OAK RIDGE NATIONAL LABORATORY

The Future of Nuclear Energy

Nuclear energy provides almost 20% of the electricity in the United States. Oak Ridge National Laboratory (ORNL) is dedicated to research and technology development that will maintain performance of the existing nuclear fleet for as long as possible; provide solutions for used nuclear fuel management and advanced fuel development; and deploy advanced technologies for safety, safeguards and security, improved economics, flexible operations, reduced environmental impact, and improved waste management.

ORNL has delivered leading US nuclear fission research for more than 70 years. A broad range of signature areas of accomplishment and core competencies have been developed for fission energy science.

- Analysis of performance and lifetime in light-water reactor designs
- Design and performance analysis of advanced reactor concepts
- Multiphysics modeling and simulation for fission
- Development and deployment of validated nuclear codes
- Development and characterization of nuclear fuel forms
- Nuclear fuel cycle technology and analysis
- Nuclear and radiological operations
- Development of safeguards and security technology

Tools for New Solutions

ORNL expertise is critical for supporting current fleet performance and delivering the R&D and technology to enable deployment of new nuclear technologies and reactor designs. ORNL offers a variety of key resources.

- **Computing**—ORNL's supercomputing facilities provide tools for modeling and simulation to investigate advanced reactor designs and safety features, potentially reducing the time required to develop and license new designs.

- **Nuclear materials and fuels science**—ORNL facilities and instruments at the Spallation Neutron Source, High Flux Isotope Reactor (HFIR), and hot cells allow ORNL scientists to develop and test materials, including current and new types of nuclear fuels, used in nuclear environments.

- **Design expertise**—ORNL is equipped to support the development of any advanced reactor design, including molten salt reactors and high-temperature gas reactors, with numerous private companies pursuing different versions of these reactors.

45+
Strategic partners including industry, national laboratories, and federal agencies

19%
Total US electricity generated by nuclear reactors in 2021

2
Advanced Reactor Demonstration program partnerships

13
Nuclear reactors built at ORNL for a variety of purposes, from research to radioisotope production

"Nuclear energy is essential to the global energy mix, ensuring reliability and security today, tomorrow, and always."

—Research and Test Reactor Physics Group Leader **Eva Davidson**

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U.S. DEPARTMENT OF ENERGY | Office of Science

Partnerships and Collaborations

ORNL takes part in a variety of efforts to support the development and implementation of nuclear technology and advanced reactors.

- Through the US Department of Energy's (DOE's) Gateway for Accelerated Innovation in Nuclear program, ORNL participates in projects to move nuclear energy technologies toward commercialization. These projects draw on the expertise of a diverse collection of industry and university partners from across the country and focus on a wide range of research challenges, from building reactor components to investigating new types of fuel.

- Additional agreements connect ORNL's expertise to industry efforts to make reactor designs a reality. Partners on these projects include Kairos Power, X-energy, Terrestrial Energy Inc., Tennessee Valley Authority, NuScale Power, and BWXT.

- ORNL is engaged in advanced materials and manufacturing to connect the needs of nuclear industry to opportunities with artificial intelligence, remote sensing, and digital design.

- ORNL hosts the annual Molten Salt Reactor Workshop, which offers an opportunity for attendees from industry, utilities, reactor design firms, the National Regulatory Commission, DOE, and universities to discuss the latest efforts to deploy new MSRs in the next decade.

Sensors are attached to a nuclear fuel package for drop testing and analysis.

MiniFuel—a small-scale, ORNL-designed experiment—drastically decreases the size of fuel specimens and capsules irradiated in HFIR. The unique platform will allow for faster qualification of new nuclear fuels, providing economic benefits to nuclear power plant operators.
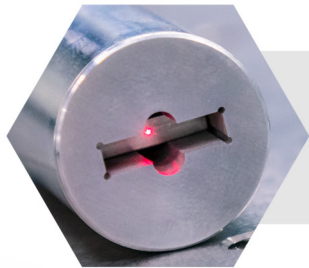
Future nuclear reactors could use new types of sensors developed at ORNL to provide real-time plant monitoring. The capability to better understand a reactor's performance would improve operations and enhance safety.

ORNL has a legacy of groundbreaking work in nuclear fuels. Today, ORNL engineers are researching advanced fuel types that could be used in the next generation of nuclear reactors.

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