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Idaho National Laboratory Research and Development to Enable Advanced Reactor Demonstrations and Deployment

INL is managed by Battelle Energy Alliance
for the US Department of Energy



Idaho National Laboratory

INL's Heritage: *The National Reactor Testing Station drove nuclear innovation in the U.S. and around the world*

1st

Nuclear power plant

U.S. city to be powered by nuclear energy

Submarine reactor tested; training of nearly 40,000 reactor operators until mid-1990s

Mobile nuclear power plant for the army

Demonstration of self-sustaining fuel cycle

Basis for LWR reactor safety

Aircraft and aerospace reactor testing

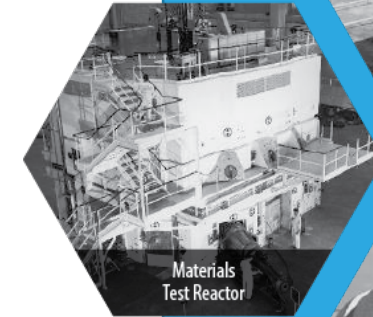
Materials testing reactors



Special Power Excursion Reactor Tests I through IV



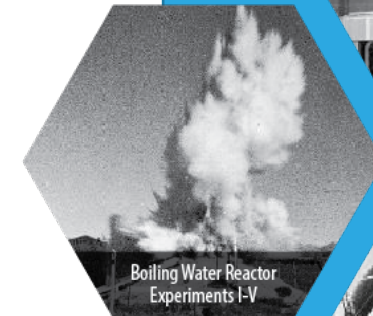
Experimental Breeder Reactor-I



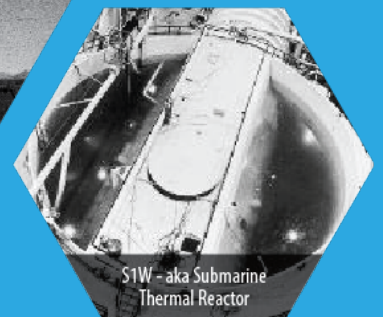
Materials Test Reactor



Loss of Fluid Test Facility



Boiling Water Reactor Experiments I-V



S1W - aka Submarine Thermal Reactor

Leveraging INL site, infrastructure, and facilities to enable energy and security R&D at scale

\$1,572 M FY21 Total Operating Cost
5,400+ Employees
569,178 Acres
890 Square Miles



128 Miles high-voltage transmission lines

17.5 Miles railroad for shipping nuclear fuel

4 Operating reactors

12 Hazard Category II & III non-reactor facilities/activities

50 Radiological facilities/activities

3 Fire Stations

Idaho Falls Research & Education Campus



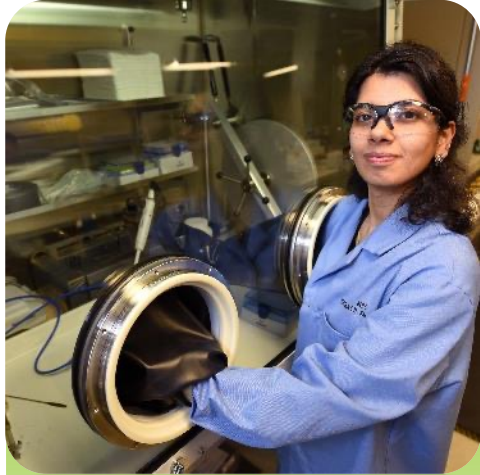
Materials and Fuels Complex



Advanced Test Reactor



INL is addressing the world's most challenging problems



Nuclear S&T

- Nuclear fuels and materials
- Reactor systems design and analysis
- Fuel cycle science and technology
- Nuclear safety and regulatory research
- Advanced Scientific Computing



Advanced Test Reactor

- Steady-state neutron irradiation of materials and fuels
 - Naval Nuclear Propulsion Program
 - Industry
 - National laboratories and universities



Materials & Fuels Complex

- Transient testing
- Analytical laboratories
- Post-irradiation examination
- Advanced characterization
- Fuel fabrication
- Space nuclear power and isotope technologies



Energy & Environment S&T

- Advanced transportation
- Environmental sustainability
- Clean energy
- Advanced manufacturing
- Biomass

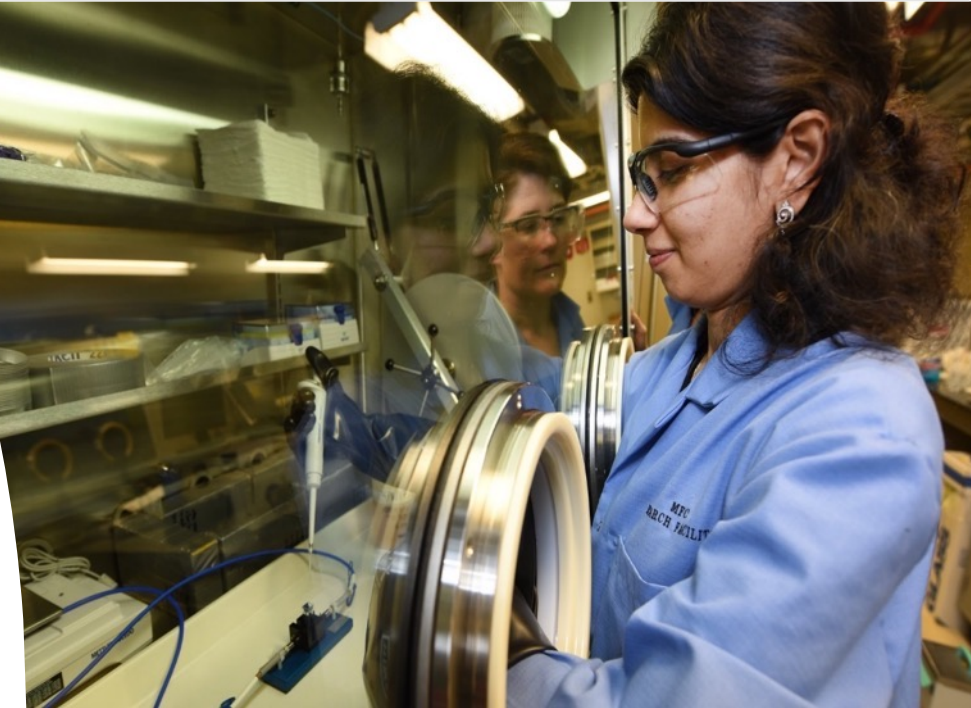


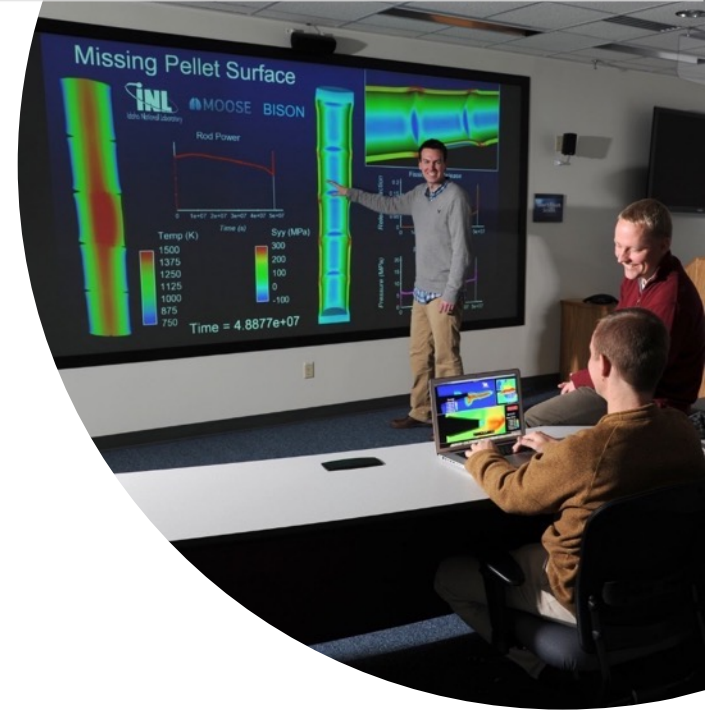
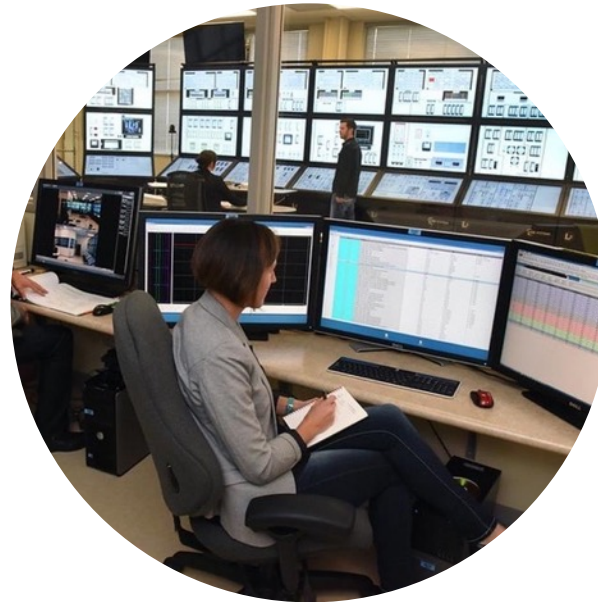
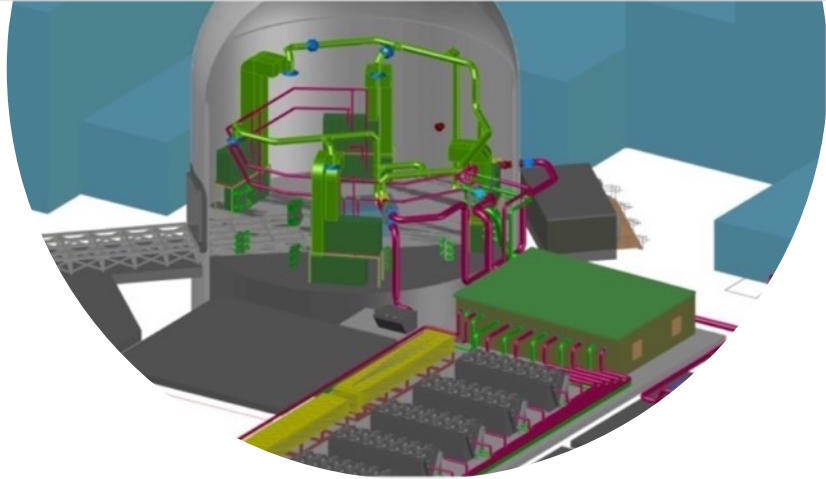
National & Homeland Security

- Critical infrastructure protection and resiliency
- Nuclear nonproliferation
- Physical defense systems

Nuclear Science & Technology's Vision, Mission, Priorities

- **Our Vision:** INL will change the world's energy future and secure our critical infrastructure.
- **Our Mission:** Discover, demonstrate, and secure innovative nuclear energy solutions, clean energy options, and secure critical infrastructure.
- **Our Priorities for Nuclear Energy:**
 - Enable the success of advanced reactor demonstrations to deploy cost-competitive nuclear energy.
 - Expand and deploy national nuclear energy strategic assets.
 - Enable INL to achieve net-zero carbon emissions by 2031.
 - Transform how we work and our work culture.





Nuclear S&T Research Supports Reactor Technology Development & Demonstration





NS&T Core Capabilities

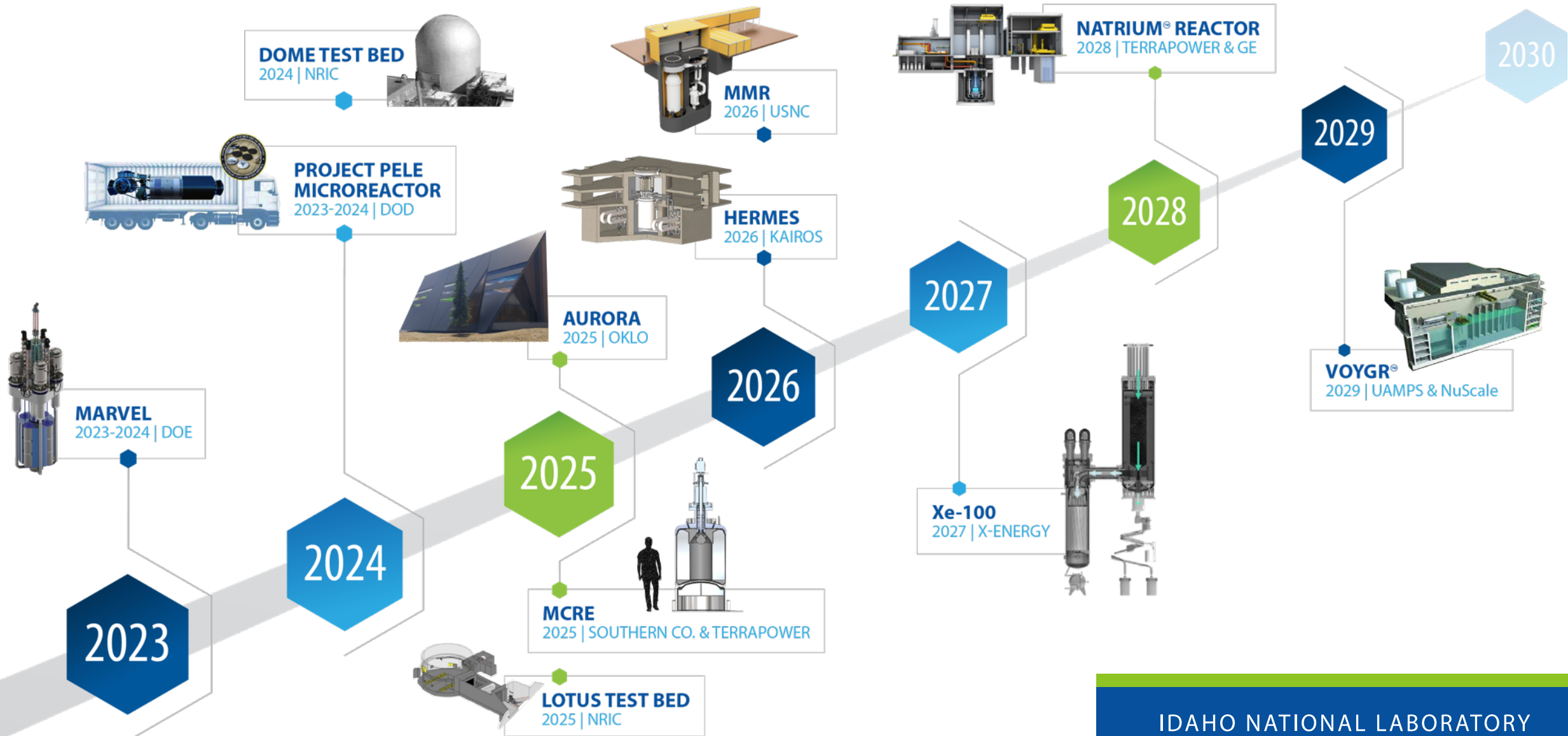
- Nuclear Reactor Design & Analysis
- Integrated Energy Systems
- Reactor Safety
- Regulatory Support
- Human Factors
- Test Beds and Demonstrations
- Aqueous & Pyrochemical Processing
- Modeling & Simulation
- Irradiation Experiments
- Fuels & Materials R&D
- Post-Irradiation Examination

Strategic Focus and Key objectives

- Sustain and optimize the light water reactor fleet for national energy security and low-carbon energy production
- Design, demonstrate, and rapidly deploy advanced reactors
- Accelerate the development and qualification of nuclear fuels and materials
- Design, demonstrate, and rapidly deploy innovative and sustainable integrated fuel cycle solutions
- Realize the Next-level INL and inspire a high-performing research organization



Accelerating advanced reactor demonstration & deployment



National Reactor Innovation Center

Enabling Reactor Demonstrations



- Established in 2019 with the purpose to provide the capabilities to support development and demonstration of advanced reactors
- Objective 1: Enable demonstration of two advanced reactors by the end of 2025
 - Make available infrastructure, sites, materials, expertise
 - Provide regulatory support
 - Best practices in public engagement
- Objective 2: Prepare DOE/labs for continuing innovation and demonstration
 - Develop best practices for planning/construction/demonstration of nuclear projects
 - Develop enduring infrastructure and expertise
 - Establish methods for efficient coordination among laboratories

National Reactor Innovation Center Testbeds

DOME



[Click image for 3D virtual Tour](#)

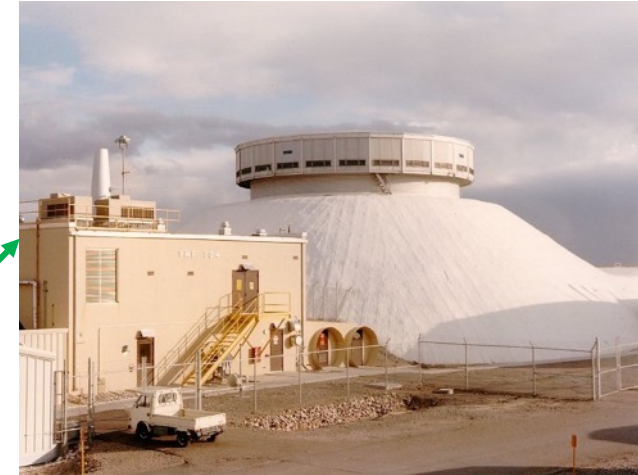
- Is currently in Final design phase
- Construction to complete Oct 2023
- First user expected Jan 2024

[Click image for Google Map](#)



Materials & Fuels Complex at INL

Safeguards Category 1 Testbed



[Click image for 3D virtual Tour](#)

- Has completed conceptual design phase
- DOE Analysis of Alternatives is in process
- Construction to complete Dec 2023*
- First user expected Jan 2026*

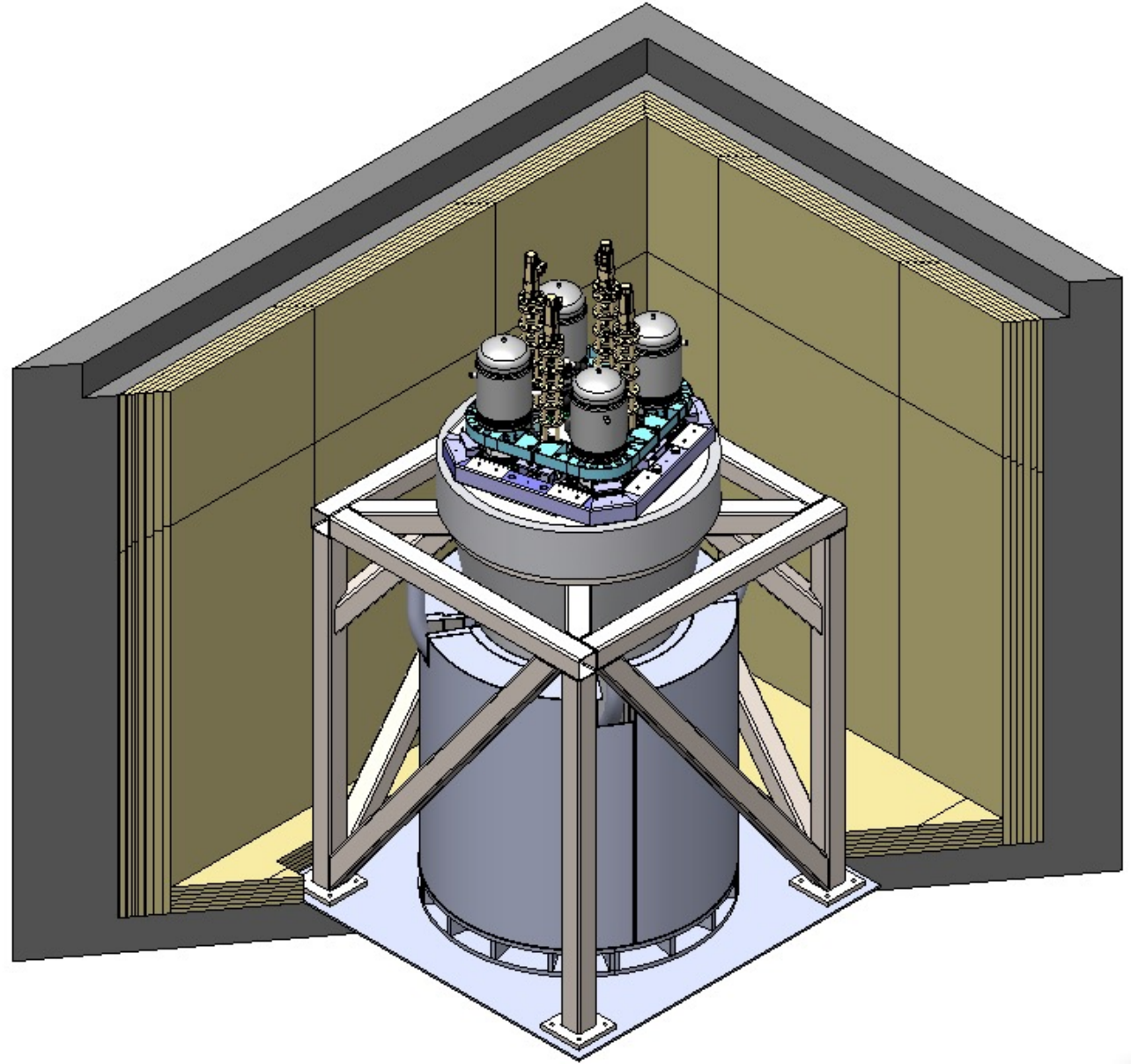
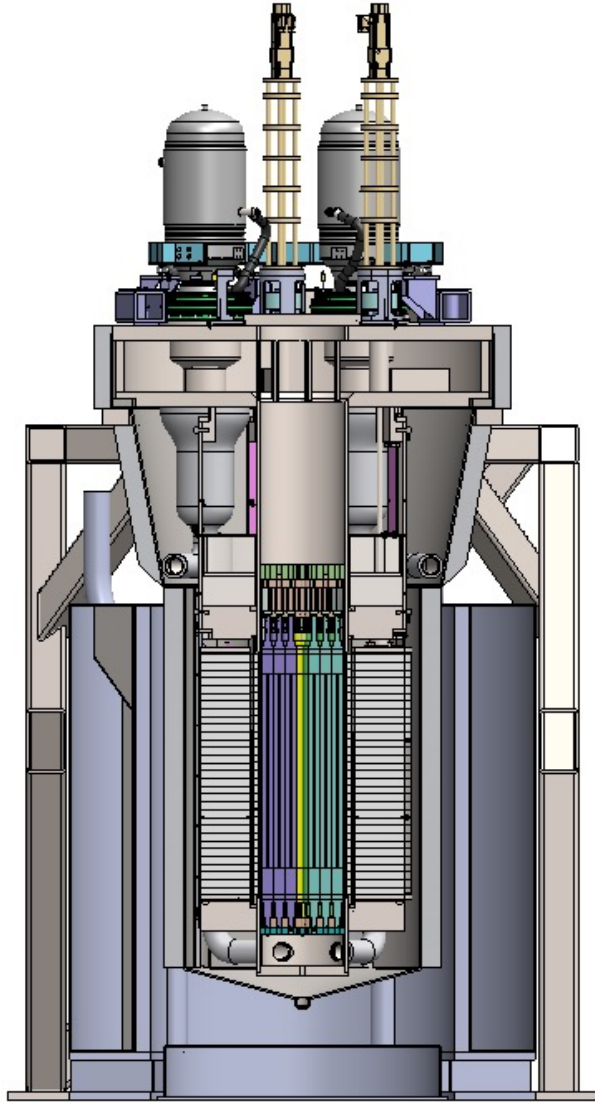
*Pending Analysis of Alternatives

MARVEL – Microreactor Applications Research, Validation & Evaluation Project

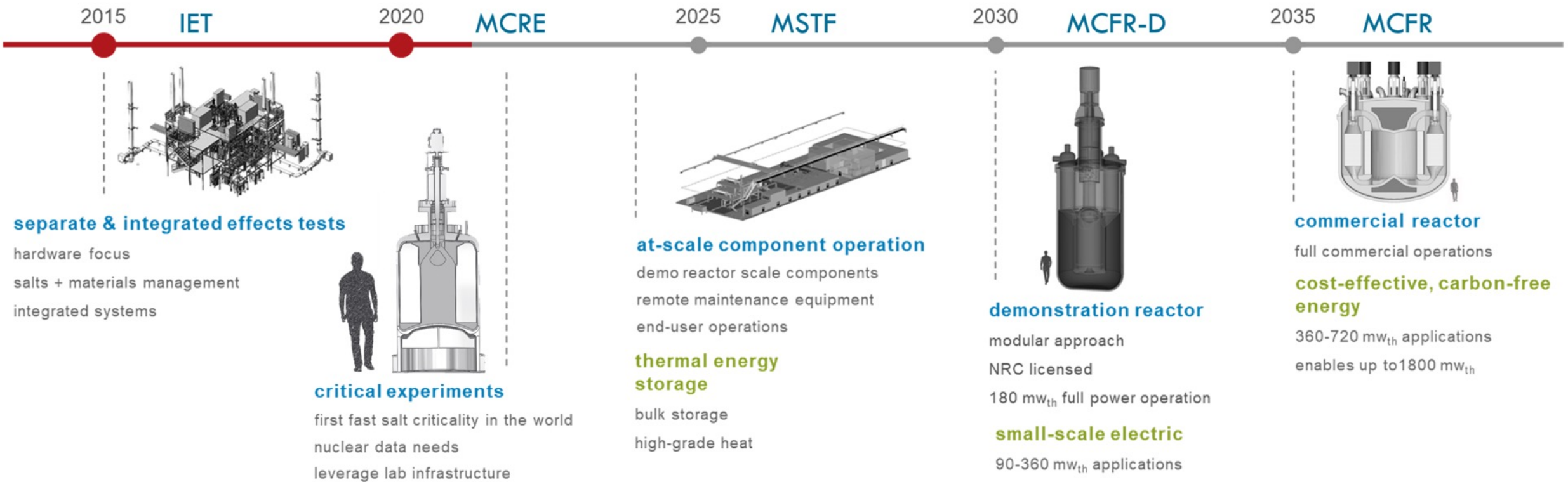
- DOE project to develop a small scale (100 kWt) microreactor to aid R&D on the unique operational aspects of these new reactors and integrating them with end-user applications.
- Rapid development timeline: planned operation by early 2023
- Provides experience in developing, constructing and operating a new nuclear reactor that can be leveraged by other developers
- Currently engaging interested end users for testing activities including:
 - Microgrid integration
 - Remote power and heat for computing, water, buildings, etc.



Assembly Within TREAT Pit



MCRE will be the second large demonstration undertaken by Southern Company, TerraPower, and INL along the Molten Chloride Fast Reactor (MCFR) deployment path.



deployment path

INL is going Net-Zero Emissions by 2031

- INL's site characteristics and operations make it a highly relevant demonstration site; representative of a city or county.
- INL will lead by example; lessons learned can inform best-practices for others.
- Net-zero aligns with DOE priorities.
-



605

Total vehicles



5,224

Employees



320

DOE-owned buildings
& trailers



27.3

MW purchased
in FY 2020

Summary: INL is...

- Advancing nuclear energy technologies through broad R&D leadership and impactful outcomes
- Developing and applying unique INL nuclear R&D capabilities for the nation
- Partnering with private sector to enable advanced reactor development, demonstration, and deployment





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.