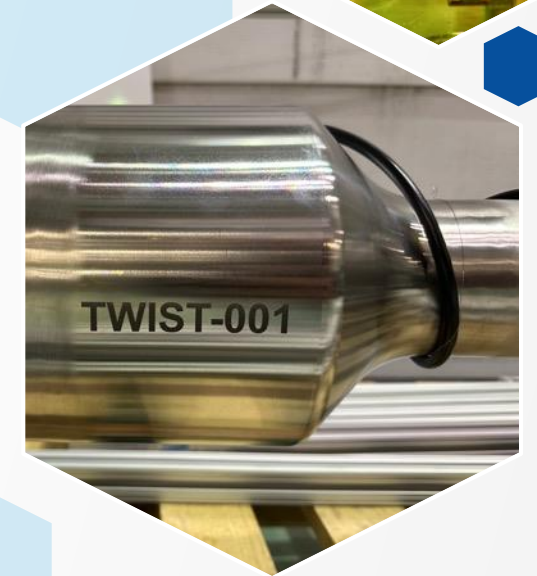
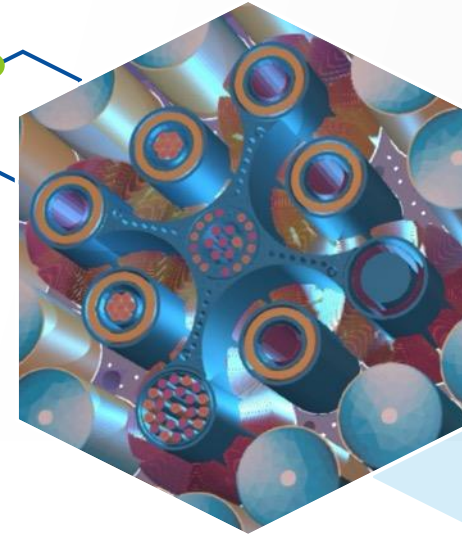
- NextGen radioisotope thermoelectric generator
- Increasing Pu-238 production
- Nuclear thermal propulsion
- Surface fission power



# Strengthening the domestic nuclear enterprise

## Strengthening the current fleet

- Reduce operating costs
- Automate operations with AI and ML
- Enhance advanced nuclear power plant design, licensing, and deployment life cycle through AI and digital engineering
- Increase safety and enhance performance of nuclear fuels and materials
- Enable LWR fuel burnup extension through new capability development



 MOOSE

  
Lightbridge

# Expanding R&D infrastructure

## Existing irradiation and post irradiation capabilities

- Advanced Test Reactor
- Transient Reactor Test Facility
- Neutron Radiography Reactor
- MFC characterization facilities

## Under development

- Sample Preparation Laboratory
- Expanded irradiation capabilities in existing facilities
- DOME and LOTUS test beds
- Expanded computing capabilities

## Infrastructure needs

- Advanced Nuclear Fuels Fabrication Laboratory
- Long term need for fast spectrum testing capabilities





# Enabling future fusion energy systems

## Modeling and simulation

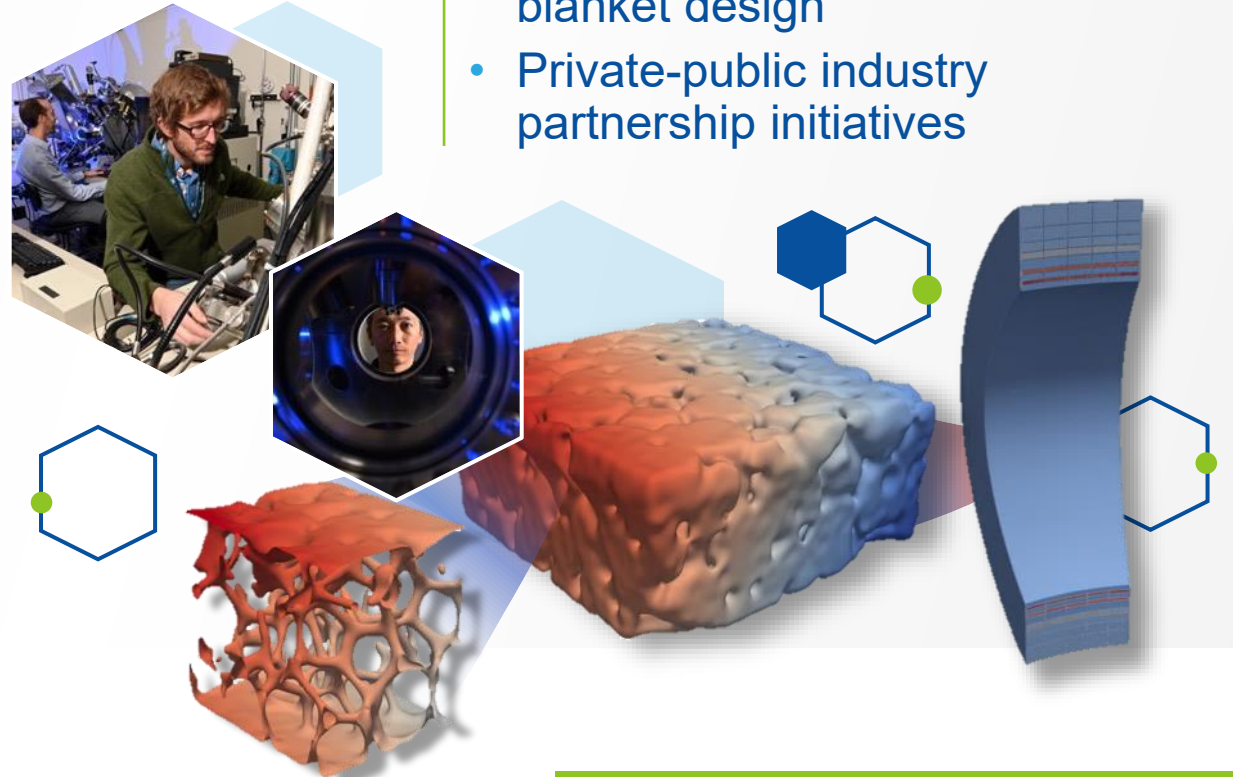
- MELCOR fusion for plant safety assessment
- Modern probabilistic risk assessment to support design and regulatory approaches
- MOOSE high-fidelity multi-physics tools

## Experimental capabilities

- Tritium production, transport and inventories (STAR facility)
- Modified neutron spectrum testing (ATR)
- Irradiated/tritium materials characterization (SPL/IMCL)

## Collaborations

- National Labs: ORNL, SRNL, PPPL and LLNL
- General Atomics for blanket design
- Private-public industry partnership initiatives



# Building the workforce of the future

In FY24, hosted  
interns, postdocs,  
and graduate fellows:

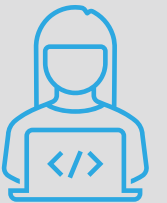
**686** INTERNS

**47** STATES

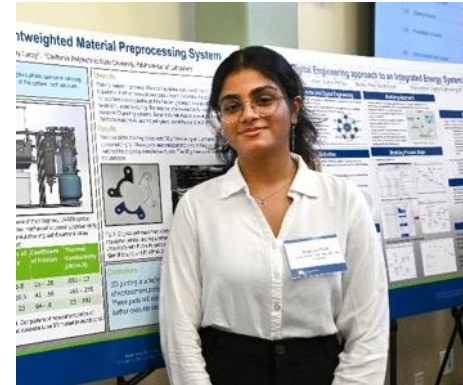


## TOP 4 MAJORS:

Mechanical Engineering  
Nuclear Engineering  
Computer Science  
Electrical Engineering



[www.inl.gov/internships](http://www.inl.gov/internships)



## Opportunities in the fields of:

- Advanced Energy Systems
- Advanced Manufacturing
- Biological Processing
- Chemistry/Chemical Engineering
- Computational Science
- Control Systems
- Cybersecurity
- Critical Infrastructure Analysts
- Data Science
- Electrochemistry
- Electrical Engineering
- Industrial Control Systems
- Material Science/Engineering
- Mechanical Engineering
- Membrane Science/Separations
- Nuclear Engineering/Science (multi sub disciplines)
- Operations
- Project Management
- Power Engineering
- Reactor Physics
- Supercritical Fluids
- Pressure Chemistry
- Radiological Technicians
- Security
- Software Development
- Wireless Communications
- Union Trades
- Welding



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