The Future of Nuclear Energy

Nuclear energy provides almost 20% of the electricity in the United States and over 60% of our carbon-free energy production. 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 with enhanced safety and security, improved economics, flexible operations, reduced environmental impact, and improved waste management.

ORNL has delivered leading US nuclear fission research for over 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

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.

“If we are going to reduce carbon emissions on a global scale, then nuclear energy has to be a part of the mix.”

Eva Davidson,
Reactor Physics Analysis Engineer
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.

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.

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, and NuScale Power.
- ORNL manages the Transformational Challenge Reactor program, which aims to accelerate deployment of advanced nuclear technology by bringing together advanced manufacturing, artificial intelligence, remote sensing, and digital design.
- The ORNL-hosted annual Molten Salt Reactor Workshop 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.

**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.

**The Transformational Challenge Reactor Program leverages advances in materials, manufacturing, sensors, and control systems to accelerate deployment of advanced nuclear systems. These fuel assembly brackets developed for Framatome are the first 3D-printed safety-related components to be inserted into a nuclear power plant.**

SOURCE: ORNL

**CONTACT:**
Jeremy Busby, Director, Nuclear Energy and Fuel Cycle Division
busbyjt@ornl.gov, 865-241-4622
One Bethel Valley Road, Oak Ridge, TN 37830

www.ornl.gov